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Antimicrobial Activity of Stem, Leave and Root Plant Extract of *Sclerocarya birrea* and *Sterculia setigera* against Some Selected Microorganisms

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ABSTRACT

Plant extracts have been used widely with and without chemical modification for various infectious diseases cause by bacterial activities. All the methanolic plant extract of *Sclerocarya birrea* showed anti-microbial activities against most of the test organism with some showing a better antibacterial and antifungal activities than others. The leave from Kem has the minimum bactericidal/fungicidal concentration of 50 mg/ml for *E. coli*, 100 mg/ml for *C. albican* and *S. aureus* but *A. niger* has 200 mg/ml whereas on the other hand from Yola *S. aureus, C. albican, A. niger* and *E. coli* has 100 mg/ml. The stem has the minimum bactericidal and fungicidal concentration of 50 mg/ml for *E. coli, S. aureus* and 100 mg/ml for *C. albican* and *A. niger* and on the other hand from Yola has 100 mg/ml for *E. coli, S. aureus* and 200 mg/ml for *C. albican* and *A. niger*. The roots from Kem has 50 mg/ml for *E. coli* and *S. aureus* and 100 mg/ml for *C. albican* and *A. niger* and from Yola has 100 mg/ml for *E. coli, S. aureus, C. albican* and *A. niger* has 200 mg/ml. This shows that the stem and roots of *Sterculia Setigera* is more sensitive to the tested organism and is bactericidal at low concentration. The leaves extract in both locations has the MIC of 50 mg/ml for *E. coli, S. aureus* and

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C. albican but 100 mg/ml for *A. niger*. The stem extract from Kem has the MIC of 25 mg/ml for bacteria and 50 mg/ml for fungi and on the other hand from Yola, the extract has MIC of 50 mg/ml for *E. coli*, *S. aureus* and *C. albican* but 100 mg/ml for *A. niger*. The root showed different minimum inhibitory concentration from Kem, the extract has 25 mg/ml for bacteria and 50 mg/ml for fungi. On the other hand, the extract from Yola has 50 mg/ml for bacteria and 100 mg/ml for fungi. Finally, the limit of detection for both plants collected from two different geographical areas for inhibitory effect has been measured successfully.

Keywords**:** *S. birrea, S. setigera,* antimicrobial, bacteria, fungal

1. INTRODUCTION

Over the years, the use of complementary and alternative medicine in both rural and urban areas across Nigeria has increased, but there is a great concern for its safety, efficacy as well as control and this poses a great challenge for health authorities and the general public. Traditional healers use plant resources in treatment of diseases, but they are yet to consider the regeneration of these important medicinal plants used by them. Simplest plant can have beneficial aspects relating to human health [1], as the use of these plants has contributed enormously to the health sector due to which, the demand for herbs, particularly in parts of Africa, has brought some plants near extinction.

Sclerocarya birrea (Anacardiaceae) is a savannah tree, belongs to the family Anacardiaceae, with a plum-like pale yellow fruit of 3-4 cm in diameter with a juicymucilaginous flesh. *Sclerocarya birrea* is deciduous and mainly dioecious, although there have been reports of monoecious trees [2]. It is a medium sized tree reaching heights of between 7 to 17 m, with grey fissured bark, stout branch lets and pale foliage. The leaves are compound, pinnate and the flowers greenish-white or reddish. The fruits are yellow, resembles a mango [2]. Rough stems-bark is flaky, with a mottled appearance due to contrasting grey and palebrown patches. The leaves are divided into 10 or more pairs of leaflets, each about 60 mm long, dark-green above, and sharp point. The flowers are borne in small, oblong clusters.

In some African countries, the stems-bark, roots and leaves of *Sclerocarya birrea* are used for an array of human ailments, including: malaria and fevers, diarrheaand dysentery, stomach ailments, headaches, sore eyes, toothache, backache andbody pains, infertility, schistosomiasis, constipation, abdominal cramps and someother unspecified gastro-intestinal problems, toothaches and swollen or infectedgums, cough, hypertension, arthritis, proctitis, epilepsy, diabetes mellitus, sores, boils,carbuncles, abscesses and certain other bacterial infections [2].

The tree is used in folk Malian medicine for the cure of several animal and human diseases. The leaves and the pulp of fruit are used for hypertension, and the leaves are used against diabetes, dysentery, snake and scorpion bites, malaria, and inflammations. Additionally, the plant is also utilized as a tonic, and the fruits are often fermented to give a refreshing drink. In Ghana, leaves are used to treat snakebite, while pruritus (filarial); the stems bark, the root and the fruits are used for the cure of pharyngitis, splenomegaly and goitre, respectively [2].

The plant, *Sterculia setigera* (Family: Sterculiaceae) is known by different indigenous cultural communities in Nigeria: Hausa– "Kukuki"; Fulani– "bo'boli"; Yoruba– "Ose-awere", [3] It is a savannah tree, widespread in savannah areas of tropical Africa. This plant is used in traditional medicine by various indigenous communities. For instance, the Yorubas of Nigeria use a black soap prepared from black powder obtained from burnt mixture of the fruits and seeds in dermatosis [3]. In Sudan, dried methanol extract. bark hot water extract is used for jaundice [4] and dried stems bark for treating wounds [5]. Stems bark decoction is used to treat diarrhea [4] by the Igedes, its bark as a mixture is macerated and used against dysentery by some tribes in central Nigeria [6,22].

Screening of plant extracts for antimicrobial activity has shown that higher plants represent a potential source of new anti-infective compounds [7]. Only a small fraction of the known plant species has been evaluated for the presence of antimicrobial compounds, and thus, it is necessary to increase the efforts in collecting and screening plants for the development of novel and environmentally safe antimicrobial agents [8].

Herein, due to high demand for less side effects and potentially effective drugs, we have studied about the **antimicrobial activity** of some local natural plants. These plants extract not only proven to be good antimicrobial agents but also the increase in concentration of extracts cause increase in antimicrobial activities. Leaf, root and stem extracts of two local plants *Sclerocarya birrea* and *Sterculia setigera* have been selected for their probable antimicrobial activities on bacteria and fungi samples collected from microbiology department, of Modibbo Adama University of Technology Yola, Nigeria [20,21,23-25]

To our knowledge, it's the first time to study extensively about the antimicrobial activity, minimum inhibitory concentration (MIC), and minimum bactericidal and fungicidal concentration of methanolic extracts of *Sclerocarya birrea* and *Sterculia setigera*. Also control (amoxicillin and nystalin) give the best antimicrobial activities against the entire tested organism than all the extracts. In addition, the change in the geographical area of the two plants causes the change in inhibitory effect. In general, the extracts of these plants has shown safer, cheaper and effective replacement of high potency drugs for cure of different diseases.

2. MATERIALS AND METHODS

2. 1. Area of Study

Shelleng Local Government is located in the South eastern geographical zone of Adamawa state between latitude 9°3'13" S and 10°34" N and longitude 11°33" E and longitude 12°38" S and 12°55" E, at an altitude of 800 m above sea level and annual rainfall between 750 mm - 1,100 mm within the northern guinea savannah sub-humid region [9].

2. 2. Collection of the Plant Materials

The root, stems and leave of *Sclerocarya birrea,* and *Steculia setigere* were collected and authenticate by Mr. Bristone Basiri of plant science department, Modibbo Adamawa University of Technology Yola. The samples were dry for 14 days at room temperature and ground into uniform powder using a mortar.

2. 3. Preparation of the Extract

The root, stem and leave of the plants materials were grounded and sieve to get a fine powdered from which the extract was prepared. Methanolic extract of the plant were obtained by taking 300 g of the powdered root, stem and leave in a separate container and 20ml of methanol was added to it. The bottles were close and shake vigorously to dissolve the sample material in the solvent. The mixture was then filtered through Whatman filter paper, and the filtrate was evaporated in oven under 40 °C temperature to obtain the crude extract WHO [10].

2. 4. Antimicrobial activity

The antimicrobial susceptibility test was done according to the method of Lu *et al*, [11] and the minimum inhibitory concentration (MIC) and minimum bactericidal and fungicidal concentration was done according to the method described by Adesokan *et al.*, 2007 [12].

2. 4. 1. Micro organism

The bacteria and fungi Isolate were obtained from microbiology department, of Modibbo Adama University of Technology Yola, Nigeria.

2. 4. 2. Preparation of nutrient broth

8 g of the nutrient broth powder were dissolved in 1 liter of distilled water and the solutions was mixed and dissolve by heating with frequent agitation, and was boiled for 1minute for complete dissolution. Then dispense into appropriate containers and sterilize in autoclave at 121 °C for 15mint and stored at 2-8 °C

2. 4. 3. Preparation of potato destrose agar (PDA)

39 g of potato destrose agar powder was weighed and dispensed in 1litre conical flask containing 1000 cm^3 deionized water, powder was dissolved completely in boiling water. The mouth of the flask was then covered with aluminium foil and taped with masking tape. The media was then sterilized by autoclave method at temperature of 121 °C for a period of 15 min, it was then allowed to cool down to 40-45 °C then poured in a liquor amount of 20 ml to a sterile petri dish and were allow to solidified and kept at 4 °C for onward used for MFC.

2. 4. 4. Preparation of nutrient agar

28 g of dehydrated nutrient agar powder was weighed and Dissolve in 1L of boiling water. The mouth of the flask was then pluged with aluminium foil paper and then taped with masking tape. The media was then sterilized by autoclave method at temperature of 121 °C for a period of 15 min, it was then allowed to cool down to 40-45 °C and was then poured in a liquor amount of 20 ml to a sterile petri dish and were allow to solidified and kept at 4 °C for on ward used for MBC.

2. 4. 5. Susceptibility testing

Determination of susceptibility testing Agar well diffusion method used by Lu *et al.*, [11] was adopted, for the bio assay in this experiment. The bacterial suspension was prepared

and adjusted to 0.5 Mcfarland standards. A sterile pasteur pipette was used to transfer 0.1 ml of Inoculums into Mueller Hinton agar plate. For the fungal inoculums 0.1 ml (What) was also transferred into potato dextrose agar plate and a sterilized bent glass rod was used to spread the inoculums evenly over the surface of the entire plate, and allowed to set for 15min. A sterilized cork borer of 6mm in diameter used to bore five wells (holes) at equidistant and 2-inch to the edge of the plate, different concentration of medicinal plant extract 6.25 mg/ml, 12.5 mg/ml 25 mg/ml and 50 mg/ml and 0.5 ml from each concentration was transferred into each well. The plate was allowed to stand for 1hr for pre-diffusion of the extract to occur and then incubated at 37 °C for 24 hours for bacteria and 25 °C for 48hrs for fungi and the zone of inhibition measured to the nearest mm. The mean of the duplicate results was taken. Amoxicillin and nystatin capsules were used as control.

2. 4. 6. Determination of determination of the minimum inhibitory concentration (MIC) and minimum bactericidal and fungicidal concentration (MBC/MFC)

Determination of the minimum inhibitory concentration (MIC) and minimum bactericidal and fungicidal concentration (MBC/MFC) was carried out using the broth dilution method [12,13]. 1 ml of the reconstituted extract solution at a concentration of 200 mg/ml was added to another test tube containing 1ml of sterile broth so as to obtained a concentration of 100 mg/ml. 1ml of this dilution was transfer to another test tube till the 7^{th} test tube was reached the 8^{th} test tube did not contain any extract, but a solution of pure solvent and served as a negative control. Then 1 ml of culture bacteria and fungi was put into each tube and thoroughly mix on a votex mixer the tube was incubated at 37 °C for 24 hr and 25 °C for 48 hr for the bacteria and fungi respectively, and observed for growth in form of turbidity. The test tube with the lowest dilution with no detectable growth by visual inspection was considered the MIC. The minimum bactericidal and fungicidal concentration (MBC/MFC) were determined by transferring 0.10 ml of bacterial and fungi suspension from the MIC tube that did not show any growth and subcultured into Mueller Hinton agar plates and pototo destrose agar and incubate at 37 °C for 24hr and 25 °C for 48 hr. After incubation the concentration at which no visible growth was recoded as the mfc /mbc

3. RESULTS AND DISCUSSION

All the methanolic plant extract of *Sclerocarya birrea* showed anti-microbial activities against most of the test organism with some showing a better antibacterial and antifungal activities than others. Whereas the control (amoxicillin and nystalin) give the best antimicrobial activities against all the tested organism than all the extracts. Generally, all the plants showed significant increase in their inhibitory effect against the tested organism with an increase in concentration of the extract.

3. 1. Comparison result of antimicrobial susceptibility test of *Sclerocarya birrea* (leave, stem and root) from the two locations methanolic extract at various concentrations against the test organism with zone of inhibition in (mm)

In Table 1, the leave of *S. birrea* from Kem showed an increase in activity with increase in concentration of the extract at 6.25 mg/ml (lowest concentration) it has a zone of inhibition

9 mm, 10 mm, 9 mm and 8 mm and at high concentration (50 mg/ml) it has a zone of inhibition of 16 mm, 17 mm, 15 mm and 15 mm for *E. coli*, *S. aureus*, C. adbican and *A. niger* respectively. On the other hand, from Yola at 6.25 mg/ml, the leaves showed a zone of inhibition of 10 mm, 11 mm, 9 mm and 7 mm and at 50 mg/ml it has a zone of inhibition of 15 mm, 16 mm 13 mm 13 mm for *E. coli*, *S. aureus*, *C. albican* and *A. niger* respectively. The stem of *S. birrea* showed the highest zone of inhibition at high concentration compared to the leaves and roots extract of the plant. In Kem, the methanolic stem extract at 6.25 mg/ml has a zone diameter of 11 mm, 13 mm, 13 mm and 9 mm and at 50 mg/ml. it showed the zone of inhibition of 16 mm, 20 mm, 18 mm and 17 mm for *E. coli*, *S. aureus*, *C. albican* and *A. niger* respectively. On the other hand, from Yola at 6.25 mg/ml the extract showed the zone of inhibition of 10 mm, 11 mm, 13 mm, and 9 mm at 50 mg.ml the extract showed activity of 16 mm, 17 mm, 16 mm, 15 mm for *E. coli*, *S. aureus*, *C. albican* and *A. niger* respectively. The roots of *S. birrea* in both location showed a varied zone of inhibition at different concentration at 6.25 mg/ml the stem extract from Kem has 10 mm, 12 mm, 13 mm, 16 mm and at high concentration of 50 mh/ml has 16 mm, 20 mm, 18 mm, 17 mm foe *E. coli*, *S. aureus*, *C. albican* and *A. niger* respectively, on the other hand from Yola, at 6.25 mg/ml it has a zone diameter of 9 mm, 10 mm, 11 mm, abd 7 mm and at 50 mg/ml it has the zone of inhibition of 14 mm, 16 mm, 14 mm and 16 mm for E.coli, *S. aureus*, *C. albican* and *A. niger* respectively.

3. 2. Comparison result of minimum inhibitory concentration of *Sclerocarya birrea*, (leave, stem and root) methanolic extract against the test organism at different concentration from the two locations (Kem and Yola)

The minimum inhibitory concentration gives the lowest concentration that inhibit or prevent the growth of the test organism. In Table 2, all the plant extract showed different minimum inhibitory concentration on the tested organism. The leaves extract in both locations has the MIC of 50 mg/ml for *E. coli*, *S. aureus* and *C. albican* but 100 mg/ml for *A. niger*. The stem extract from Kem has the MIC of 25 mg/ml for bacteria and 50 mg/ml for fungi and on the other hand from Yola, the extract has MIC of 50 mg/ml for *E. coli*, *S. aureus* and *C. albican* but 100 mg/ml for *A. niger*. The root showed different minimum inhibitory concentration from Kem, the extract has 25 mg/ml for bacteria and 50 mg/ml for fungi. On the other hand, the extract from Yola has 50 mg/ml for bacteria and 100 mg/ml for fungi.

3. 3. Comparison result of minimum bactericial and fungicidal concentration of methanolic (leave stem and root) extract of *Sclerocarya birrea* on test organism from the two locations (Kem and Yola)

The minimum bactericidal and fungicidal concentration (MBC/MFC) is the low concentration that kills the the test organism. In Table 3, the leaves from Kem and Yola has MBC/MFC of 100 mg/ml for *E. coli*, *S. aureus* and *C. albican* but for *A. niger* has MFC of 200 mg/ml. The stem in Kem has the mbc of 50 mg/ml for *E. coli*, *S. aureus* and *C. albican*, and *A. niger* has 100 mg/ml. on the other hand from Yola *E. coli*, and *C. albican* has MBC/MFC of 100 mg/ml. *A niger* has minimum fungicidal concentration of 200 mg/ml and *S. aureus* has 50 mg/ml. The root has minimum bacterial/ fungicidal concentration of 50 mg/ml for bacterial and fungi 100 mg/ml from Kem, while from Yola *E. coli*, and *S. aureus* has minimum bactericidal concentration of 100 mg/ml and 200 mg/ml for *C. albican* and *A.*

niger. From the result, the stem extract has the highest activity than the root and leaves of the extract. Also among the test organism the extract is more sensitive to bacteria

The antimicrobial activities of the plant extract differ according to the plant parts. The activities of all the plant extract were observed to increase with an increase in the concentration. However, the activities of control (Amoxicilin and Nystacin) against the four test organism were more than all the six plant extract tested on the organism. From the result it showed that the stem extract of *S. birrea* from Kem is more effective compared to the other extracts of *S. birrea*, generally the extract from Kem show high activity compared to those from Yola and it was observed that the extracts showed strong activity on the bacteria than the fungi, this is because the bacteria are unicellular organisms and fungi are multicellular organisms.

The difference in activity of the extract might be due to the fact that plants from Kem are on rocks and locate along spring water unlike those from Yola on a flat land. Another factor for such variation might be also the phytochemical composition difference of the plant which is influenced by various environmental factors such as temperature, rainfall, vegetation, soil mineral, climatic condition [14].The present study is in agreement with the previous work who reported that the methanolic leave extract of *S. birrea* have antimicrobial activities and coincident with the work of Mariod *et al.*, [15] who reported that the root of *S. birrea* inhibit the growth of *E. coli*, *S. aureus* and *C. albican*. Although all the methanolic plant etract of *sclerocarya birrea* from Yola and Kem showed varying degree of zone of inhibition. At different concentration, the higher the concentration of the extract the more the sensitive the extract to the test organism.

3. 4. Comparison result of antimicrobial susceptibility test of *Sterculia setigera* (leave, stem and root) from the two locations methanolic extract at various concentrations against the test organism with zone of inhibition in (mm)

Although all the methanolic plant etract of *Sterculia Setigera* from Yola and Kem showed varying degree of zone of inhibition. At different concentration, the higher the concentration of the extract the more the sensitive the extract to the test organism. In Table 4, the lowest concentration was 6.25 mg/ml and the hughest was 50 mg/ml. the leave of *Sterculia setigera* has a zone diameter of 11 mm, 13 mm, 9 mm at low concentration (6.25 mg/ml) and 16mm, 14mm and 15mm for *E. coli*, *S. aureus*, *C. albican* and *A. niger* respectively.

In, Yola at 6.25 mg/ml the leave showed 910.87 mm and 15, 14, 12 and 13 at 50 mg/ml for *E. coli*, *S. aureus* and *C. albican* respectively. The stem from Kem has zone of inhibition at 10 mm, 12 mm, 13 mm, 10mm, at 6.25 mgm/ml for *E. coli*, *S. aureus* and *C. albican* respectively and on the other hand from Yola, the extract has 9 mm, 10 mm, 12 mm, 9 mm at 6.25 mg/ml and 15 mm, 16 mm, 15 mm and 16 mm at 50 mg/ml for *E. coli*, *S. aureus* and *C. albican* respectively. The root of the extract in Kem has 9 mm, 10 mm, 11 mm and 8 mm at 6.25 mg/ml and 16 mm, 17 mm, 16 mm, 14 mm for *E. coli*, *S. aureus*, *C. albican* and *A. niger* respectively whereas on the other hand Yola 8 mm, 9 mm, 9 mm, 9 mm at 6.25 mg/ml and 14 mm, 14 mm, 15 mm, and 12 mm at 50 mg/ml for *E. coli*, *S. aureus* and *C. albican* and *A. niger*.

3. 5. Comparison result of minimum inhibitory concentration of *Sterculia setigera*, (leave, stem and root) methanolic extract against the test organism at different concentration from the two locations (Kem and Yola)

Table 5 the MIC give the lowest concentration that inhibit the growth of the test organism although all the extract showed varying minimum concentration that inhibit the growth of the test organism. The leave from Kem has minimum inhibitory concentration of 25 mg/ml of *E. coli*, 50 mg/ml for *S. aureus* and *C. albican* and 100 mg/ml for *A. niger*. On the other hand, from Yola 50 mg/ml was recorded for *E. coli*, *S. aureus*, *C. albican* and *A. niger*. The stem from Kem has minimum inhibitory concentration of 25 mg/ml for *E. coli*, *S. aureus* and 50 mg/ml for *C. albican* and *A. niger* while on the other hand from Yola, *E. coli* and *S. aureus*, has 50 mg/ml, and *C. albican*, *A. niger* has 100mg/ml. The root from Kem has the minimum inhibitory concentration of 25 mg/ml for *E. coli*, *S. aureus* and 50 mg/ml for *C. albican* and *A. niger* and on the other hand from Yola the root has minimum inhibitory concentration of 50 mg/ml for *E. coli*, *S. aureus* and C. *albican* and 100 mg/ml for *S. aureus*.

3. 6. Comparison result of minimum bactericial and fungicidal concentration of methanolic (leave stem and root) extract of Sterculia setigera against the test organism from the two locations (Kem and Yola)

In Table 6, all the extract showed high concentration compared to the methanolic extract of *S. birrea*. The leave from Kem has the minimum bactericidal/fungicidal concentration of 50 mg/ml for *E. coli*, 100 mg/ml for *C. albican* and *S. aureus* but *A. niger* has 200 mg/ml whereas on the other hand from Yola *S. aureus*, *C. albican*, *A. niger* and *E. coli* has 100 mg/ml. The stem has the minimum bactericidal and fungicidal concentration of 50 mg/ml for *E. coli*, *S. aureus* and 100 mg/ml for *C. albican* and *A. niger* and on the other hand from Yola has 100 mg/ml for *E. coli*, *S. aureus* and 200 mg/ml for *C. albican* and *A. niger*. The roots from Kem has 50 mg/ml for *E. coli* and *S. aureus* and 100 mg/ml for *C. albican* and *A. niger* and from Yola has 100 mg/ml for *E. coli*, *S. aureus*, *C. albican* and *A. niger* has 200 mg/ml. This shows that the stem and roots of *Sterculia Setigera* is more sensitive to the tested organism and is bactericidal at low concentration.

4. CONCLUSIONS

The antimicrobial activities of the extract differ according to the plant part and the location of the plants. The activities of all the extract was observed to showed increase in the concentration of the extract. The control (Amoxicilin and Nystatin) showed wider zone of inhibition compared to any extract of the plant. It was also observed that the extracts are more effective on the bacteria than on the fungi at low minimum bactericidal and fungicidal concentration. The fungi have high minimum fungicidal concentration, this might be because the fungi are Eukaryotic organisms and bacteria are Prokaryotic organisms. The stem extract of plant from Kem showed lower minimum inhibitory concentration and minimum bactericidal and fungicidal. The difference in the activity of the plants might be as a result of geographical location. Kumarawa *et al.*, [16] pointed out that differences might also be attributed to the changes in the environmental condition such as rainfall, climate attitude, vegetation etc. according to Ayoola *et al.*, [17] the genetic and environmental factors and their

interaction affect the secondary metabolites like phenol, flaronoid in the plants. This study is in good agreement with the previous work of Ajanyeoba *et al.*, [18] who reported that methanolic leave extract of *W. tetra* inhibit the growth of *E. coli*, *S. aureus* and coincidence with the works of Ouedrago *et al.*, [19] who stated that the stem back of Sterculia Setigera showed strong antifungal activity.

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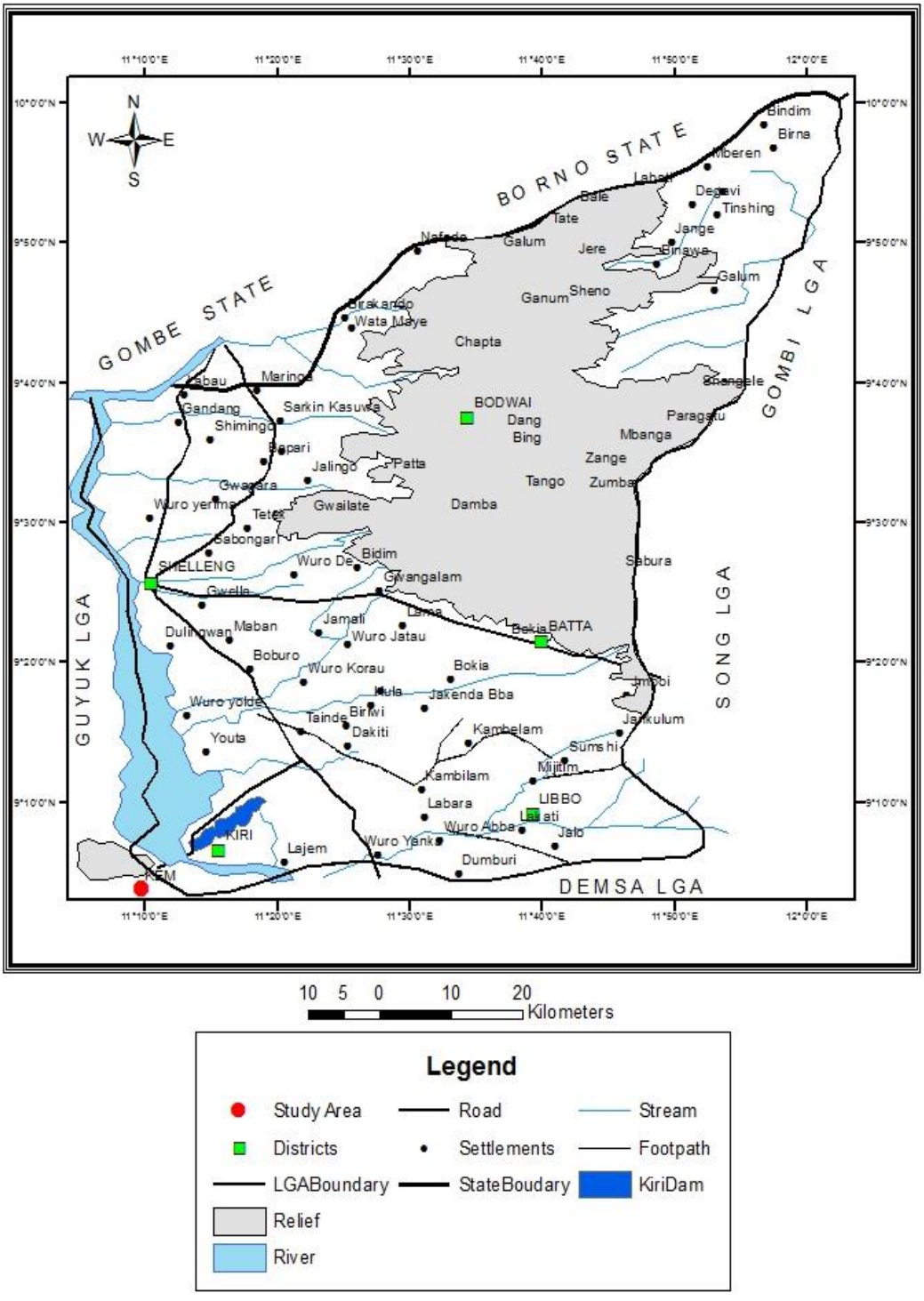

Figure 1; Map of Shelleng L. G. A Showing Study Area

(Source: GIS Laboratory Department of Geography, MAUTECH, Yola 2016)

Fig. 1. Map of Shelleng L.G.A showing study area
(Source GIS Laboratory Department of Geography, MAUTECH, Yola 2016)

Fig. 2. Sterculia setigera

Fig. 3. *Sclerocarya birrea*

Table 1. Antimicrobial susceptibility test of methanolic extracts of *Slerocarya birrea* (leave, stem and root) from the two locations (Kem and Yola) on the test organism

Test organism	Zone of inhibition				
Extract	Concentration (mg/ml)	*E.coli*	*S.aureus*	*C. albican*	*A. niger*
LSBK	6.25	9	10	9	16
	12.5	10	10	11	17
	25	15	14	13	15
	50	16	17	15	14
	Amoxicilin	24	24	-	-
	Nystatin	-	-	24	23
SSBK	6.25	11	13	13	9
	12.5	10	15	16	11
	25	15	17	15	16
	50	20	19	17	18
	Amoxicilin	24	24	-	-
	Nystatin	-	-	23	24
RSBK	6.25	10	12	13	16
	12.5	9	14	12	20
	25	15	18	17	18
	50	16	20	18	17
	Amoxicilin	24	24	-	-
	Nystatin	-	-	23	23
LSBY	6.25	10	11	9	7
	12.5	12	11	10	12
	25	14	13	9	10
	50	15	16	13	13
	Amoxicilin	24	24	-	-
	Nystatin	-	-	23	23
SSBY	6.25	10	11	13	9
	12.5	12	13	14	12
	25	13	15	14	15
	50	16	17	16	15
	Amoxicilin	24	24	-	-
	Nystatin	-	-	24	23
RSBY	6.25	9	10	11	7
	12.5	8	13	13	11
	25	12	14	15	13
	50	14	16	14	16
	Amoxicilin	24	23	-	-
	Nystatin	-	-	24	23

Key: LSBK = Leave of *Sclerocarya birrea* Kem, SSBK = Stem of *Sclerocarya birrea* Kem, RSBK = Root of *Sclerocarya birrea* Kem, LSBY = Leave of *Sclerocarya birrea* Yola, SSBY = Stem of *Sclerocarya birrea* Yola, RSBY = Root of *Sclerocarya birrea* Yola

Table 2. Minimum inhibitory concentration (MIC) of methanolic (leave stem and root) extracts of *Sclerocarya. birrea* from the two locations (Kem and Yola) against the test organism

Concentration in mg/ml								
Extract	Test Organism	3.125	6.25	12.5	25	50	100	200
LSBK	*E. coli*	+	+	+	+	-	-	-
	S. aureus	+	+	+	+	-	-	-
	C. albican	+	+	+	+	-	-	-
	A. niger	+	+	+	+	+	-	-
SSBK	*E. coli*	+	+	+	-	-	-	-
	S. aureus	+	+	+	-	-	-	-
	C. albican	+	+	+	-	-	-	-
	A. niger	+	+	+	+	-	-	-
RSBK	*E. coli*	+	+	+	-	-	-	-
	S. aureus	+	+	+	-	-	-	-
	C. albican	+	+	+	+	-	-	-
	A. niger	+	+	+	+	-	-	-
LSBY	*E. coli*	+	+	+	+	-	-	-
	S. aureus	+	+	+	+	-	-	-
	C. albican	+	+	+	+	-	-	-
	A. niger	+	+	+	+	+	-	-
SSBY	*E. coli*	+	+	+	+	-	-	-
	S. aureus	+	+	+	-	-	-	-
	C. albican	+	+	+	+	-	-	-
	A. niger	+	+	+	+	+	-	-
RSBY	*E. coli*	+	+	+	+	-	-	-
	S. aureus	+	+	+	+	-	-	-
	C. albican	+	+	+	+	+	-	-
	A. niger	+	+	+	+	+	-	-

Key: + = Turbid - = Clear
LSBK = Leave of *Sclerocarya birrea* Kem, SSBK = Stem of *Sclerocarya birrea* Kem, RSBK = Root of *Sclerocarya birrea* Kem, LSBY = Leave of *Sclerocarya birrea* Yola, SSBY = Stem of *Sclerocarya birrea* Yola, RSBY = Root of *Sclerocarya birrea* Yola

Table 3. Minimum bactericidal and fungicidal concentration (MBC/MFC) of *Sclerocarya birrea* (leave, stem and root) against the test organism from both locations (Kem and Yola)

Extract	Test Organism	MBC/MFC
LSBK	*E. coli* *S. aureus* *C. albican* *A. niger*	100 100 100 200
SSBK	*E. coli* *S. aureus* *C. albican* *A. niger*	50 50 50 100
RSBK	*E. coli* *S. aureus* *C. albican* *A. niger*	50 50 100 100
LSBY	*E. coli* *S. aureus* *C. albican* *A. niger*	50 50 50 100
SSBY	*E. coli* *S. aureus* *C. albican* *A. niger*	50 25 50 100
RSBY	*E. coli* *S. aureus* *C. albican* *A. niger*	100 100 200 200

Key: LSBK = Leave of *Sclerocarya birrea* Kem, SSBK = Stem of *Sclerocarya birrea* Kem, RSBK = Root of *Sclerocarya birrea* Kem, LSBY = Leave of *Sclerocarya birrea* Yola, SSBY = Stem of *Sclerocarya birrea* Yola, RSBY = Root of *Sclerocarya birrea* Yola.

Table 4. Antimicrobial susceptibility test of methanolic extracts of *Sterculia setigera* (leave, stem and root) from the two locations (Kem and Yola) on the test organism

Test organism	Zone of inhibition				
Extract	Extract con. (mg/ml)	*E. coli*	*S. aureus*	*C. albican*	*A. niger*
LSSK	6.25	11	13	9	9
	12.5	13	16	10	11
	25	14	14	13	12
	50	16	16	14	15
	Amoxicilin	24	24	-	-
	Nystatin	-	-	23	23
SSSK	6.25	10	12	13	10
	12.5	12	14	15	14
	25	16	16	17	15
	50	18	20	17	18
	Amoxicilin	24	24	-	-
	Nystatin	-	-	24	23
RSSK	6.25	9	10	11	8
	12.5	10	12	10	10
	25	12	13	12	11
	50	16	17	16	14
	Amoxicilin	24	23	-	-
	Nystatin	-	-	25	23
LSSY	6.25	9	10	8	7
	12.5	11	13	9	10
	25	12	13	12	11
	50	15	14	12	13
	Amoxicilin	24	24	-	-
	Nystatin	-	-	23	24
SSSY	6.25	9	10	12	9
	12.5	11	13	13	12
	25	14	15	15	13
	50	15	16	16	16
	Amoxicilin	24	24	-	-
	Nystatin	-	-	23	24
RSSY	6.25	8	9	9	9
	12.5	10	10	9	10
	25	12	12	11	10
	50	14	14	15	12
	Amoxicilin	23	24	-	-
	Nystatin	-	-	23	24

Key: LSSK = Leave of *Sterculia setigera Kem*, SSSK = Stem *Sterculia setigera Kem*, RSSK = Root *Sterculia setigera Kem*, LSSY = Leave of *Sterculia setigera* Yola, SSSY = Stem of *Sterculia setigera* Yola, *RSSY = Root Sterculia setigera* Yola

Table 5. Minimum inhibitory concentration (MIC) of methanolic (leave stem and root) extracts of *Sterculia setigera* from the two locations (Kem and Yola) against the test organism

Concentration in mg/ml								
Extract	Test organism	3.125	6.25	12.5	25.0	50.	.100	200
LSSK	*E. coli* *S. aureus* *C.albican* *A. niger*	+ + + +	+ + + +	+ + + +	- + + +	- - - +	- - - -	- - - -
SSSK	*E. coli* *S. aureus* *C.albican* *A. niger*	+ + + +	+ + + +	+ + + +	- - + +	- - - -	- - - -	- - - -
RSSK	*E. coli* *S. aureus* *C.albican* *A. niger*	+ + + +	+ + + +	+ + + +	- - + +	- - - -	- - - -	- - - -
LSSY	*E. coli* *S. aureus* *C.albican* *A. niger*	+ + + +	+ + + +	+ + + +	+ + + +	- - - -	- - - -	- - - -
SSSY	*E. coli* *S. aureus* *C.albican* *A. niger*	+ + + +	+ + + +	+ + + +	+ + + +	- - + +	- - - -	- - - -
RSSY	*E. coli* *S. aureus* *C.albican* *A. niger*	+ + + +	+ + + +	+ + + +	+ + + +	- - - +	- - - -	- - - -

Key: LSSK = Leave of *Sterculia setigera Kem*, SSSK = Stem *Sterculia setigera Kem*, RSSK = Root *Sterculia setigera Kem*, LSSY = Leave of *Sterculia setigera* Yola, SSSY = Stem of *Sterculia setigera* Yola, *RSSY = Root Sterculia setigera* Yola
+ = Turbid - = Clear

Table 6. Minimum bactericidal and fungicidal concentration (MBC/MFC) of *Sterculia setigera* (leave, stem and root) against the test organism from both locations (Kem and Yola)

Extract	Test Organism	MBC/MFC
LSSK	*E. coli* *S. aureus* *C. albican* *A. niger*	50 100 100 200
SSSK	*E. coli* *S. aureus* *C. albican* *A. niger*	50 50 100 100
RSSK	*E. coli* *S. aureus* *C. albican* *A. niger*	50 50 100 100
LSSK	*E. coli* *S. aureus* *C. albican* *A. niger*	100 100 100 100
SSSY	*E. coli* *S. aureus* *C. albican* *A. niger*	100 100 200 200
RSSY	*E. coli* *S. aureus* *C. albican* *A. niger*	100 100 100 200

Key: LSSK = LSSK = Leave of *Sterculia setigera Kem,* SSSK = Stem *Sterculia setigera Kem,* RSSK = Root *Sterculia setigera Kem,* LSSY = Leave of *Sterculia setigera* Yola, SSSY = Stem of *Sterculia setigera* Yola, *RSSY = Root Sterculia setigera* Yola