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On Some Computational Methods for Solving an Ordinary Differential Equation with Initial Condition.

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ABSTRACT

Abstract: This research presents computational methods for solving ordinary differential equation with initial condition. Ogunrinde et al.(2012) presented Euler's method and Runge Kutta method for solving initial value problem in ordinary differential equation. We shall use Adomian decomposition method to solve the problem solved by Ogunrinde et al.(2012) and compare the results and error. The error incurred is undertaken to determine the accuracy and consistency of the three methods

Keywords: Adomian Decomposition Method (ADM), Differential Equation, Euler's Method, Error, Stability Runge Kutta Method,.

Aims Research Journal Reference Format:
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1. INTRODUCTION

Ordinary Differential equations can describe nearly all system undergone change. Many mathematicians have studied the nature of these equations and many complicated systems can be described quite precisely with compact mathematical expressions. However, many systems involving differential equations are so complex. It is in these complex systems where computer simulations and numerical approximations are useful. The techniques for solving differential equations based on numerical approximations were developed before programmable computers existed. The problem of solving ordinary differential equations is classified into initial value and boundary value problems, depending on the conditions specified at the end points of the domain.

There are numerous methods that produce numerical approximations to solution of initial value problems in ordinary differential equations such as Euler's method which was the oldest and simplest method originated by Leonhard Euler in 1768, Improved Euler's method and Runge Kutta methods described by Carl Runge and Martin Kutta in 1895 and 1905 respectively.

There are many excellent and exhaustive texts on this subject that may be consulted, such as [8], [4], [6], [5],[17],[18] and [1] just to mention few. In this work we present the practical use of Adomian decomposition method for solving ordinary differential equations with initial conditions.

2. NUMERICAL METHOD

Numerical method forms an important part of solving initial value problems in ordinary differential equations, most especially in cases where there is no closed form solution. Next we present three numerical methods namely Euler's Method, Runge Kutta method, and Adomian Decomposition method.

2.1 Runge Kutta Method

Runge Kutta method is a technique for approximating the solution of ordinary differential equation. This technique was developed around 1900 by the mathematicians Carl Runge and Wilhelm Kutta. Runge Kutta method is popular because it is efficient and used in most computer programs for differential equation.
The following are the orders of Runge Kutta Method as listed below:
-Runge Kutta method of order one is called Euler's method.
-Runge Kutta method of order two is the same as modified Euler's or Heun's Method.
-Runge Kutta method of order four is called classical Runge Kutta method

2.2 Euler's Method

Euler's method is also called tangent line method and is the simplest numerical method for solving initial value problem in ordinary differential equation, particularly suitable for quick programming which was originated by Leonhard Euler in 1768. This method subdivided into three namely,
2.2.1 Forward Euler's method.
2.2.2 Improved Euler's method.
2.2.3 Backward Euler's method.

2.3 Adomian Decomposition Method

The Adomian decomposition method, proposed by Adomian initially with the aims to solve frontier physical problem, has been applied to a wide class of deterministic and stochastic problems, linear and nonlinear, in physics, biology and chemical reactions etc. For nonlinear models, the method has shown reliable results in supplying analytical approximation that converges very rapidly. It is well known that the key of the method is to decompose the nonlinear term in the equations into a peculiar series of polynomials are the so-called Adomian polynomials. Adomian formally introduced formulas that can generate Adomian polynomials for all forms of nonlinearity. Recently, a great deal of interests has been focused to develop a practical method for the calculation of Adomian polynomials An.

However, the methods developed by [9]-[15] also require a huge size of calculations. [16] Established a promising algorithm that can be easily programmed in Maple, and be used to calculate Adomian polynomials for nonlinear terms in the differential equations. Let us first recall the basic principles of the Adomian decomposition methods for solving differential equations.

Consider the general equation Fu ¼ g, where F represents a general nonlinear differential operator involving both linear and nonlinear terms, the linear term is decomposed into L þ R, where L is easily invertible and R is the remainder of the linear operator. For convenience, L may be taken as the highest order derivate. Thus the equation may be written as:

Lu+ Ru+ Nu= g, (1)

Where Nu represents the nonlinear terms. Solving Lu from
(1), we have Lu = g – Ru- Nu (2)
Because L is invertible, the equivalent expression is Lu = L^{-1}g – L^{-1}Ru- L^{-1}Nu (3)
L^{-1}
If L is a second order operator, for example, L^{-1} is a twofold integration operator and L^{-1}Lu= u- u(0) -t (0), then (3) for u yields

u'

u = a+ bt+ $L^{-1}g - L^{-1}Ru - L^{-1}Nu$ (4)

Therefore, u can be presented as a series
u= $\sum_{n=0}^{\infty} u_n$ (5)

with u_0 identified as a + bt + $L^{-1}g$ and u_n $(n > 0)$ is to be determined. The nonlinear term Nu will be decomposed by the infinite series of Adomian polynomials.

$$Nu = \sum_{n=0}^{\infty} A_n, \tag{6}$$

where A_n's are obtained by writing

$$v(\lambda) = \sum_{n=0}^{\infty} \lambda^n u_n, \tag{7}$$

$$N(v(\lambda)) = \sum_{n=0}^{\infty} \lambda^n A_n. \tag{8}$$

Here λ is a parameter introduced for convenience. From (7) and (8), we deduce

$$A_n = \frac{1}{n!}\left[\frac{d^n}{d\lambda^n} N(v(\lambda))\right]_{\lambda=0}, \quad n = 0, 1, \ldots \tag{9}$$

Now, substituting (5) and (6) into (4), we obtain

$$\sum_{n=0}^{\infty} u_n = u_0 - L^{-1}R\sum_{n=0}^{\infty} u_n - L^{-1}\sum_{n=0}^{\infty} A_n.$$

Consequently, we can write

$$u_0 = a + bt + L^{-1}g,$$
$$u_1 = -L^{-1}Ru_0 - L^{-1}A_0,$$
$$\vdots$$
$$u_{n+1} = -L^{-1}Ru_n - L^{-1}A_n.$$

All of u_n are calculable, and $u = \sum_{n=0}^{\infty} u_n$. Since the series converges and does so very rapidly, the n-term partial sum $\varphi_n = \sum_{i=0}^{n-1} u_i$ can serve as a practical solution.

3. NUMERICAL EXPERIMENTS

We shall now proceed by using ADM Method In order to confirm the applicability and suitability of the methods for solution of initial value problems in ordinary differential equations, it was computerized in Maple software package. The performance of the methods was checked by comparing their accuracy and efficiency with methods used by Ogunrinde et al.(2012). The efficiency was determined from the number iterations counts and number of functions evaluations per step while the accuracy is determined by the size of the discretization error estimated from the difference between the exact solution and the numerical approximations.

Example:
We use Adomian Decomposition method to approximate the solution of the initial value problem y' , $y(0) = 2$, with step size $h = 0.1$ on the interval $0 \le x \le 1$ whose exact solution is given by $y(x) = e^x + x + 1$. The results obtained shown in Table 1 and Table 2, the comparison of the method to Euler, Runge Kutta and exact solution and the error incurred respectively.

3.1 Table of Results

Table 1: The Comparative Result Analysis of Adomian Decomposition Method, Runge Kutta Method and Euler's Method

n	x_n	$y(x_n)$	*Runge Kutta*	*Euler*	*Adomian*
0	0.0	2.0000	2.0000	2.0000	2.0000
1	0.1	2.2052	2.2051	2.2000	1.8048
2	0.2	2.4214	2.4213	2.4100	1.6186
3	0.3	2.6498	2.6497	2.6310	1.4402
4	0.4	2.8918	2.8918	2.8641	1.2684
5	0.5	3.1487	3.1486	3.1105	1.1018
6	0.6	3.4221	3.4221	3.3716	0.9392
7	0.7	3.7137	3.7137	3.6487	0.7792
8	0.8	4.0255	4.0255	3.9436	0.6203
9	0.9	4.3596	4.3596	4.2579	0.4611
10	1.0	4.7182	4.7182	4.5937	0.3000

Table 2: Error incurred in Adomian Decomposition Method, Runge Kutta Method and Euler's Method

n	x_n	*Runge kutta Error*	*Euler Error*	*Adomian Error*
0	0.0	0.0000	0.0000	0.0000
1	0.1	0.0001	0.0052	0.4004
2	0.2	0.0001	0.0114	0.8028
3	0.3	0.0001	0.0188	1.2096
4	0.4	0.0000	0.0277	1.6234
5	0.5	0.0001	0.0382	2.0469
6	0.6	0.0000	0.0505	2.4829
7	0.7	0.0000	0.0650	2.9345
8	0.8	0.0000	0.0819	3.4052
9	0.9	0.0000	0.1017	3.8985
10	1.0	0.0000	0.1245	4.4182

3.2 Graph of Result

Given below is the graph of results

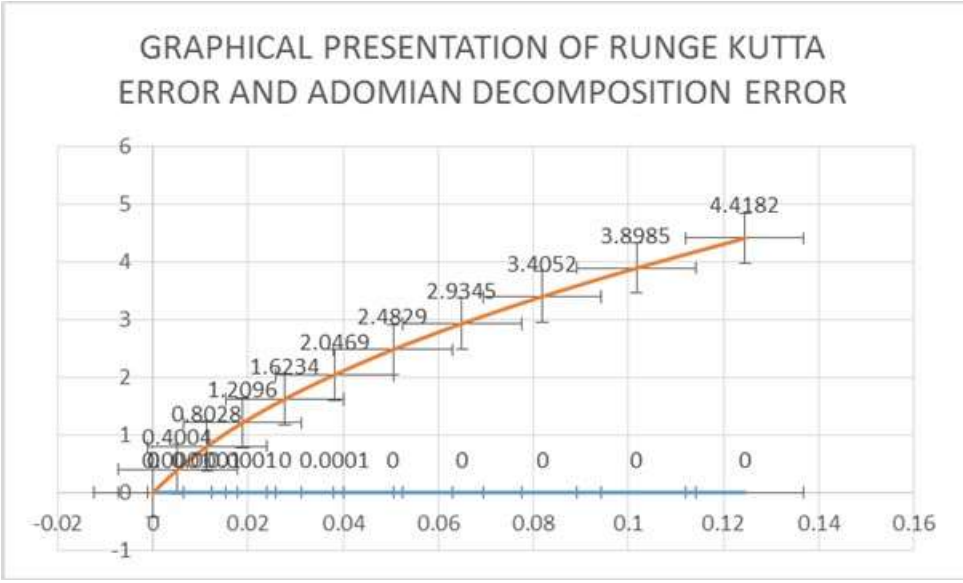

Fig. 1: Graphical Presentation of Runge Kutta4. DISCUSSION OF RESULTS

We noticed that in Table 2, the error incurred in Adomian Decomposition Method is greater than that of Runge Kutta method and Euler Method and at the same time get larger as *n* increases. Hence Runge Kutta method is more accurate than its counterpart Euler's method and Adomian Decomposition Method as we can see from Table 2.

5. CONCLUSION

We have in our disposal three numerical methods for solving initial value problems in ordinary differential equations. In general, numerical method has its own advantages and disadvantages of use. From the problem solved using MAPLE, it is observed that a lot of useful insights into numerical solution of initial value problem have been gained. We conclude that Runge Kutta method is consistent, convergent, quite stable and more accurate than Euler's method and Adomian Decomposition Method and it is widely used in solving initial value problems in ordinary differential equations.

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Antimicrobial Activities of Extracellularly Synthesized Silver Nanoparticles from *Aspergillus Flavus* and *Alternaria Alternata*

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ABSTRACT

This study was carried out to evaluate the extracellular biosynthesis of Silver Nanoparticles using *Aspergillus flavus* and *Alternaria alternata* isolated from fruit waste (Orange) samples using the vegetative and cell-free filtrate method. The antimicrobial activity was performed against *Escherichia coli* and *Streptocous fecalis*. Characterization of the silver nanoparticles was achieved using Color change, UV-Visible Spectrophotometry and Fourier Transform Infrared Spectroscopy (FTIR). The Nanoparticles showed UV-Visible absorbance peaks that correspond to the Plasmon resonance of silver nanoparticles. The FTIR spectra showed the presence of aromatic and aliphatic amines, confirming the presence of proteins as the stabilizing agent surrounding the silver nanoparticles. The silver nanoparticles showed higher antimicrobial activity against *Escherichia coli.* Silver nanoparticles (1mM) from *Aspergillus flavus* were not significantly different ($p<0.05$) from Nitrofurantoin. The use of these fungi for silver nanoparticles synthesis offers the benefits of eco-friendliness and amenability for large-scale production and shows that biosynthesized silver nanoparticles can be effective as an alternative therapy in solving antimicrobial resistance problems.

Keywords: *Aspergillus flavus; Alternaria alternata;* Silver nanoparticles; Antimicrobial Resistance; Green Synthesis.

Aims Research Journal Reference Format:
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1. INTRODUCTION

There is an urgent need to develop new bactericides because of the emergence and increase of microbial organisms which are resistant to multiple antibiotics and have become an increasing public health problem [1]. Silver has been used for years in the medical field for antimicrobial applications, however, Nanosilver, being less reactive than silver ions, is expected to be more suitable for medical applications [2]. Humans have learned to harness fungi for the protection of human health in antibiotics, anti-cholesterol statins, and immunosuppressive agents [3], while industry has utilized fungi for large scale production of enzymes, acids, and bio surfactants [4].

With the arrival of contemporary applied science, fungi have remained important by providing a greener alternative to chemically synthesized nanoparticle [5]. Fungi have a number of advantages for nanoparticles synthesis in comparison with other organisms, as they are relatively easy to isolate and culture and they secrete large amounts of enzymes, particularly extracellular ones[4]. Nanoparticles biosynthesis occurs once the microorganisms grab target ions from their environment and switch the metal ions into the component metal through enzymes generated by the cell activities [6].

Antibacterial assays of photosynthesized Silver Nanoparticles have been assessed against human pathogenic Gram-positive and Gram-negative bacteria including *Staphylococcus epidermidis* and *Salmonella typhimurium*[7]. The antibacterial activity has also been evaluated using *Sphaerulina albispiculata* in synthesis of Silver nanoparticles [8]. Nanoparticles biosynthesis have been reported and established using the vegetative and/or the cell-free filtrate methods [2]. However, whether using myco-synthesized nanoparticles and their antibacterial activities both as an option to confront the transmission of and infection by human pathogenic bacteria and most importantly as a means of biological waste management remain to be established [5].

Thus this work is aimed at exploring the potentials of the metabolites of two fungal organisms (*Aspergillus flavus* and *Alternaria alternata*) isolated form fruit wastes from South-West Nigeria in the green synthesis of Silver Nanoparticles and evaluating the antimicrobial susceptibility of two major bacteria of clinical importance (*Escherichia coli* and *Streptococcus fecalis*) to the synthesized particles. To explore the synthesizing activities and eco-usefulness of a microorganism gotten from a fruit waste, two major fungal species were isolated and identified from Orange fruit waste gotten from Ede, Osun State and products of their metabolites were challenged with different concentration of silver nitrate for the reduction to silver nanoparticles, which were then further assayed for antibacterial activities against clinical pathogens of *Escherichia coli* and *Streptococcus fecalis*. This was done after characterization of established silver nanoparticles.

2. MATERIALS AND METHODS

2.1 Isolation of Fungal Cultures

Silver nitrate was obtained from Sigma Aldrich and used without further purification. All other reagents were of analytical grade with maximum purity and were all properly washed with distilled water and oven dried before use. Potato Dextrose agar was purchased from Oxoid and prepared according to manufacturer's instructions. Spoilt Orange samples were gotten aseptically from Ede, Osun state market; serial dilution and pour plate methods were carried out in the Microbiology Laboratory according to the method described by [5]. A volume of 1ml each of the dilution were transferred to Potato Dextrose Agar, incubated for five (5) days, a pure culture gotten after sub-culture. Macroscopic identification was done based on colonial morphology, color, texture and shape, while microscopic identification was done using Lactophenol blue as a staining agent according to the method described by [6]

2.2 Silver Nanoparticle Biosynthesis

2.2.1 Vegetative Method

According to the method described by [6] each fungal sample was grown in 200ml bottles each containing 100ml of potato dextrose broth and at 25-28^{o}C under continuous mixing condition by a magnetic stirrer(rotary shaker) at 120rpm for 72 hours.

The mycelial (vegetative part of the fungus) mass was then separated from the culture broth by sterile filter paper, and the settled mycelia were washed thrice with sterile distilled water. 10g of the harvested mycelial mass was mixed with a 100ml aqueous solution of 1mM silver nitrate solution ($AgNO_3$). Then the mixture was placed in a 100rpm rotating shaker at 28^{o}C for 72hours duration. In this process, silver nanoparticles were produced through reduction of the silver ions to metallic silver (Ag^{+} to Ag^{0}). Change in color of the fungal biomass incubated with silver nitrate solution was visually observed over a period of time.

2.2.2 Cell-free Filtrate Method

Fungal isolates were grown in Potato Dextrose Broth liquid medium. The flasks were inoculated with spores and incubated at 28^{o}C in static conditions for 72 hours. The biomass was harvested by filtration using Whatman filter paper No. 1 and washed with distilled water to remove any components of the medium. Biomass of 25g was placed in individual flasks containing 100ml Milli-Q water then the flasks were incubated under the conditions described above for 24 hours. The biomass was filtered, and the crude cell filtrate was collected and treated with 1mM silver nitrate solution at room temperature in the dark. Control containing cell-free filtrate without silver nitrate solution. Change in color was observed over a period of time.

2.3 Characterization of the Biosynthesized Silver Nanoparticle

Color Change

The color change in the reaction mixture was recorded through visual observation. The color change from yellow to dark brown indicated that the silver nanoparticles were synthesized.

UV-Visible Spectrophotometry

UV-Visible measurements Spectral analysis for the development of nanoparticles were observed using UV-Visible Spectrophotometer from (200-800nm) in 2ml quartz cuvette with 1cm path length at a resolution of 1nm at room temperature. Silver nanoparticles formed gave a sharp Plasmon band in the range of visible region of the electromagnetic spectrum.

Fourier Transform Infrared Spectroscopy

Fourier Transform Infrared Spectroscopy (FTIR) was carried out to identify the possible interactions between silver and bioactive molecules. A known weight of sample (1mg) was ground with 2.5g of dry potassium bromide and filled in a 2mm internal diameter micro-cup and loaded unto FTIR set at 26^{o}C. The samples were scanned using infrared in the range of 4000-500 cm-1 using Fourier Transform Infrared Spectrometer (SCHIMADZU) Model-6700). The spectral data were compared with the reference chart to identify the functional groups present in the sample.

2.4 Antibiotic Susceptibility Testing

The bacteria *Escherichia coli* and *Streptococus fecalis* were obtained from Adeleke University Medical Microbiology and Bacteriology Laboratory and inoculated into nutrient broth. Mueller Hinton Agar (MHA) was poured into sterile petri plates which werse left overnight at 37^{o}C and subsequently bacterial lawns were prepared using each bacterial strain. Agar wells were made on MHA plates using 6mm Cork borer, the plates were then loaded with synthesized silver nanoparticles and incubated at 37^{o}C. Commercial antibiotic discs were used as control. After incubation the plates were examined for zone of inhibition, and these methods were carried out according to the method standardized by the Clinical and Laboratory Standards Institute [9]. The sensitivity of the isolates to Silver Nanoparticles 1mM and 5mM were classified as 'resistant' and 'susceptible' according to their zones of inhibition.

Statistical Analysis

The antibacterial activities of silver nanoparticles (1mM and 5mM) against commercial antibiotics [Ciprofloxacin (5µg), Gentamycin (10 µg), Nitrofurantoin (300 µg)] were compared statistically with Statistical Analysis Software 92.2 (SAS) using Analysis of Variance (ANOVA). Statistical significance was defined by a *p* value less than 0.05.

3. RESULTS AND DISCUSSION

Biosynthesis of Silver Nanoparticles

A total of sixteen fungal isolates were detected on Potato Dextrose Agar (PDA). The purified fungal isolates were then grouped into four major genera, as shown in Table 1.0. Cell-free filtrate and silver nitrate solution mixture changed from almost colorless to light yellow after 24 hours and later to dark brown after 72 hours. The control sample, however, remained colorless. This is shown in Plate 1.0. This difference in the color intensity in the vegetative-agitated fungal biomass as compared to the cell-fee filtrate biomass could be due to the production of more metabolites by fungi through agitation [10], thus implying that agitation could be better than static conditions and vegetative rather than cell-free filtrate method.

UV-Vis spectra for cell-free filtrates of *Aspergillus flavus* silver nitrate reaction mixtures (1mM,2mM, 3mM,5mM) alongside reaction mixtures containing Vegetative, agitated *Alternaria alternata* and *A. flavus*+ 1mM silver nitrate solution mixture after two weeks were recorded at 400-450nm after 72 hours as shown in Figure 1.0. The UV-Vis spectra for *A.flavus* (1mM and 2mM) showed absorbance peaks at 425nm, and 3mM at 429 nm, this is indicative of the wavelength at which Plasmon Resonance (excitation of conduction electrons) occurs in the silver nanoparticles[11]. UV-Vis spectra for 5mM however did not reveal a significant absorbance peak. UV-Vis spectra for *A.flavus* (1mM) after two weeks remained at 425nm indicating stabilization of the biosynthesized silver nanoparticles[11].

The UV-Vis spectra for the vegetatively synthesized silver nanoparticles from *A. alternata* also showed an absorbance peak at 440nm. The UV-Visible spectroscopy results suggest that the absorption band at a 420-440nm range is indicative of plasmon interactions under certain conditions, e.g light or dark. This is referred to as Surface Plasmon Resonance [2].

In addition, 5mM reaction mixture had lower absorption peak than the rest concentrations, implying that higher concentrations of silver ions in interaction with fungal cells could lead to aggregation or agglomeration of the reaction solution and thus, instability of the silver nanoparticles formed. This correlates with the results reported by [12].

Table 1.0: Morphological characteristics of fungal species isolated form spoilt Oranges.

Name	Colony/Color on PDA	Reverse	Conidia Head	Conidia Shape	Seriation
Aspergillus flavus	Yellowish green, flat and granular	Yellow	Radial	Globulose	Biseriate
Alternaria alternata	Grayish black, floccus	Brown	Branched, acropetal, elongated	Short, ovoid	Multi-celled
Penicillum notatum	Dense green,fluffy	Dark brown	Single cell	Flask-shaped	Chin philiades
Fusarium oxysporum	Creamy chalky	White	Fusiform, slightly curved with pointed tip	Short, single-celled	Non-septate, not in chain

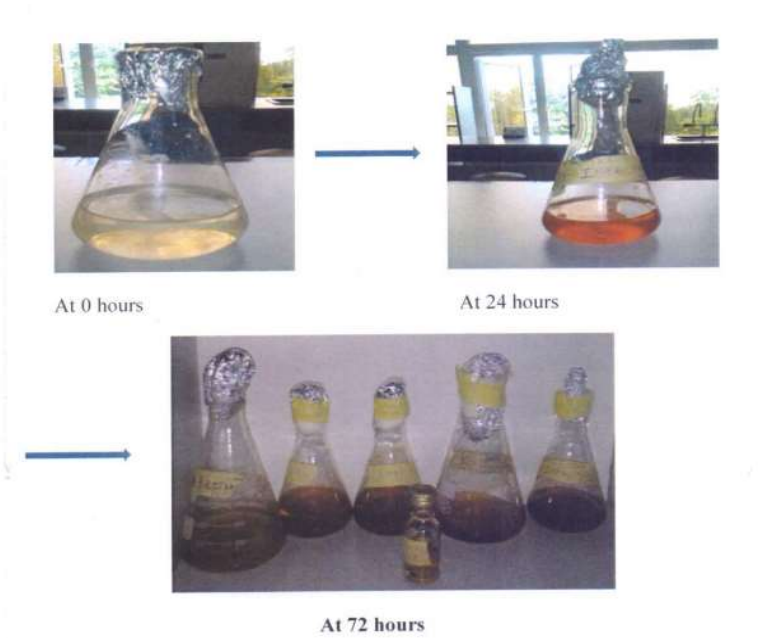
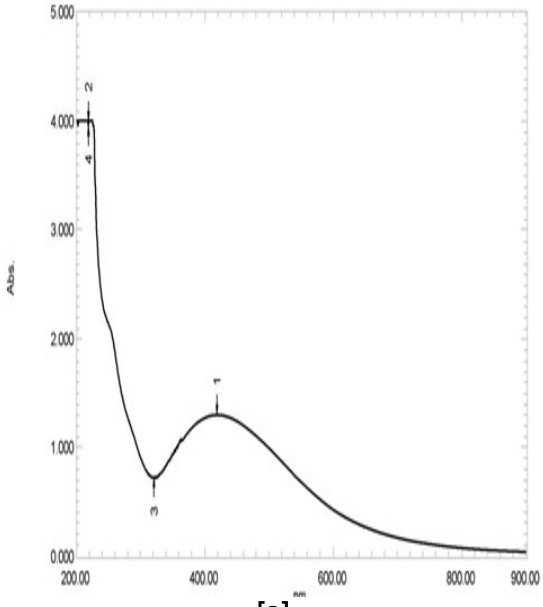


Plate 1.0: Reaction Mixture of *Aspergillus flavus* and *Alternaria alternata* biomass and Slver Nitrate Solution at Different Time Intervals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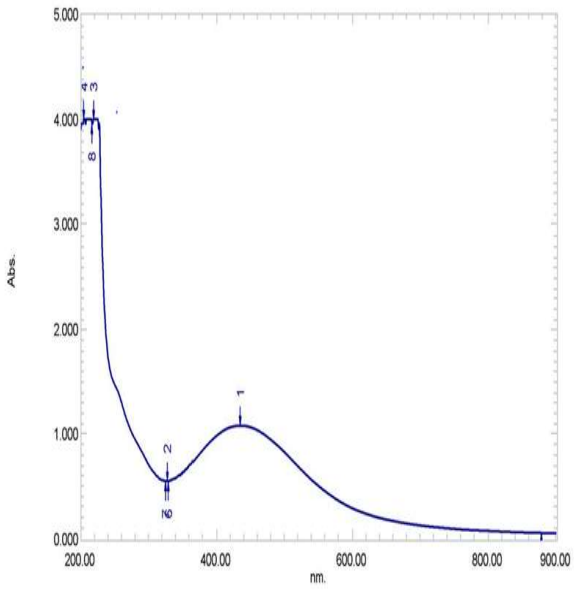
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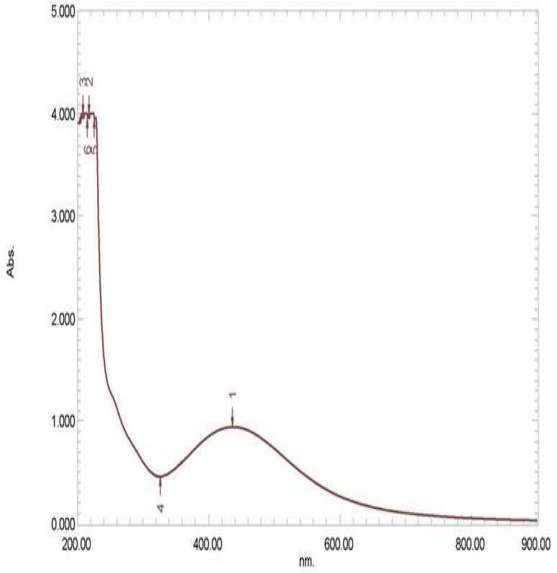
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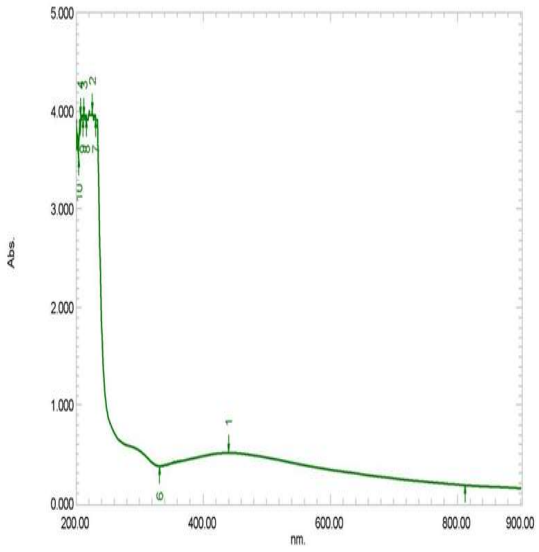
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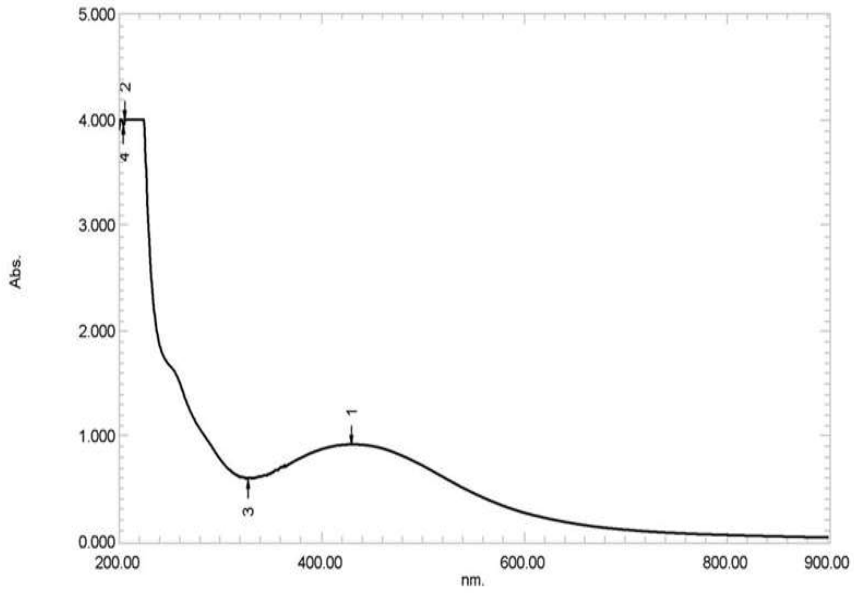
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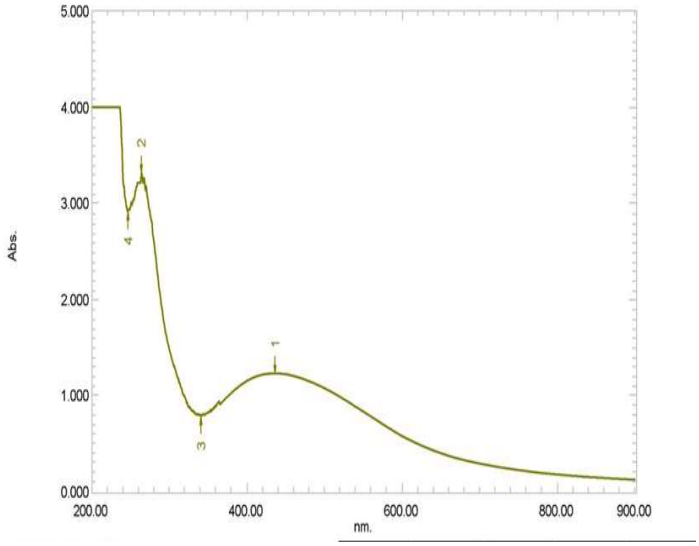
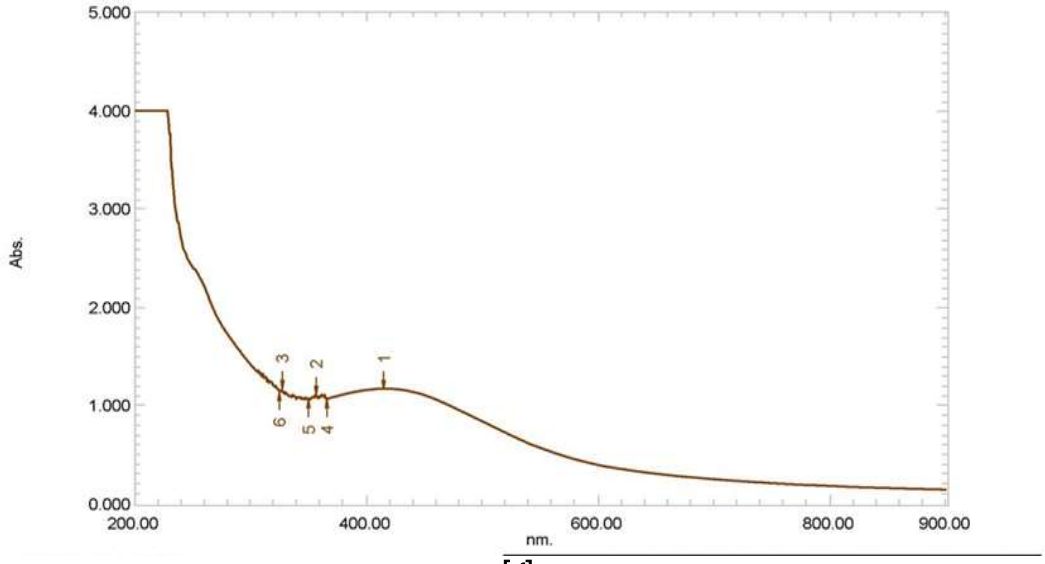


[[[[[e]

[f]



[g]

Fig.1; UV-VIS Spectra for AgNPs (a-e) 1,2,3 and 5mM Silver Nitrate+*Aspergillus flavus* reaction mixture (f) 1mM Silver Nitrate+*Alternaria alternata* cell-free filtrate reaction mixture (g) Reaction mixture after 2 weeks

For vegetative, agitated *Alternaria alternata*, FTIR spectra revealed the presence of 8 bands at 3343.05, 2945.4, 2426.53, 2096.62, 1635.69, 1384.94, 1080.17, 1039.87 cm^{-1} as shown in figure 8.0. The bands at 163.69 and 3343.05 correspond to the binding vibrations of Amide 1 band of protein with N-H stretching. The bands observed at 1384.94 and 1080.17 can be assigned to C-N stretching vibrations of aromatic and aliphatic amines respectively. The other bands however, are fingerprint regions.

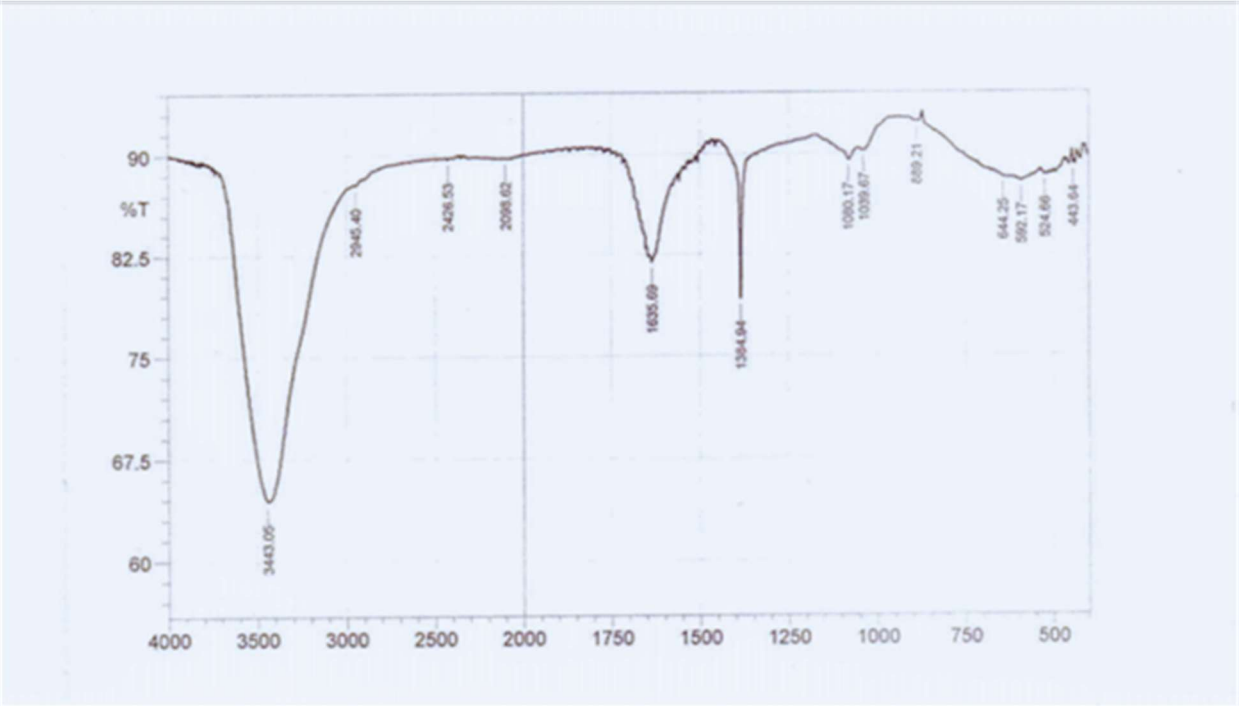


Fig. 8.0: FTIR Analysis of *Alternaria alternata* silver nanoparticles

For *Aspergillus flavus*, the FTIR revealed the presence of 6 bands at 3343.05, 2360.95, 1635.69, 1384.94,1114.89 and 1085.96 as shown in Figure 9.0. The other bands are fingerprint regions. The interpretations are similar to that of *A. alternata*.

The FTIR results were suggestive of the fact that the surrounding biological molecules (proteins and other metabolites) could possibly perform the dual functions of forming and stabilizing the nanoparticles in aqueous medium [13].

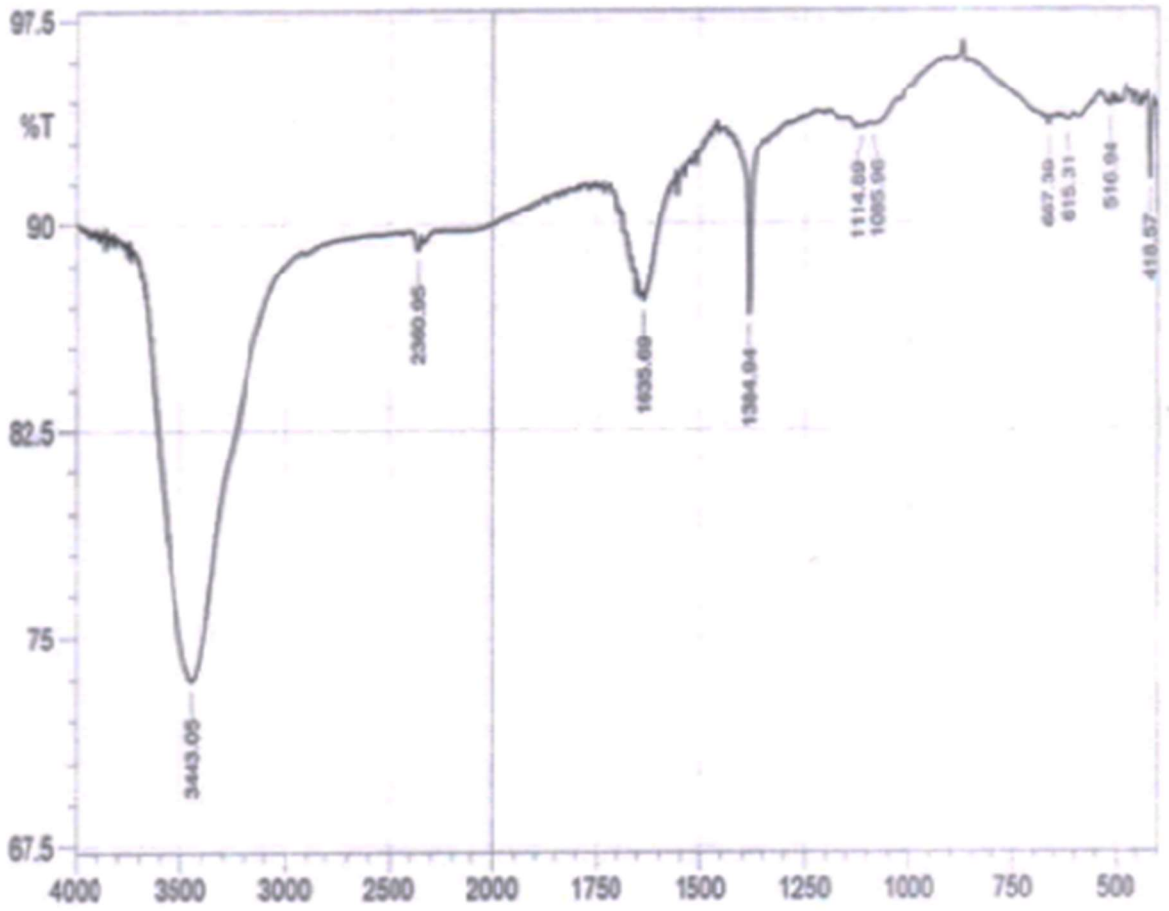


Fig. 9.0: FTIR Analysis of *Aspergillus flavus* silver nanoparticles

3.1 Antibacterial Activities of Biosynthesized Silver Nanoparticles

The antibacterial activities of 1mM and 5mM silver nanoparticles on Escherichia coli and *Streptococcus fecalis* in comparison with commercial antibiotics are as shown in Figure 8.0. The zones of inhibition of the silver nanoparticles vary with each concentration of silver nitrate and commercial antibiotics used.

Fig. 10.0 shows the graphical representation of the antibacterial activity of both concentrations of silver nanoparticles against the bacterial isolates in comparison with the commercial antibiotics used. It shows similar activity between Silver nanoparticles (1mM) and Ciprofloxacin. The organisms were also susceptible to Gentamycin, Nitrofurantoin and Ciprofloxacin.

It is indicated that Silver nanoparticle (1mM) has the same activity as Nitrofurantoin and *Escherichia coli*, there was similar activity between Silver nanoparticles (1mM and 5mM), Gentamycin and Nitrofurantoin against *Streptococcus fecalis.* According to [11], antibacterial activities shown by the nanoparticles might be by oxidative stress generated by reactive oxygen species, and that it is possible that the nanoparticles, other than interact with the surface of the membrane, also penetrate the insides of the bacteria.

The result showed that the inhibition zone diameters of *Escherichia coli* were wider than those of *Streptococcus fecalis*, implying that the nanoparticles of 1mM rather than 5mM had higher antibacterial activity against human pathogenic Gram-negative rods. [14] however reported higher inhibition zones in a Gram-positive organism, *Staphylococus aureus*.

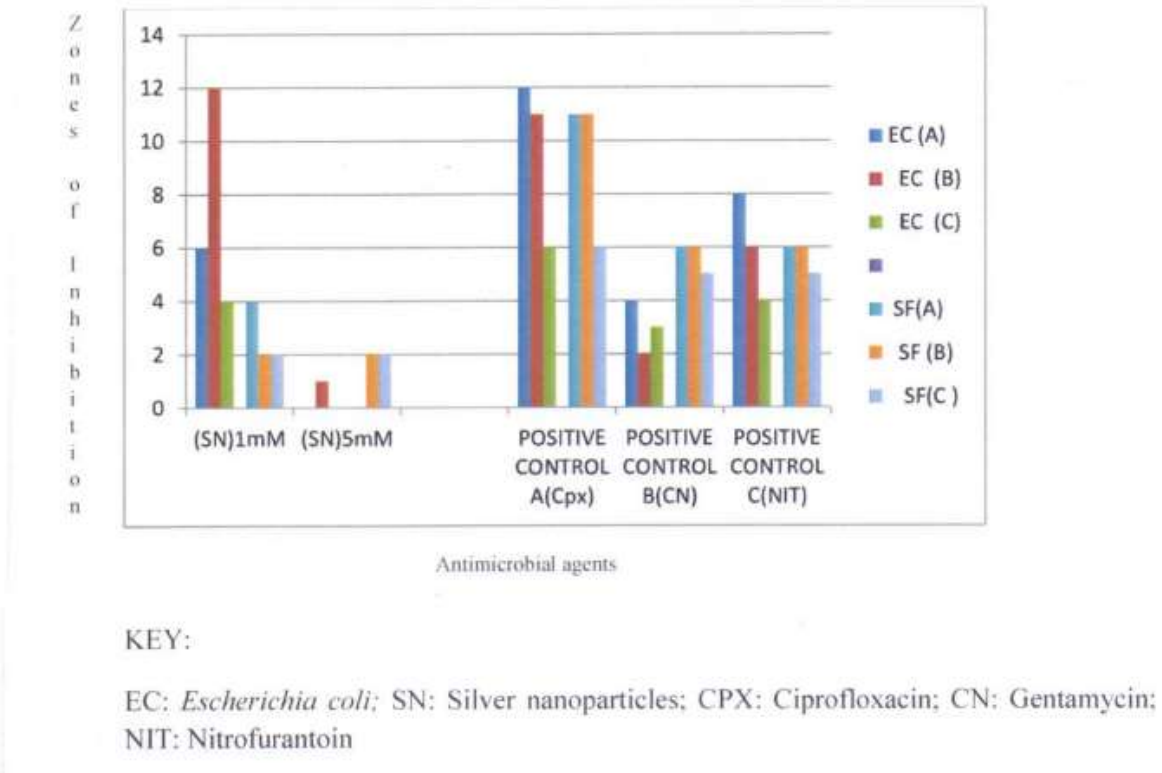


Fig 10.0; Zones of inhibition (mm) of Silver Nanoparticles (1mm and 5mm) and Control Antibiotics against Escherichia coli and *Streptococcus fecalis*.

4. CONCLUSION

This research work was aimed to throw more light on the importance of microorganisms not only for nanoparticles production but also indicates the use of nanoparticles as antibacterial agents. The suggested mechanism for the extracellular biosynthesis of silver nanoparticles by fungi is thought to occur with the involvement of carboxylic group or through nitrate-dependent reductase [12]. The fungus mycelium, upon exposure to the metal salt solution, produces metabolites for its own survival, leading to the reduction of the toxic metal ions to a non-toxic nanoparticle through the catalytic effects of the extracellular enzymes and metabolites of the fungus [15].

The findings of this study thereforedemonstrate the simple, safe, cost-effective and eco-friendly preparation of silver-nanoparticles using the fungi *Aspergillus flavus* and *Alternaria alternata*. The antibacterial activity of the synthesized nanoparticles was exhibited more at lowest concentrations against Gram-negative bacteria. Thus, application of biosynthesized silver nanoparticles may lead to the development of suitable pharmaceutical and other industrial products.

4.1 Recommendation

It is recommended that further studies be done on the synergistic application of nanotechnology and bioinformatics tools in vaccine prediction for tackling antimicrobial resistance.

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Parasites and Associated Haematological Changes in Some Fruit Bats (*Eidolon helvum and Epomops franqueti*) In Southwest Nigeria

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ABSTRACT

This study investigated the different types of ectoparasites and hemoparasites associated with fruit bats (*Eidolon helvum* and *Epomops franqueti*) that are prevalent in our environment. A total of 30 bat samples were collected at different sites within Obafemi Awolowo University (OAU) Ile-Ife and University of Ibadan (UI) campuses with the use of mist nets. The species of trapped bats were identified based on the morphological features, afterward, ectoparasites observed were collected for scientific identification and blood samples were also collected for full blood count with hemoparasites analysis. Data generated were analyzed and values of statistical significance were taken at $p<0.05$. *Eidolon helvum* had ectoparasites which were mainly bat flies (*Nycteribia alternata* and *Eucampsipoda africanum*) while *Epomops franqueti* had none. Both species of bats had hemoparasites with prevalence rates- *Babesia* sp (13.3%)*; Erhlichia sp.* (6.6%)*; Hemosporidia sp* (10%)*;* Microfilaria (3.3%)*; Anaplasma sp (*3.3%). There were no significant differences ($p<0.05$) in the haematological values and body weight of bats that had hemoparasites and those without hemoparasites. Therefore, the fruit bats investigated in this present study, though infested with parasites, were able to adapt favourably and the incidence of parasitism did not significantly affect their body weight and haematological values.

Keywords: *Eidolon helvum, Epomops franqueti, haemoparasites, Eucampsipoda africanum, Nycteribia alternata*

Aims Research Journal Reference Format:
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1. INTRODUCTION

Over the past decade, there has been increasing interest in bats as reservoirs of infectious diseases being the only mammals capable of true or sustained flight, with their wings anatomically resembling the human hand, having extremely elongated fingers and a wing membrane stretched between. Bats are the second most diverse orders of mammals (behind rodent), being ubiquitous and found in each continent, except the Antarctica.

They have been recorded in deserts, grasslands and forests in the tropical, subtropical, and temperate zones (Kunz, 1988; Simmons, 2005). Bat species are poorly documented and classified especially in West Africa where the last comprehensive study was by Rosevear (1965), although a number of new species have been identified (Koopman, 1989; Fahr et al., 2002). Bats have been implicated as reservoirs of life-threatening zoonotic diseases such as Nipah, Hendra, Marburg and Ebola viruses (Newman et al., 2011; Olival et al., 2013; Baker et al., 2014), only a few studies have been conducted on the parasites associated with bats (Patterson et al., 2008; Hamilton et al., 2012; Gay et al., 2014).

The knowledge of the ecology of parasites that bats can harbour, the effects of the parasites on their system and on the human population will serve as a guide to epidemiologists, conservationists, physicians and veterinarians in order to effectively regulate disease outbreaks within bats and human populations, and also help to manage the health of the public worldwide. Some ectoparasites of bats are known to transmit haemoparasites and other disease causing agents like *Trypanosoma sp.* and *Bartonella sp.* to their hosts (Billetter et al., 2012; Kamari et al., 2014). Despite the numerous pathogens that bats harbour, they rarely show any clinical manifestation of diseases (Luis et al., 2013) because they are believed to have evolved to keep most pathogens in check (Hayman et al., 2008; Schneeberger, 2013) due to their great ability to adapt to changing environmental conditions through a higher genetic variability.

Studies have shown that some fruit bats e.g. *Eidolon helvum,* migrate seasonally especially during the middle of the wet season (Richter and Cumming, 2005; Ossa et al., 2012) and are likely to carry as well as shed some diseases across population of bats and humans in various areas they inhabit during migration. Some cases of the transmission of zoonotic diseases and the recent outbreak of Ebola in West Africa are suspected examples of such cases (Fletcher, 2007; Hayman et al., 2012; Moratelli and Calisher, 2015). Due to their migratory nature, they have developed adaptation to exploit varying habitats and vegetation types which predisposes them to parasitic infestation. This study was therefore designed to investigate the types of parasites associated with fruit bats found in this part of the country and to observe changes the presence of these parasites could cause on their haematological parameters and other health indices.

2. MATERIALS AND METHODS

Study Site

The samples used for this study were trapped from bat territories located at Obafemi Awolowo University (Lat 08° 28' N and Long 04° 33' E) situated in Ile-Ife, Osun state and University of Ibadan (Lat 07° 23' N and Long 03° 54' E), Ibadan, Oyo state, both in the South western part of Nigeria.

Sample collection

A total number of 30 bats were captured from both sample sites with the use of mist nets with four shelves and thereafter, they were removed, placed in cages and brought to the working area for species identification and examination for parasites. Gloves were used for removing the bats from the nets to prevent scratches and bites. Subsequently, the cages were opened and each bat species was first identified, their sex determined (using the reproductive condition and physical characteristics), the body weight (using a weighing scale) was recorded and then examined for the presence of

ectoparasites (bat flies, mites, fleas and ticks). This was done by physical examination of the fur, ear, face, wings and tail membranes. A pair of thumb forceps was used to extract the ectoparasites. Ectoparasites seen were extracted into sample bottles that was half filled with ethanol (70%) and labelled. Blood volume of 2ml per bat was collected through the heart into EDTA sample bottles with the use of 21gauge needle and 5ml syringe. Blood samples were immediately taken to pathology (clinical) laboratory for analysis while the parasites inside sample bottles containing 70% ethanol were taken to parasitology laboratory for proper identification.

Laboratory Analyses

Red Blood Cell Count Determination

1ml of red blood cell diluents was poured into a dilution bottle, and 10 microliter of blood was drawn with the aid of a micropipette and added to the dilution bottle containing the diluents. 3-5 drops of this mixture was dispensed to fill the Neubauer's counting chamber and allowed to settle for 3seconds, then it was viewed under the light microscope, all red cells in 80 small squares were counted and the figure multiplied by 10000 (Fankhauser, 2003).

White Blood Cell Count Determination

1ml of Turk's solution was dispensed into dilution bottles and 50 microlitres of blood was pipette and added to the dilution bottles. The mixtures were allowed to mix and thereafter dispensed onto the Neubauer's counting chamber. Under the light microscope, on the Neubauer's counting chamber, all white blood cells in 64 large squares were counted and the figure multiplied by 50 (Pagana and Pagana, 1997).

Determination of Leucocyte Differentials

A differential determines the percentage of each of the five types of mature WBCs. The five types of white blood cells are; Neutrophil, Basophil, Lymphocyte, Eosinophil, and Monocytes. The manual method of using differential to count each type on a stained slide using the light microscope at 1000 magnifications (Stamminger et al., 2002)

Determination of Packed Cell Volume (PCV)

Blood was drained into capillary tubes and sealed with plasticine at both ends of the capillary tube to avoid spillage. They were arranged in the centrifuge and the centrifuge was allowed to spin at 3000rpm for 5mins in order to separate red cells from plasma and also obtain the packed cell volume (PCV) values. After 5minutes, the PCV of each blood sample was read using a micro-hematocrit reader by placing the capillary tube on a reader (Fankhauser, 2003). The point between red cell and plasticine was positioned on the lowest line (black) on the reader while the topmost end of the plasma was adjusted to the uppermost line on the reader and the middle line of the reader was adjusted just below the buffy coat (area of white blood cell) in order to determine the PCV.

Haemoglobin Determination

Using the Sahli's apparatus graduated tube, normal HCl was poured into the tube up to 20ml (using lower meniscus). 20microlitres of blood was pipetted from the sample bottles using the micropipette and poured into the Sahli's apparatus tube containing normal HCl. This mixture was let to react for 5minutes. After 5minutes, the mixture was then compared with the standard Sahli's comparator in terms of colour. If the colors do not tally, the mixture was diluted with distilled water till the colours matched. (Schalm et al., 1975)

Mean Corpuscular Volume (MCV)

This is the average volume of each erythrocyte in a blood sample. The MCV is calculated as:

$$MCV = \frac{PCV\ (\%) \times 10}{RBC\ (million/\mu l)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Mean Corpuscular Haemoglobin Concentration (MCHC)

This is the average weight of haemoglobin content in a red blood cell and it was calculated as:

$$MCHC = \frac{HB\ concentration\ (g/dl) \times 100}{PCV\ (\%)} \quad \ldots\ldots\ldots (2)$$

Blood Smear Examination for Haemoparasites

This was carried out according to Houwen, (2000). A drop of the blood sample was placed on a clean glass slide and spreader was used to disperse out the blood over the slide' length forming a feathered end with the aim of producing a monolayer in order to be able to identify the cells. The smears were air dried, and thereafter immersed briefly in 99% methanol for about 3minutes for fixing. After fixing, the slide was stained with Giemsa stain for about 30minutes, after which the slides were rinsed with water and allowed to dry before viewing under the microscope. The stained slides were viewed under the microscope with magnification x1000 (oil immersion).

Ectoparasites Identification

The parasites that were preserved in ethanol and subsequently observed under a dissecting microscope. Identification and classification of the parasites was based on morphological criteria

Statistical Analysis

All data were presented as mean ± SD and statistical analysis was carried out by T-test using GraphPad Prism 5 software (GraphPad Software, Inc. La Jolla, California, US). Values of $P < 0.05$ were considered statistically significant.

3. RESULTS

Body weight comparison between species

As shown in Figure 1, the body weight of *Eidolon helvum* (285g ± 45) observed in this study was signifi-cantly higher ($p<0.05$) when compa red with the values of *Epomops franqueti* (77g ± 23)

Comparison of haematological parameters of Eidolon helvum and Epomops franqueti

The haematological parameters show variations between *Eidolon helvum* and *Epomops franqueti* as shown in Table 1. Erythrocyte values (PCV, Hb, RBC, MCV, MCH) of *Eidolon helvum* (n=15) were significantly lower ($p<0.05$) than those observed in *Epomops franqueti* (n=15). Similar difference was observed in leucocyte parameter (neutrophil counts) and platelets of *Eidolon helvum* when compared with Epomops franqueti ($p<0.05$) but the lymphocyte and eosinophil values seen in *Eidolon helvum* were significantly higher than the values of *Epomops franqueti* (Tab. 1). However, the total WBC count did not show any significant difference between the two species.

Table 1. Hematological values of *Eidolon helvum* and *Epomops franqueti.*

Parameters	*PCV (%)*	*Hb (g/ dL)*	*RBC (x1012/L)*	*MCV (fL)*	*MCHC (g/dL)*	*MCH (pg)*	*WBC (103/ ml)*	*LYM (103/ ml)*	*NEU (103/ ml)*	*MON (103/ ml)*	*EOS (103/ ml)*	*Platelets (103/ml)*
Eidolon helvum n=15	42.3 ± 14.4a	13.8 ± 4.65 a	7.10 ± 2.53 a	56.0 ± 15.7 a	30.5 ± 8.44 a	18.3 ± 5.15 a	6154 ± 2630 a	4332 ± 2074 a	1048 ± 1044 a	151 ± 130 a	554 ± 482 a	83067 ± 28677 a
Epomops franqueti n=15	62.1 ± 12.0b	19.4 ± 3.09 b	9.16 ± 1.17 b	67.6 ± 8.23 b	31.5 ± 1.46 a	21.2 ± 1.76 b	5013 ± 2106 a	1504 ± 755 b	3306 ± 1762 b	137 ± 60.9 a	70.4 ± 76.2 b	115533 ± 42052 b
P Values	0.0003	0.0005	0.0077	0.0170	0.6487	0.0469	0.2005	< 0.0001	0.0002	0.6894	0.0006	0.0199

Mean ± SD values with different superscripts within columns a, b are significantly different ($P<0.05$).

Prevalence of parasitism across species

The incidence of ectoparasitism was restricted to *Eidolon helvum* samples while no ectoparasite was observed on *Epomops franqueti* as seen in Table 2. Figure 2 shows the two identified ectoparasites (bat flies), *Nycteribia alternata* and *Eucampsipoda africanum.* Out of the 30 blood samples analyzed, only 9 were positive for Hemoparasites; 6 from *Eidolon helvum* and 3 from *Epomops franqueti*. Hemoparasites identified, as seen in Fig 3-7, with the prevalence, were *Babesia sp* (13.3%)*; Erhlichia sp* (6.6%)*; Hemosporidia sp* (10%)*;* Microfilaria (3.3%)*; Anaplasma sp* (3.3%). Table 2 shows that both species had *Babesia sp. Eidolon helvum* samples were also positive for *Erhlichia sp* and *Hemosporidia sp* unlike *Epomops franqueti*. Microfilaria and *Anaplasma sp* were present in *Epomops franqueti* whereas they were not observed in *Eidolon helvum* samples.

Effect of haemoparasitism on blood values

In Table 3, there was no significant difference (P>0.05) in the erythrocyte values and leucocyte parameters of both haemoparasite positive and negative samples.

Effect of haemoparasitism on the body weight

There was no significant difference in the body weight of bat species that were either positive (212g ± 118) or negative (168g ± 109) for hemoparasites used in this study (p>0.05). There was no significant difference in the body weight of both haemoparasite positive and negative *Eidolon helvum* bats likewise for *Epomops franqueti* as seen in Fig. 8.

Table 2. Parasitism observed in *Eidolon helvum* and *Epomops franqueti.*

Species	Ectoparasites	Hemoparasites				
		Babesia	Hemosporidia	Erhlichia	Microfilaria	Anaplasma
E. helvum	+	+	+	+	-	-
E.franqueti	-	+	-	-	+	+

Legends: *(+) present;* *(-) absent;*

Table 3. Hematological values of samples analyzed for haemoparasitism.

Parameters	*PCV (%)*	*Hb (g/dL)*	*RBC (x1012/L)*	*MCV (fL)*	*MCHC (g/dL)*	*MCH (pg)*	*WBC (103/ml)*	*LYM (103/ml)*	*NEU (103/ml)*	*MON (103/ml)*	*EOS (103/ml)*	*Platelets (103/ml)*
HEMOPARASITES (+ve) n=9	50.0 ± 8.77	16.2 ± 2.67	8.30 ± 1.50	60.4 ± 2.15	32.4 ± 0.638	19.6 ± 0.88	5856 ± 2214	3528 ± 2320	1851 ± 1021	113 ± 41.1	369 ± 577	101889 ± 25206
HEMOPARASITES (-ve) n=21	53.1 ± 19.0	16.8 ± 5.55	8.06 ± 2.48	62.4 ± 16.4	30.4 ± 7.09	19.8 ± 4.87	5467 ± 2534	2656 ± 2003	2317 ± 2089	157 ± 115	287 ± 345	98190 ± 44163
P Values	0.6402	0.7501	0.7849	0.7098	0.4011	0.8759	0.6932	0.3058	0.5323	0.2746	0.6315	0.8167

Mean ± SD values with different superscripts within columns a, b are significantly different (P<0.05).

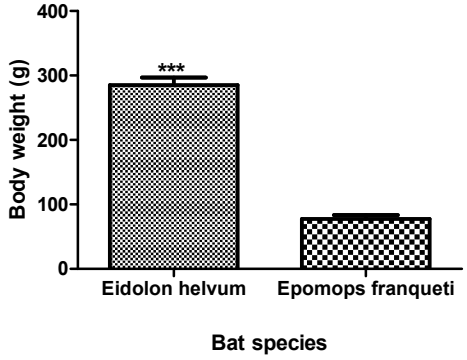

Figure 1: Body weight comparison of *Eidolon helvum* and *Epomops franqueti*. *** indicates significant difference ($p<0.05$).

Figure 2: Photographs of identified ectoparasites (bat flies) on *Eidolon helvum* as seen under the dissecting microscope.

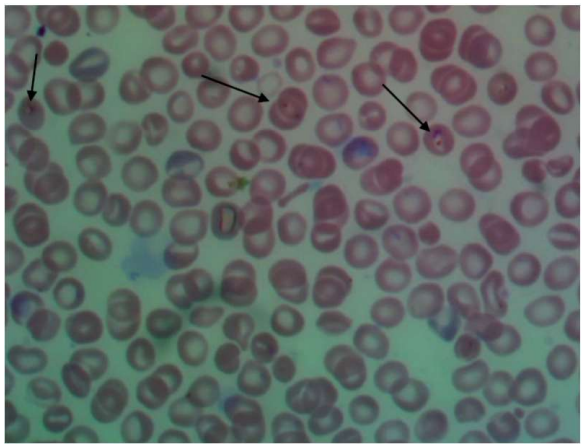

Figure 3: Photomicrograph of Giemsa stained blood smear showing presence of Babesia-like organisms (arrow) within bat erythrocytes. Mag x1000.

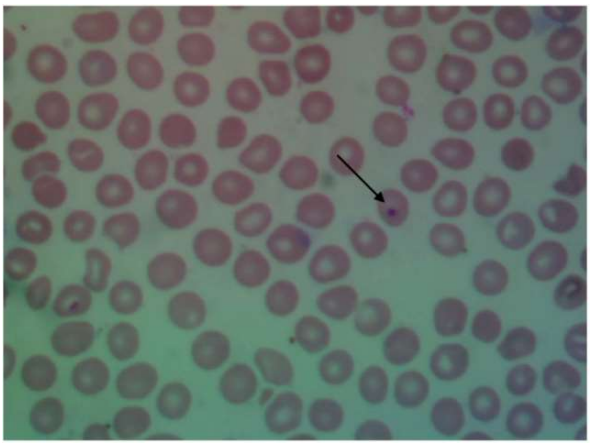

Figure 4: Photomicrograph of Giemsa stained blood smear showing presence of Anaplasma-like organisms (arrow) within bat erythrocytes. Mag x1000.

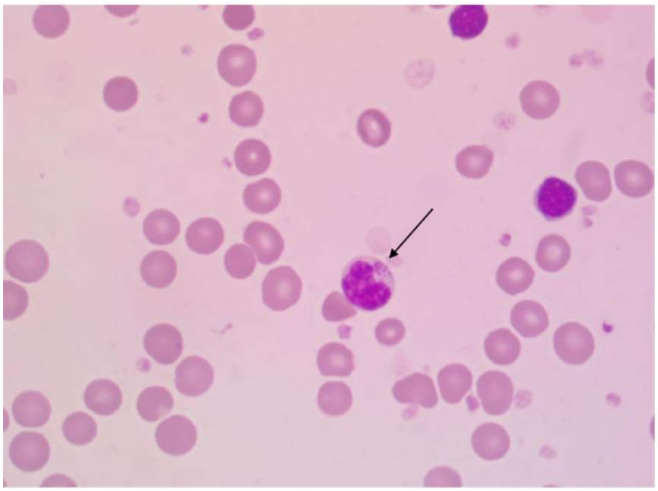

Figure 5: Photomicrograph of Giemsa stained blood smear showing presence of Erhlichia-like organisms (arrow) within bat granulocytes.

Mag x1000.

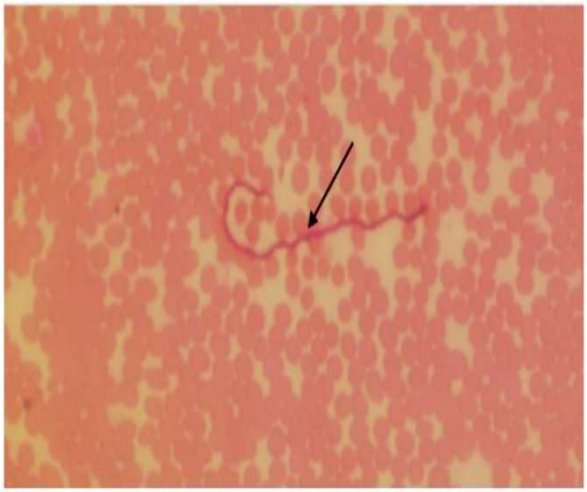

Figure 6: Photomicrograph of Giemsa stained blood smear showing presence of microfilaria organisms (arrow)

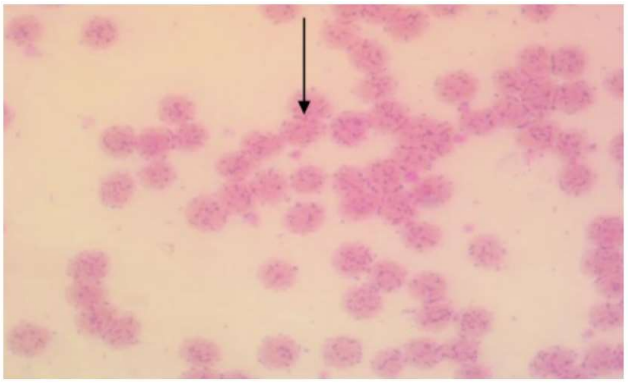

Figure 7: Photomicrograph of Giemsa stained blood smear showing presence of Hemosporidial organisms (arrow) within bat erythrocytes. Mag x1000.

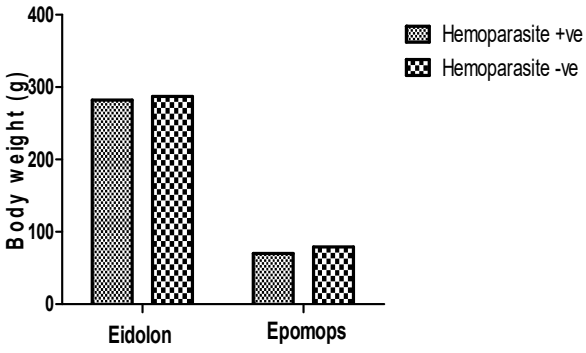

Figure 8: Body weight of bats species that were haemoparasite positive and negative.

4. DISCUSSION

In the present study, the hematological parameters of *Eidolon helvum* were essentially within the range of values found in other fruit bats (Olayemi *et al.,* 2006). The erythrocyte values of *Eidolon helvum* were however significantly lower when compared with the erythrocyte values of *Epomops franqueti*. The mean RBC count of *Eidolon helvum* in this study (7.10x10^{12}/L) considerably differs from the report of Selig *et al.* (2016) in the same species with a mean RBC count of 9.47 x1012/L. The mean RBC count of 9.16 x10^{12}/L in *Epomops franqueti* is similar to the findings of Ekeolu and Adebiyi, (2018) who reported a mean value of RBC count as 9.15 x10^{12}/L. However, these are lower than RBC values reported in some temperate breeds of bats, 12.39 x10^{12}/L in the Serotine bat (Wolk and Ruprecht, 1988) and 11.35 x10^{12}/L in *Myotis myotis* (Albayrak *et al.,* 2016).

The observed variations with regards to *E. helvum* RBC count in this study and the report of Selig *et al.* (2016) could be attributed to a difference in geographical location, sex, food quality and environmental factors where the experiment was carried out (Ratnasooriya *et al*., 2005). The PCV of 42.3% in *E. helvum* observed in this study is similar to the observations of Selig *et al.* (2016) but lower than 62.1% ob-served in *E. franqueti*. Ekeolu and Adebiyi, (2018) reported a PCV of 54.90% in *E. franqueti* but this is lower than the PCV of 62.1% seen in the same species in this present study. Arevalo *et al.* (1992) and Viljoen *et al.* (1997) concluded that bats have higher PCV and hemoglobin values when compared with other terrestrial mammals and that their varying blood-oxygen requirement during seasonal changes may also be responsible for the high hematocrit and hemoglobin levels reported in bats.

Leucocyte parameters are subject to changes depending on the health status of the sampled individuals. In this present study, there was no significant difference in the total WBC counts of the two species of bats sampled. The mean WBC count of 6.15 x10^{9}/L for *E. helvum* observed in this study was within the reference values reported by Selig *et al.* (2016). They also concluded that the WBC count of *E. helvum* was naturally lower when compared with other species of the pteropodid fruit bat. Furthermore, the WBC counts for *E. franqueti,* 5.03 x10^{9}/L, is lower than 13.46 x10^{9}/L which was reported by Ekeolu and Adebiyi (2018). The wide difference could be due to age, time and breeding season in which the animals were captured. There exists, however, variations within the cell types which make up the body's defence system. The mean values of neutrophils and platelets in *E. helvum* were significantly lower when compared with *E. franqueti*. On the contrary, mean values of lymphocytes and eosinophils were significantly higher in *E. helvum* when compared with the values obtained in *E. franqueti.*

The mean neutrophil count of 1.04 x10^{9}/L for *E. helvum* is however within the reference range de-scribed in previous works (Selig *et al.,* 2016). The mean neutrophil count of 3.31 x10^{9}/L for *E. franqueti* was lower than the mean value of 6.09 x10^{9}/L from the same bat species reported by Ekeolu and Adebiyi (2018). This observed reduced neutrophil count is subjective as the value recorded is close to the lower limit of neutrophil count of 5.62 x10^{9}/L reported in the study carried out by Ekeolu and Adebiyi (2018) which could have accommodated much variation in this parameter given a large sample size was used. However, the overall health status of the animals was not known and it is unlikely that they were free of pathogenic micro-organisms e.g. bacteria, which could possibly have caused the reduced neutrophil count without obvious clinical manifestation as bats are usually asymptomatic carriers of some diseases (Luis *et al.,* 2013).

Values of lymphocytes and eosinophils are indicators of the level of stress and parasitism/allergy within an animal respectively. Mean lymphocyte values of 4.33 x10^9/L in *E. helvum* observed in this present study is a little above the upper limit of the reference values (4.03 x10^9/L) reported by Selig *et al.* (2016). Prevalent environmental factors such as climatic conditions, food availability, diseases could contribute to the seeming lymphocytosis observed in this species. On the other hand, the apparent lymphopenia, 1.5 x10^9/L, seen in *E. franqueti* in this study is contrary to the mean value of 6.24 x10^9/L reported by previous authors (Ekeolu and Adebiyi, 2018). Stress factors and viral infections are some of the causes of lymphopenia and these, probably, could be the reason for the observed decreased lymphocyte count.

Eosinophil values, though significantly different between both species used in the present study, are within the reference range and values reported by previous authors (Selig *et al.,* 2016; Ekeolu and Adebiyi, 2018). The body weight of the two species of bats studied was significantly different with *E. helvum* higher than *E. franqueti*, both belonging to the sub-order *megachiroptera.* The mean body weight of *E. helvum* in this study was 285g and this is in agreement with the range of body weight reported by Mickleburgh *et al.* (2008). Similarly, *E. franqueti* had a mean body weight of 77g which is in consonance with the study conducted by Nowak and Walker (1994) where it was reported to range between 56-160g. Due to the nature of their habitats and feeding habits, bats are exposed to quite a number of parasites present within the environment. Both species of bats sampled in this present study were infested with either ectoparasites (bat flies), hemoparasites or both. *E. helvum* was infested with ectoparasites whereas none was observed on *E. franqueti*.

This gives credence to the reports of Nartey (unpublished data, 2015) who carried out a survey on bat species for parasites in Ghana in which he found out that *E. franqueti* had little or no ectoparasites infestation. According to his observation, most commonly encountered ectoparasites of bats include bat flies, mites, ticks, and fleas. Some species of bats harboured a high number of a particular kind of ectoparasite than other species of bats, indicating a high degree of host specialization among these parasites. In terms of bat flies, *Rousettus aegyptiacus, Lissonycterus angolensis* and *Eidolon helvum* were more heavily infested than the other species of bats and this may be attributed to the roosting habits of the three bat species (Nartey [unpublished data], 2015).

This report is in agreement with what was observed in this present study in which *Eidolon helvum* was found to be infested with bat flies of the family *Nycteribiidae* (*Nycteribia alternata* and *Eucampsipoda africanum*). *Eidolon helvum*, for instance, is the most widely distributed fruit bat in Africa which tend to live in groups of over 100,000; roosts can build up to millions at the same place at a time (Mickleburgh *et al.,* 2008). This results in individual bats being very close to each other for easy transfer of parasites across members of the colony. This may be the reason for the high number of parasites harboured by *E. helvum*.Furthermore, the present study had a prevalence of 30% for hemoparasitism in which hemoparasites were observed in both species of bats. The endoparasites reported in bats include protozoans [*Plasmodium* sp*., Nycteria* sp*., Hepatocystis* sp. and *Polychromophilus* sp. (Schaer *et al*., 2013)], trypanosomes (Thomas *et al.,* 2007). Nartey (unpublished data, 2015) reported that hemosporidial organisms; *Hepatocystis* sp., *Nycteria* sp. were observed in pteropodid bats, including *E. helvum* and *E. franqueti*, sampled in some region within Ghana. In this present study, out of 9 samples which were positive for hemoparasites.

4 samples were identified with *Babesia sp.* based on morphological identification criteria. Other hemoparasites identified were *Hemosporidia sp, Erhlichia sp,* Microfilaria and *Anaplasma sp.* The presence of ectoparasites on the body of bats has been linked with the prevalence of some hemoparasites as they serve as vectors for some of these protozoans (Kudo 1966). In this present study, there were no significant differences in body weight and hematological parameters of samples that were positive for hemoparasites when compared with the negative samples. This however means that the prevalence and occurrence of haemoparasitism did not alter, or better still, caused minimal change to the physiological status of the animals sampled.

Per-adventure, the system of the affected animals has been able to adapt favorably to accommodate the parasites and still maintain a stable homeostasis. Significant differences observed in haematological parameters and body weight of the species of bats that were ectoparasites positive when compared with those that had no ectoparasites was mostly due to species differences. Of the two species sampled in this study, *E. helvum* was the only species positive for ectoparasites while there was none on *E. franqueti.* Therefore, suffice to say that the observed variation in the body weight was expected as *E. helvum* are usually bigger than *E. franqueti* (Nowak and Walker, 1994; Mickleburgh *et al.,* 2008).

5. CONCLUSION

In conclusion, this present study reveals that fruit bats found in this environment, especially *Eidolon helvum,* are infested with ectoparasites which are mostly bat flies (*Nycteribia alternata* and *Eucampsipoda africanum*). The predominant protozoans are *Babesia-like* organism and *Hemosporidial* organisms which still require further identification. Therefore, fruits bats investigated in this present study were infested with parasites and were able to adapt favourably as parasitism did not affect the blood values.

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An Adoption of Minutiae-Based Feature Extraction Technique for a Finger Vein Recognition System.

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ABSTRACT

Finger vein recognition system is a biometric recognition system that uses the features of the vein to identify or verify a user. The Vein is a subcutaneous element of the skin with its distinct feature reliable enough to identify a user. A standard finger vein reignition system requires a reliable device to take the image of the vein, pre-process the image for feature extraction with the capability to use the extracted feature for identification or verification. Apart from having a good quality of the vein, effective feature extraction is key to the efficiency of the finger vein recognition system.

Keywords: Finger vein recognition system. Vein feature extraction, False Rejection Rate, Security Image Enhancement.

Aims Research Journal Reference Format:
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1. INTRODUCTION

Finger vein recognition system (FRS) uses feature of the vein to identify or verify a user. The feature of the vein is unique to specific user, located beneath the skin surface. It is difficult to forge, not affected by race, age and dermal related issues [6]. The vein image is captured when a near infrared rays of between 700nm to 1000nm passes through the skin tissues. It can only be used on a life body [3]. The Deoxygenated blood in the vein absorbs the ray of light making the vein to appear darker than other parts of the skin. (FRS) has a false acceptance rate (FAR) of as low as 0.0001 % and false reject rate (FRR) of 0.1% [9]. Generally, finger vein recognition system comprises of 3 stages: Vein image capturing. Pre-processing of the vein image, feature extraction and matching for decision making. However, improvement in combination use of various image processing algorithms could alter the sequence of the stages [3][4]. For example, Xie et al. was able to extract the vein pattern directly from the vein image for recognition without going through the segmentation stage [6]. Segmentation and enhancement are principal functions in pre-processing stage [3].

Also, 2D Gabor filter was also used directly on vein image to extract directional texture and phase feature use in recognition from finger vein image. [5] Feature extraction is a very important stage whose outcome largely defines the effectiveness and efficiency of an FRS [3]. There are various ways vain feature can be extracted for individual identification [3], these various methods can be grouped into 4 different techniques [3]:

i. Vein-based: Vein-based feature extraction techniques basically, look out for the specific vein pattern for extraction. The vein vessel has an oriented pattern [3], local orientation and frequency of the vein are some of the distinguished features of the vein [7].
ii. Local Binary-based Method. It is implemented by comparing the grey value of a central pixel with its neighbouring pixels to produce ordered set of binary values which can be represented in decimal form [3].
iii. Dimensionality Reduction-Based Method: It is a machine learning based approach, vein image. In dimensionality reduction-based method, finger vein image is changed to low dimensional space through dimension reduction transformed into a low dimensional space by dimension reduction, in which the required information is kept and spurious data are discarded. [8]
iv. Minutiae Point-Based Method. Minutiae points refer to points where the vein pattern ends and bifurcates. Mantrao et al. [9] and Prabhakar et al. [10] based their vein feature extractions on where blood vessel ends and bifurcate, improved FRS performance and precision were recorded.

The following section describes the design algorithm. Section 2 describes pre-processing stages, Section 3 gives details on feature extraction based on minutiae feature of the vein image while the section gives the conclusive view of the work.

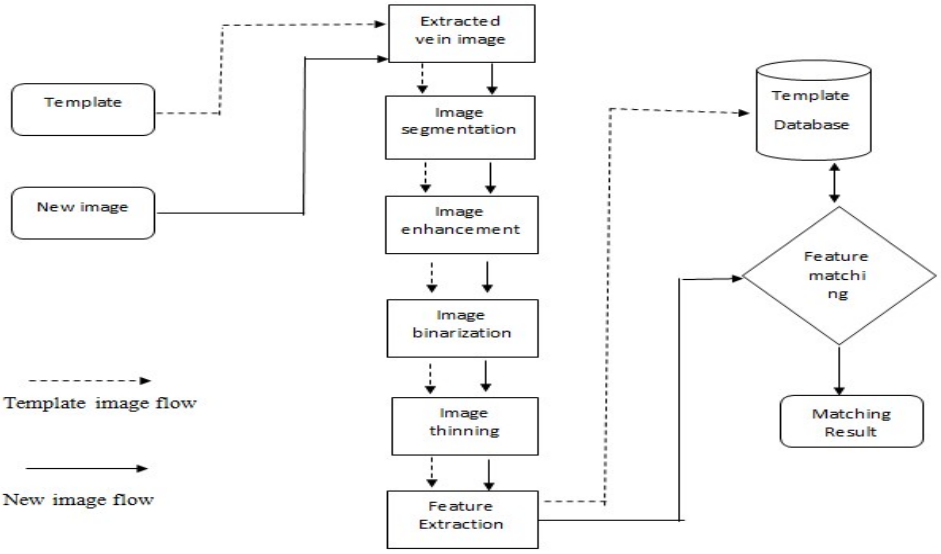

Figure 1: Design algorithm flow

1.1 Image Acquisition

The acquisition of the finger vein image is a critical step in biometric identification system because the system's quality, depend largely on the quality of the image to be processed. The finger vein image is acquired through a method that uses near infrared light to reflect the image of the vein beneath the epidermis [3]. The Deoxygenated blood in the vein absorbs the ray of light making the vein to appear darker than other parts of the skin [12]. There are three methods of image acquisition used in FRS: The light transmission, light reflection and two-way radiating methods. Among the three, the light transmission produced the high contrast image and most widely implemented [11]. A good image-acquiring device is very important; the product of the image acquisition process has direct impact on the quality of the features to be extracted during image processing [2]. An Image of Finger Vein Scanner is shown below.

Figure 2: Image of finger vein scanner

2. IMAGE PRE-PROCESSING

Basically, this stage comprises of 2 processes: Segmentation and enhancement. there are 2 types of image processing: Image filtering and image warping [13]. Filtering requires that the values of pixels are change while their positions remain unchanged, whereas, warping an image changes the position of the image while the colour of the pixel remain unchanged. (image). The primary goals of filters are to modify or enhance properties of an image and to extract needed information from the image such as edges blobs and corners [13]. Moving average filters and image segmentation filters are commonly used. Basically, the moving average filter works by replacing each pixel with the average pixel value of it and a neighbourhood window of adjacent pixels. Often use in smoothing image. Image segmentation filters on the other hand are used to divide image into regions based on the attributes of the pixel, making the image simpler in identifying objects and boundaries. One of the popular methods of implementing segmentation is thresholding. There are global and local thresholding. Global threshold uses single threshold across the image, while local threshold uses different threshold in different areas of the image having different illumination. Image segmentation is essentially used to extract region of interest (ROI) in finger vein image processing [3]. It is a common

2.1. Finger Vein Image segmentation

The next stage after the finger vein image has been acquired and fit is to extract region of interest (ROI) from the image in order to focus on only important part of the image. The work uses adaptive thresholding for segmenting the vein region from the background noise. Generally, adaptive or dynamic thresholding takes a grayscale (or colour) as input and converts it to a binary image which represents the segmented image [14]. Unlike global thresholding, for each pixel in the image, a threshold has to be calculated thereby making it suitable for image with uneven illumination across the image area. If the pixel value is below the threshold it is set to the background value, else it is set to foreground value [15].

$$T(x,y) = \frac{\sum_{i=0}^{N-1}\sum_{j=0}^{N-1} g(x+i, y+j)}{N^2}$$

T(x, y) is the threshold value of the threshold image in the position (x, y) related to the original image f(x, y), N is the window size, g is the gray value of the original image, using a 15 X 15 window size. Each pixel f(x,y) of the image is compared with the calculated threshold value T(x,y) where if , f(x,y) less than or equal to T(x,y) (set as background pixel) ,then f(x,y) = 0, else, f(x,y) = 255 (set as foreground pixel). 0 is black while 255 is white. Hence, the background and the foreground image is separated [1] .

2.2. Finger Vein image enhancement

The primary purposes of image enhancement are to provide clarity for structure of the finger vein image for better human understanding of the required data and to provide a quality image for the binarization stage [3]. The segmented image is not very clear or sufficient data for feature matching. At this stage there are lots of noises across the image. Median filtering is efficient in denoising and smoothing of edges and Connected Component Labelling (CCL) giving the image clarity along vein's original local connection of the vein structure. This will aid to provide clearer understanding of the vein's image for extraction as spurious vein image outside the connection path are removed [1,3]. Median filter works by considering each pixel in the image in turn and looks at its nearby neighbours to determine whether or not it is representative of its surroundings if not, it replaces the non-representative pixel value with the *median* of the neighbourhood values. For example:

Table of 3X3 neighbourhood

114	117	156	123	142
118	123	112	121	127
134	130	267	152	132
122	136	131	144	155
114	126	114	101	128

Neighbourhood values: 112, 121, 123, 130, 131, 136, 144, 152, 267
Median Value: 131.

After de-noising with median filtering, the next is to ensure that the remnant artefacts along the vein pattern are removed after the median filtering. CCL will be applied on the enhanced image. CCL works by scanning all pixels one after the other (top to bottom and left to right) identifying each pixel based on intensity of adjacent pixels. Basically, it scans image by grouping its pixels into component based on pixel connectivity. CCL can work on Binary image or grey-level image with different numbers of connectivity possible. In this case, regions of adjacent pixels which share the same set of intensity values *V*. (For a binary image *V={1}*; however, in a grey-level image *V* will take a range of values, say: *V={51, 52, 53, …, 77, 78, 79, 80}*.)

The connected components labelling operator scans the image by moving along a row until it comes to a point *p* (where *p* denotes the pixel to be labelled at any point in the scanning process) for which *V={1}*. When this is true, it inspects the four neighbours of *p* which have already been scanned (*i.e.* the neighbours (i) to the left of *p*, (ii) above it, and (iii and iv) the two upper diagonal terms).

Based on this information, the labelling of *p* goes as follows:

i. If all four neighbours are 0, assign a new label to *p*, else
ii. if only one neighbour has *V={1}*, assign its label to *p*, else
iii. if more than one of the neighbours have *V={1}*, assign one of the labels to *p* and make a note of the equivalences.

When scan is completed, the equivalent label pairs are arranged into equivalence classes and a unique label is assigned to every class. Finally, a second scan is made through the image, during which each label is substituted by the label assigned to its equivalence classes.

2.3. Finger Vein image Binarization

Basically, the binarization converts the grey scale image to 0 or 1, black and white. The simple reason for this conversion is because, a simple black and white image is clearer and contains less noise compared to grey level image [16]. Otsu is better for grey scale image binarization than other algorithms for binarization [16]. The steps for Otsu binarization are as follow:

1. Separate the pixels into two clusters according to the threshold.

$$q1(t) = \sum_{i=1}^{t} p(i) \quad and \quad q2(t) = \sum_{i=t+1}^{I} p(i)$$

2. Find the mean of each cluster

$$1(t) = \sum_{j=1}^{t} \frac{ip(i)}{q1(t)} \; and$$

$$2(t) = \sum_{j=t+1}^{I} \frac{ip(i)}{q2(t)}$$

.

3. Calculate the individual class variance.

$$\sigma_1^2(t) = \sum_{i=1}^{t}[i - \ 1(t)]^2 \ \frac{p(i)}{q1(t)}$$

and

$$\sigma_2^2(t) = \sum_{i=t+1}^{I}[i - \ 2(t)]^2 \ \frac{p(i)}{q2(t)}$$

4. Square the difference between the means.

$$\sigma_b^2(t) = \sigma^2 - \sigma_w^2(t)$$

$$= \ q1(t)[1 - q1(t)] \ [\ 1(t) - \ 2(t)]^2$$

5. Finally, this expression can safely be maximized, and the solution is **t** that is Maximizing.

$\sigma_b^2(t)$ [16]

2.4. Finger vein image thinning (Skeletonization)

The next stage is to turn the image to 1 pixel-width based image. This is a process where the vein pattern is 1-pixel width size. Thinning is normally only applied to binary images and produces another binary image as output [17]. Like any other morphological operators, the behaviour of the thinning operation is determined by a structuring element. The thinning of an image *I* by a structuring element *J* is:

$$\text{thin}(I, J) = I - \text{hit-and-miss}(I, J)$$

where the subtraction is a *logical subtraction* defined by:

$$X - Y = X \cap \text{NOT}\, Y \text{ . [17]}$$

The thinning operation is calculated by converting the origin of the structuring element to each possible position of the pixel in the image, and at each such position, comparing it with the pixels of the image underlying it. If the foreground and background pixels in the structuring element *exactly match* background and foreground pixels in the image, then the image pixel under the origin of the constructing element is set to background 0. Else it is left untouched. And the element must have a blank or 1 at the origin Note that the constructing element must always have a 1 or a blank at its origin for it to have any effect. [17]

3. FINGER VEIN FEATURE EXTRACTION

Thinning the binarized image would produce a simpler binary output image that can easily be processed to extract feature. The pixel-wise image can easily be scanned to determine vein ending and bifurcation points, pixel wise. Once pixels that fall on ending and branching points are identified, their x and y coordinates, orientation value and vein property (ending or bifurcation) are identified [18]. Once all the pixels of interest have been identified along with the associated parameters (distance and direction) then a crossing number approach would be used to extract the feature as explained below: 3*3 window to scan the local neighbourhoods of each ridge pixel '*p*' in the image. The crossing number of '*p*' is defined as half the sum of the differences between pairs of adjacent pixels defining the 8-neighborhood of '*p*'.[18] Mathematically:

$$CN = 0.5 \sum_{i=1}^{8} |P_i - P_{i+1}|,$$

where Pi is the pixel value (zero or one) in a 3 x 3 neighbourhood of P

3*3 Mask

N	Characteristcs
0	Isolated Point
1	End Point
2	Continuing Point
3	Branch Point
4	Crossing Point

Characteristics of crossing number

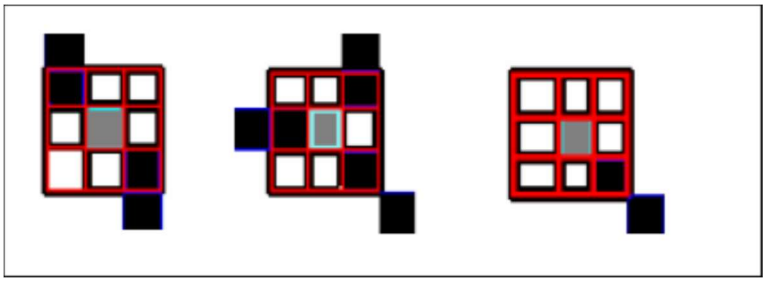

Figure 3 [Source: 18]

cn (p)=2,cn (p)=3 and cn (p)=1 representing a non-minutiae region, a bifurcation and a vein ending.

4 FINGER VEIN IMAGE MATCHING AND DECISION MAKING

The extracted and stored feature is matched with a stored template for identification.Minutiae based matching will be used. Minutiae based matching consists of finding the similarity between the stored template and the new input minutiae group that results in the maximum number of minutiae pairing. [19]

The algorithm compares two minutiae sets: template T = {m1, m2.....mj} from reference fingerprint and input I={m1, m2.....mi} from the query and returns similarity score S (T, I). The minutiae pair mi and mj are said to be matched only if difference in their position and directions are below tolerance distances:

$$sd(m_i, m_j) = 1 \Leftrightarrow \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2} \leq r_0$$
$$dd(m_i, m_j) = 1 \Leftrightarrow \min(|\theta_i - \theta_j|, 360 - |\theta_i - \theta_j|) < \theta_0$$

[19]

5 PERFORMANCE METRICS

Metrics for computing accuracy (acc) is giving below:

$$\mathbf{Acc} = \left(100 - \frac{(FAR(\%) + FRR(\%))}{2}\right)$$

Where $FAR = \frac{\sum_{i=1} W_{ai}}{\mathbf{t}} X100\%$

$$FRR = \frac{\sum_{i=1} W_{ri}}{\mathbf{t}} X100\%$$

W_a is the wrongly accepted individual

W_r is the wrongly rejected individual

t is total no. of users experimented with

[20]

6 RESULT

Finger vein templates of 40 volunteered members of staff of Evans therapeutics Ltd. With age range of 21 - 62 years having 10 females and 30 males. The vein image taken has an image size of 256 X 360 pixels. The finger vein image templates of the 20 users were stored in a database. New finger vein image of all the 20 users were taken to be matched against the templates for verification purpose. The remaining 20 users had no template stored in the database but were equally subjected to verification as given below:

User	Template	False rejection (FR)	False Acceptance (FA)	Accuracy
User1	1	-		
User2	1	-		
User3	1	-		
User4	1	-		
User5	1	-		
User6	1	-		
User7	1	-		
User8	1	-		
User9	1	-		
User10	1	-		
User11	1	-		
User12	1	1		
User13	1	-		
User14	1	-		
User15	1	-1		
User16	1	-		
User17	1	-		
User18	1	-		
User19	1	-		
User20	1	-		
User21	0		-	
User22	0		-	
User24	0		-	
User25	0		-	
User26	0		-	
User27	0		-	
User28	0		-	
User29	0		-	
User30	0		-	
User31	0		-	
User32	0		-	
User33	0		-	
User34	0		-	
User35	0		-	
User36	0		-	
User37	0		-	
User38	0		-	
User39	0		-	
User40	0		-	
		FRR = 2	FAR=0	99.75

7. EXPLANATION OF RESULT

User 1 to 20 had their templates stored in the database base for matching; user 21 to 40 had no templates in the database. Users 1 to 20 were subjected to verification by taking new finger vein image of the same finger taken during template registration. 2 out of the users were falsely rejected at single attempt. User 21 to 40 that had no previous template in the database was subjected to verification to test false acceptance capability of the device. None of the 20 users whose template was not in the database was successfully verified, hence false acceptance rate is nil. The system has an accuracy of 99.75 %. However, a large database may increase the likelihood of having false acceptance and a higher false rejection which may change the value of performance accuracy

8. CONCLUSION

The process to produce a high-performance finger vein recognition system starts from vein image acquisition stage. The pre-processing stage is equally important to any of the four techniques of feature extraction mentioned in this paper. However, image enhancement is sacrosanct to minutiae-based feature extraction before binarization and thinning of the image are done, this is because, image enhancement actually makes the image interpretable and gives decisive details about the vein properties such as ending and bifurcation points among others (a helpful function in dealing with oriented image pattern) as regard to vein properties, unlike in Vein-based feature extraction method where a high-quality image that gives enough pattern of the vein may only be required for feature matching, despite not going through the image segmentation.

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Antimicrobial Activities of Extracellularly Synthesized Silver Nanoparticles from *Aspergillus Flavus* and *Alternaria Alternata*

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ABSTRACT

This study was carried out to evaluate the extracellular biosynthesis of Silver Nanoparticles using *Aspergillus flavus* and *Alternaria alternata* isolated from fruit waste (Orange) samples using the vegetative and cell-free filtrate method. The antimicrobial activity was performed against *Escherichia coli* and *Streptocous fecalis*. Characterization of the silver nanoparticles was achieved using Color change, UV-Visible Spectrophotometry and Fourier Transform Infrared Spectroscopy (FTIR). The Nanoparticles showed UV-Visible absorbance peaks that correspond to the Plasmon resonance of silver nanoparticles. The FTIR spectra showed the presence of aromatic and aliphatic amines, confirming the presence of proteins as the stabilizing agent surrounding the silver nanoparticles. The silver nanoparticles showed higher antimicrobial activity against *Escherichia coli.* Silver nanoparticles (1mM) from *Aspergillus flavus* were not significantly different ($p<0.05$) from Nitrofurantoin. The use of these fungi for silver nanoparticles synthesis offers the benefits of eco-friendliness and amenability for large-scale production and shows that biosynthesized silver nanoparticles can be effective as an alternative therapy in solving antimicrobial resistance problems.

Keywords: *Aspergillus flavus; Alternaria alternata;* Silver nanoparticles; Antimicrobial Resistance; Green Synthesis.

Aims Research Journal Reference Format:
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1. INTRODUCTION

There is an urgent need to develop new bactericides because of the emergence and increase of microbial organisms which are resistant to multiple antibiotics and have become an increasing public health problem [1].

Silver has been used for years in the medical field for antimicrobial applications, however, Nanosilver, being less reactive than silver ions, is expected to be more suitable for medical applications [2]. Humans have learned to harness fungi for the protection of human health in antibiotics, anti-cholesterol statins, and immunosuppressive agents [3], while industry has utilized fungi for large scale production of enzymes, acids, and bio surfactants [4]. With the arrival of contemporary applied science, fungi have remained important by providing a greener alternative to chemically synthesized nanoparticle [5]. Fungi have a number of advantages for nanoparticles synthesis in comparison with other organisms, as they are relatively easy to isolate and culture and they secrete large amounts of enzymes, particularly extracellular ones[4]. Nanoparticles biosynthesis occurs once the microorganisms grab target ions from their environment and switch the metal ions into the component metal through enzymes generated by the cell activities [6].

Antibacterial assays of photosynthesized Silver Nanoparticles have been assessed against human pathogenic Gram-positive and Gram-negative bacteria including *Staphylococcus epidermidis* and *Salmonella typhimurium*[7]. The antibacterial activity has also been evaluated using *Sphaerulina albispiculata* in synthesis of Silver nanoparticles [8]. Nanoparticles biosynthesis have been reported and established using the vegetative and/or the cell-free filtrate methods [2]. However, whether using myco-synthesized nanoparticles and their antibacterial activities both as an option to confront the transmission of and infection by human pathogenic bacteria and most importantly as a means of biological waste management remain to be established [5].

Thus this work is aimed at exploring the potentials of the metabolites of two fungal organisms (*Aspergillus flavus* and *Alternaria alternata*) isolated form fruit wastes from South-West Nigeria in the green synthesis of Silver Nanoparticles and evaluating the antimicrobial susceptibility of two major bacteria of clinical importance (*Escherichia coli* and *Streptococcus fecalis*) to the synthesized particles. To explore the synthesizing activities and eco-usefulness of a microorganism gotten from a fruit waste, two major fungal species were isolated and identified from Orange fruit waste gotten from Ede, Osun State and products of their metabolites were challenged with different concentration of silver nitrate for the reduction to silver nanoparticles, which were then further assayed for antibacterial activities against clinical pathogens of *Escherichia coli* and *Streptococcus fecalis*. This was done after characterization of established silver nanoparticles.

2. MATERIALS AND METHODS

2.1 Isolation of Fungal Cultures

Silver nitrate was obtained from Sigma Aldrich and used without further purification. All other reagents were of analytical grade with maximum purity and were all properly washed with distilled water and oven dried before use. Potato Dextrose agar was purchased from Oxoid and prepared according to manufacturer's instructions. Spoilt Orange samples were gotten aseptically from Ede, Osun state market; serial dilution and pour plate methods were carried out in the Microbiology Laboratory according to the method described by [5]. A volume of 1ml each of the dilution were transferred to Potato Dextrose Agar, incubated for five (5) days, a pure culture gotten after sub-culture. Macroscopic identification was done based on colonial morphology, color, texture and shape, while microscopic identification was done using Lactophenol blue as a staining agent according to the method described by [6]

2.2 Silver Nanoparticle Biosynthesis

2.2.1 Vegetative Method

According to the method described by [6] each fungal sample was grown in 200ml bottles each containing 100ml of potato dextrose broth and at 25-28^{o}C under continuous mixing condition by a magnetic stirrer(rotary shaker) at 120rpm for 72 hours.

The mycelial (vegetative part of the fungus) mass was then separated from the culture broth by sterile filter paper, and the settled mycelia were washed thrice with sterile distilled water. 10g of the harvested mycelial mass was mixed with a 100ml aqueous solution of 1mM silver nitrate solution ($AgNO_3$). Then the mixture was placed in a 100rpm rotating shaker at 28^{o}C for 72hours duration. In this process, silver nanoparticles were produced through reduction of the silver ions to metallic silver (Ag^{+} to Ag^{0}). Change in color of the fungal biomass incubated with silver nitrate solution was visually observed over a period of time.

2.2.2 Cell-free Filtrate Method

Fungal isolates were grown in Potato Dextrose Broth liquid medium. The flasks were inoculated with spores and incubated at 28^{o}C in static conditions for 72 hours. The biomass was harvested by filtration using Whatman filter paper No. 1 and washed with distilled water to remove any components of the medium. Biomass of 25g was placed in individual flasks containing 100ml Milli-Q water then the flasks were incubated under the conditions described above for 24 hours. The biomass was filtered, and the crude cell filtrate was collected and treated with 1mM silver nitrate solution at room temperature in the dark. Control containing cell-free filtrate without silver nitrate solution. Change in color was observed over a period of time.

2.3 Characterization of the Biosynthesized Silver Nanoparticle

Color Change

The color change in the reaction mixture was recorded through visual observation. The color change from yellow to dark brown indicated that the silver nanoparticles were synthesized.

UV-Visible Spectrophotometry

UV-Visible measurements Spectral analysis for the development of nanoparticles were observed using UV-Visible Spectrophotometer from (200-800nm) in 2ml quartz cuvette with 1cm path length at a resolution of 1nm at room temperature. Silver nanoparticles formed gave a sharp Plasmon band in the range of visible region of the electromagnetic spectrum.

Fourier Transform Infrared Spectroscopy

Fourier Transform Infrared Spectroscopy (FTIR) was carried out to identify the possible interactions between silver and bioactive molecules. A known weight of sample (1mg) was ground with 2.5g of dry potassium bromide and filled in a 2mm internal diameter micro-cup and loaded unto FTIR set at 26^{o}C. The samples were scanned using infrared in the range of 4000-500 cm-1 using Fourier Transform Infrared Spectrometer (SCHIMADZU) Model-6700). The spectral data were compared with the reference chart to identify the functional groups present in the sample.

2.4 Antibiotic Susceptibility Testing

The bacteria *Escherichia coli* and *Streptococus fecalis* were obtained from Adeleke University Medical Microbiology and Bacteriology Laboratory and inoculated into nutrient broth. Mueller Hinton Agar (MHA) was poured into sterile petri plates which werse left overnight at 37^{o}C and subsequently bacterial lawns were prepared using each bacterial strain. Agar wells were made on MHA plates using 6mm Cork borer, the plates were then loaded with synthesized silver nanoparticles and incubated at 37^{o}C. Commercial antibiotic discs were used as control. After incubation the plates were examined for zone of inhibition, and these methods were carried out according to the method standardized by the Clinical and Laboratory Standards Institute [9]. The sensitivity of the isolates to Silver Nanoparticles 1mM and 5mM were classified as 'resistant' and 'susceptible' according to their zones of inhibition.

Statistical Analysis

The antibacterial activities of silver nanoparticles (1mM and 5mM) against commercial antibiotics [Ciprofloxacin (5µg), Gentamycin (10 µg), Nitrofurantoin (300 µg)] were compared statistically with Statistical Analysis Software 92.2 (SAS) using Analysis of Variance (ANOVA). Statistical significance was defined by a *p* value less than 0.05.

3. RESULTS AND DISCUSSION

Biosynthesis of Silver Nanoparticles

A total of sixteen fungal isolates were detected on Potato Dextrose Agar (PDA). The purified fungal isolates were then grouped into four major genera, as shown in Table 1.0. Cell-free filtrate and silver nitrate solution mixture changed from almost colorless to light yellow after 24 hours and later to dark brown after 72 hours. The control sample, however, remained colorless. This is shown in Plate 1.0. This difference in the color intensity in the vegetative-agitated fungal biomass as compared to the cell-fee filtrate biomass could be due to the production of more metabolites by fungi through agitation [10], thus implying that agitation could be better than static conditions and vegetative rather than cell-free filtrate method.

UV-Vis spectra for cell-free filtrates of *Aspergillus flavus* silver nitrate reaction mixtures (1mM,2mM, 3mM,5mM) alongside reaction mixtures containing Vegetative, agitated *Alternaria alternata* and *A. flavus*+ 1mM silver nitrate solution mixture after two weeks were recorded at 400-450nm after 72 hours as shown in Figure 1.0. The UV-Vis spectra for *A.flavus* (1mM and 2mM) showed absorbance peaks at 425nm, and 3mM at 429 nm, this is indicative of the wavelength at which Plasmon Resonance (excitation of conduction electrons) occurs in the silver nanoparticles[11]. UV-Vis spectra for 5mM however did not reveal a significant absorbance peak. UV-Vis spectra for *A.flavus* (1mM) after two weeks remained at 425nm indicating stabilization of the biosynthesized silver nanoparticles[11].

The UV-Vis spectra for the vegetatively synthesized silver nanoparticles from *A. alternata* also showed an absorbance peak at 440nm. The UV-Visible spectroscopy results suggest that the absorption band at a 420-440nm range is indicative of plasmon interactions under certain conditions, e.g light or dark. This is referred to as Surface Plasmon Resonance [2].

In addition, 5mM reaction mixture had lower absorption peak than the rest concentrations, implying that higher concentrations of silver ions in interaction with fungal cells could lead to aggregation or agglomeration of the reaction solution and thus, instability of the silver nanoparticles formed. This correlates with the results reported by [12].

Table 1.0: Morphological characteristics of fungal species isolated form spoilt Oranges.

Name	Colony/Color on PDA	Reverse	Conidia Head	Conidia Shape	Seriation
Aspergillus flavus	Yellowish green, flat and granular	Yellow	Radial	Globulose	Biseriate
Alternaria alternata	Grayish black, floccus	Brown	Branched, acropetal, elongated	Short, ovoid	Multi-celled
Penicillum notatum	Dense green,fluffy	Dark brown	Single cell	Flask-shaped	Chin philiades
Fusarium oxysporum	Creamy chalky	White	Fusiform, slightly curved with pointed tip	Short, single-celled	Non-septate, not in chain

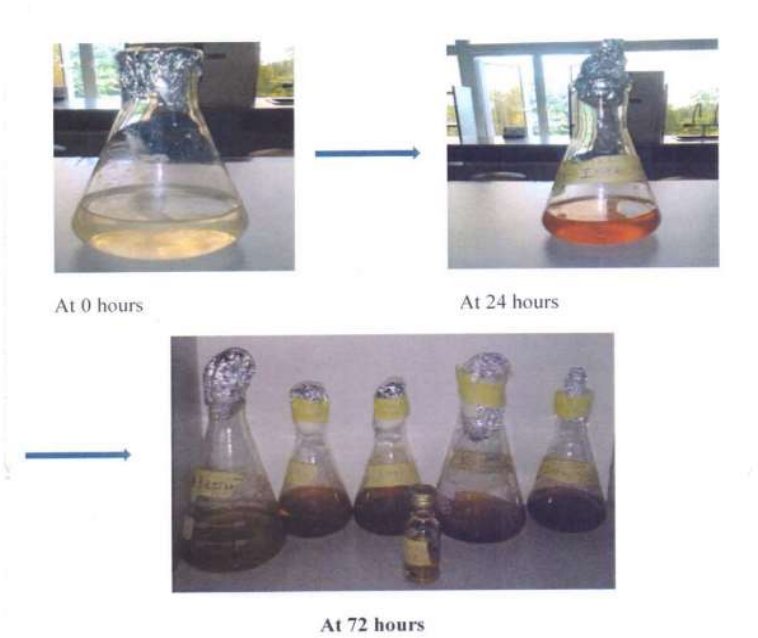
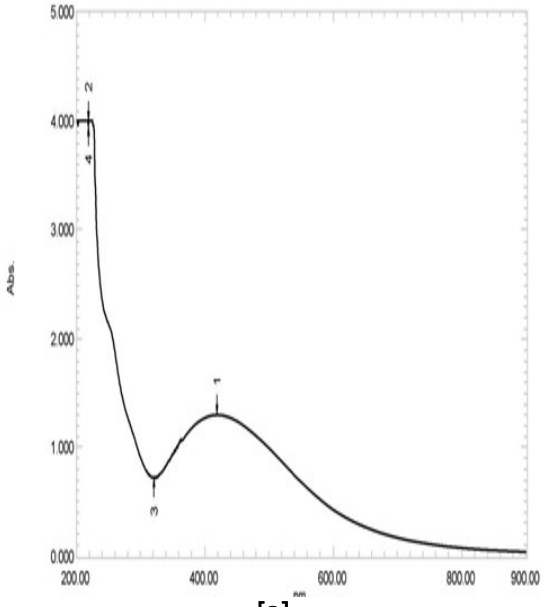


Plate 1.0: Reaction Mixture of *Aspergillus flavus* and *Alternaria alternata* biomass and Slver Nitrate Solution at Different Time Intervals


5.000
4.000
3.000
2.000
1.000
0.000
Abs.
200.00
400.00
600.00
800.00
900.00
nm.

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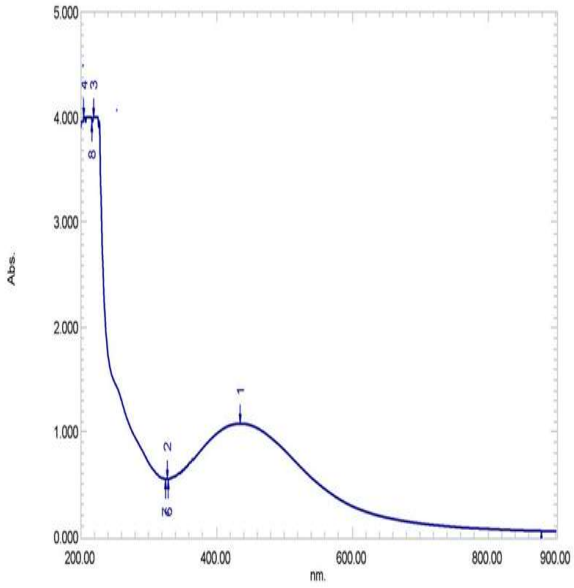
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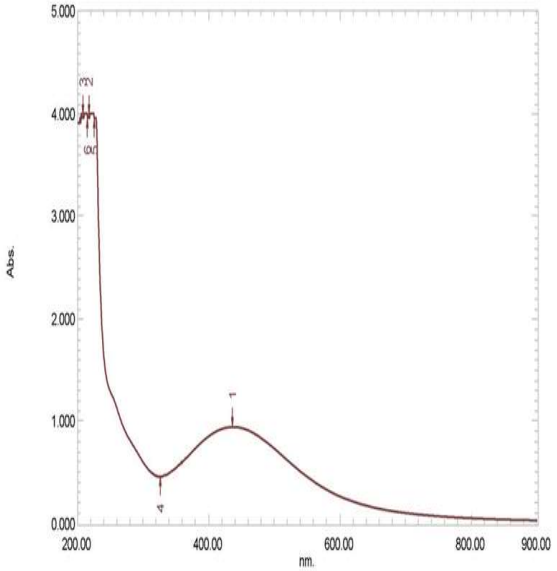
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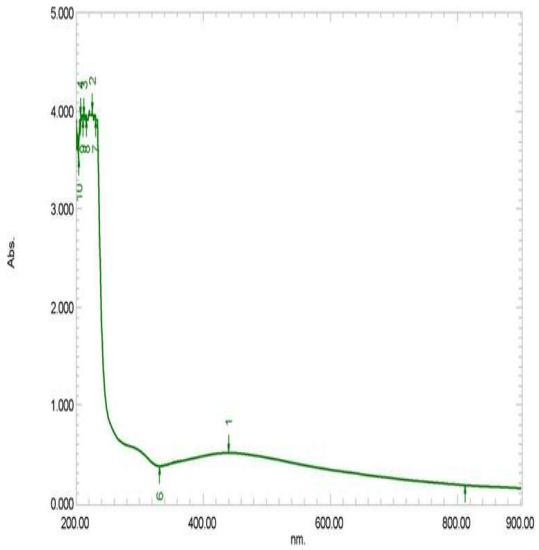
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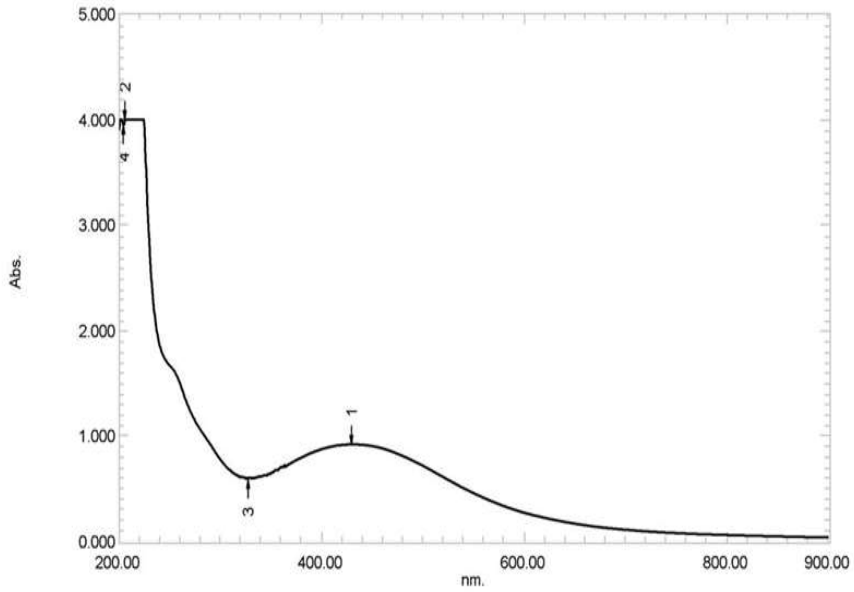
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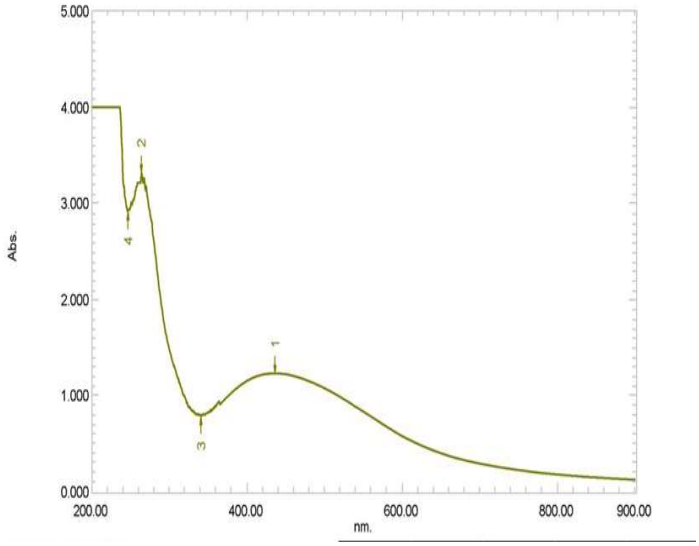

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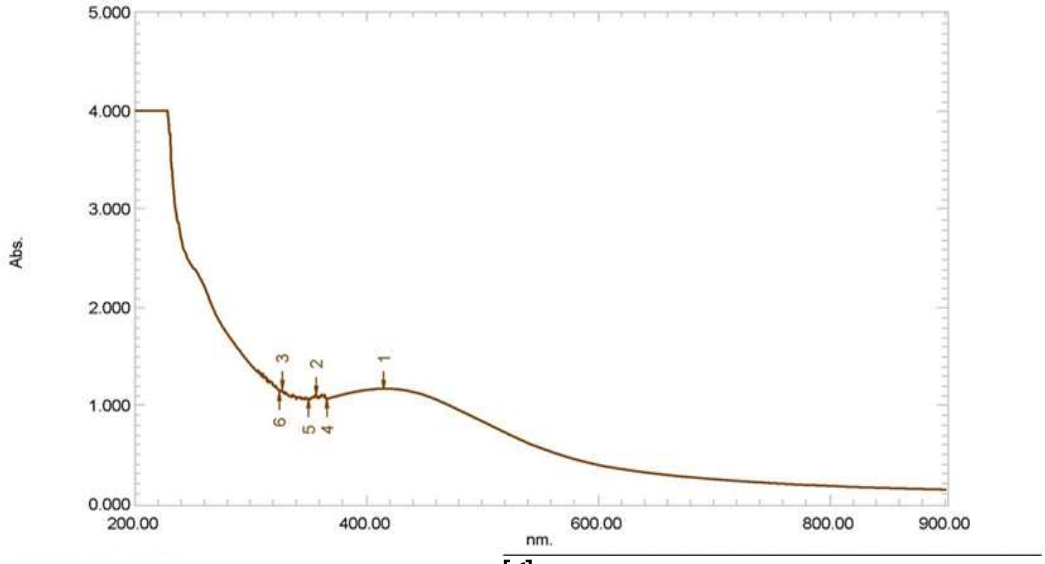

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Fig.1; UV-VIS Spectra for AgNPs (a-e) 1,2,3 and 5mM Silver Nitrate+*Aspergillus flavus* reaction mixture (f) 1mM Silver Nitrate+*Alternaria alternata* cell-free filtrate reaction mixture (g) Reaction mixture after 2 weeks

For vegetative, agitated *Alternaria alternata*, FTIR spectra revealed the presence of 8 bands at 3343.05, 2945.4, 2426.53, 2096.62, 1635.69, 1384.94, 1080.17, 1039.87 cm^{-1} as shown in figure 8.0. The bands at 163.69 and 3343.05 correspond to the binding vibrations of Amide 1 band of protein with N-H stretching. The bands observed at 1384.94 and 1080.17 can be assigned to C-N stretching vibrations of aromatic and aliphatic amines respectively. The other bands however, are fingerprint regions.

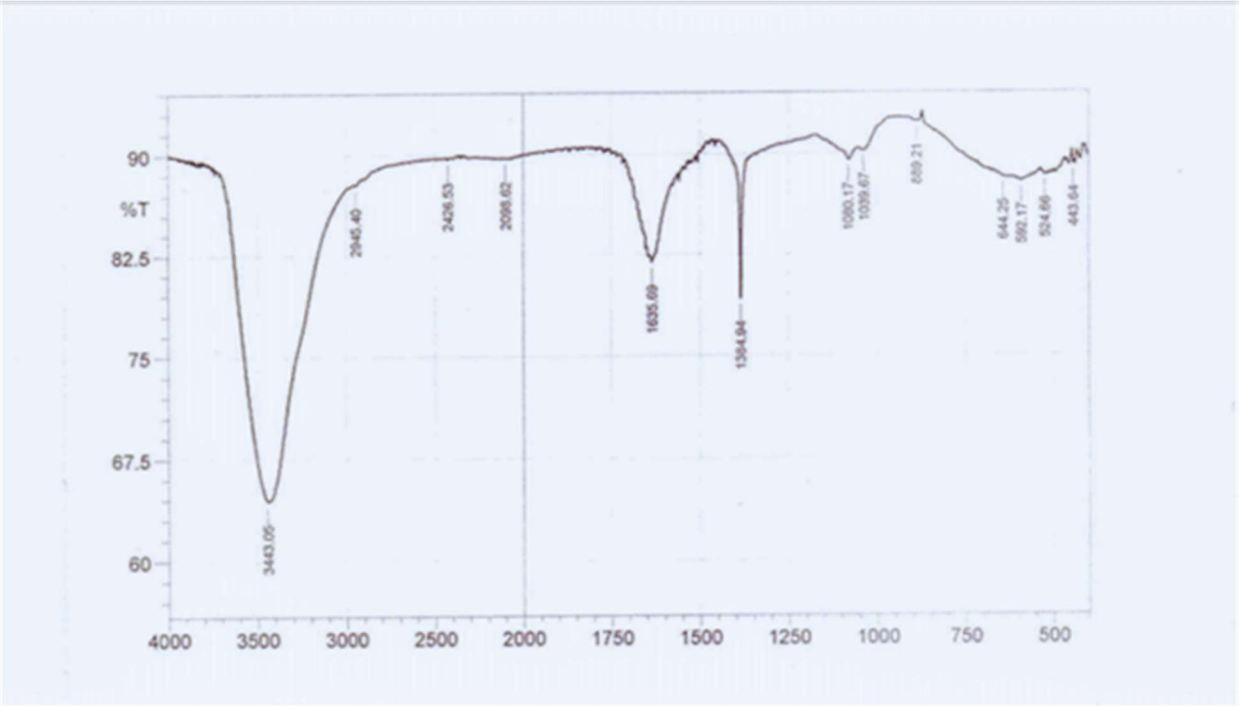

Fig. 8.0: FTIR Analysis of *Alternaria alternata* silver nanoparticles

For *Aspergillus flavus*, the FTIR revealed the presence of 6 bands at 3343.05, 2360.95, 1635.69, 1384.94,1114.89 and 1085.96 as shown in Figure 9.0. The other bands are fingerprint regions. The interpretations are similar to that of *A. alternata*.

The FTIR results were suggestive of the fact that the surrounding biological molecules (proteins and other metabolites) could possibly perform the dual functions of forming and stabilizing the nanoparticles in aqueous medium [13].

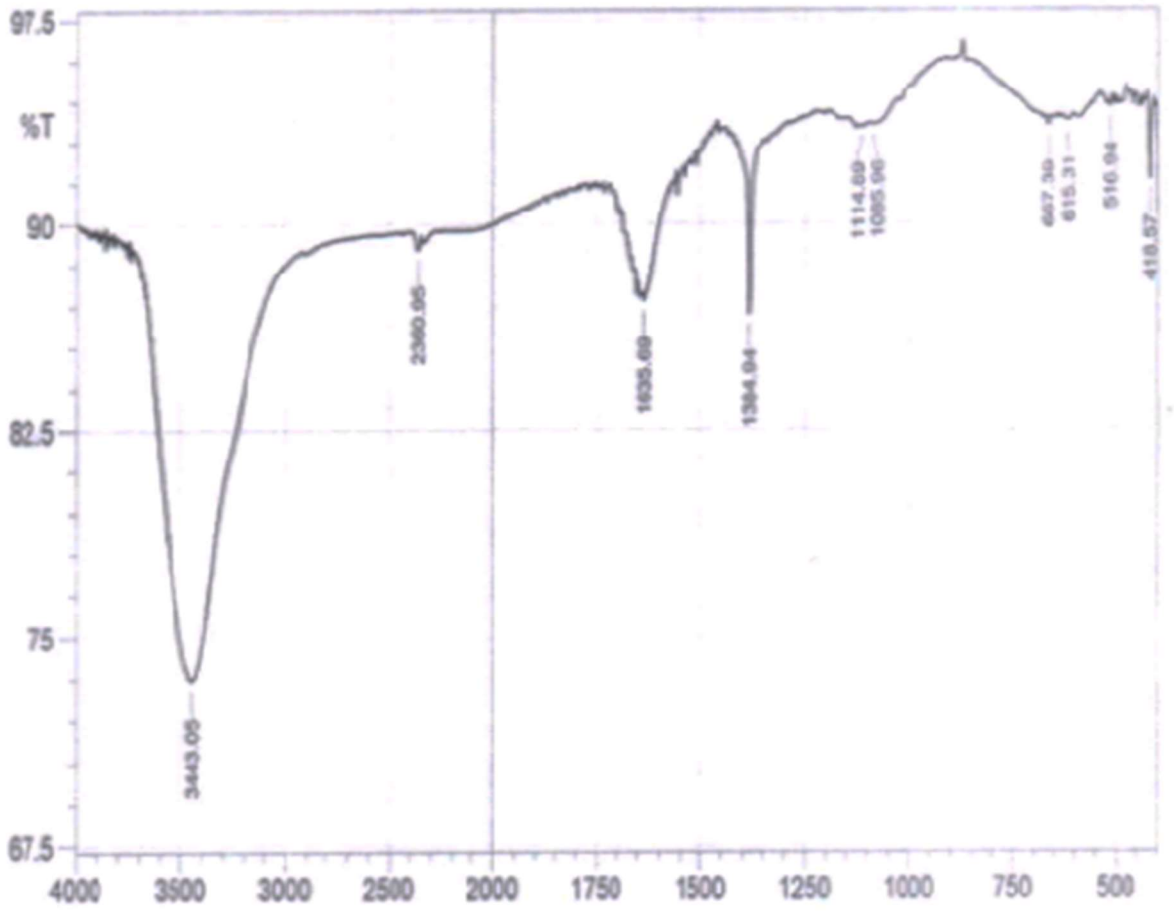

Fig. 9.0: FTIR Analysis of *Aspergillus flavus* silver nanoparticles

3.1 Antibacterial Activities of Biosynthesized Silver Nanoparticles

The antibacterial activities of 1mM and 5mM silver nanoparticles on Escherichia coli and *Streptococcus fecalis* in comparison with commercial antibiotics are as shown in Figure 8.0. The zones of inhibition of the silver nanoparticles vary with each concentration of silver nitrate and commercial antibiotics used.

Fig. 10.0 shows the graphical representation of the antibacterial activity of both concentrations of silver nanoparticles against the bacterial isolates in comparison with the commercial antibiotics used. It shows similar activity between Silver nanoparticles (1mM) and Ciprofloxacin. The organisms were also susceptible to Gentamycin, Nitrofurantoin and Ciprofloxacin.

It is indicated that Silver nanoparticle (1mM) has the same activity as Nitrofurantoin and *Escherichia coli*, there was similar activity between Silver nanoparticles (1mM and 5mM), Gentamycin and Nitrofurantoin against *Streptococcus fecalis.* According to [11], antibacterial activities shown by the nanoparticles might be by oxidative stress generated by reactive oxygen species, and that it is possible that the nanoparticles, other than interact with the surface of the membrane, also penetrate the insides of the bacteria.

The result showed that the inhibition zone diameters of *Escherichia coli* were wider than those of *Streptococcus fecalis*, implying that the nanoparticles of 1mM rather than 5mM had higher antibacterial activity against human pathogenic Gram-negative rods. [14] however reported higher inhibition zones in a Gram-positive organism, *Staphylococus aureus*.

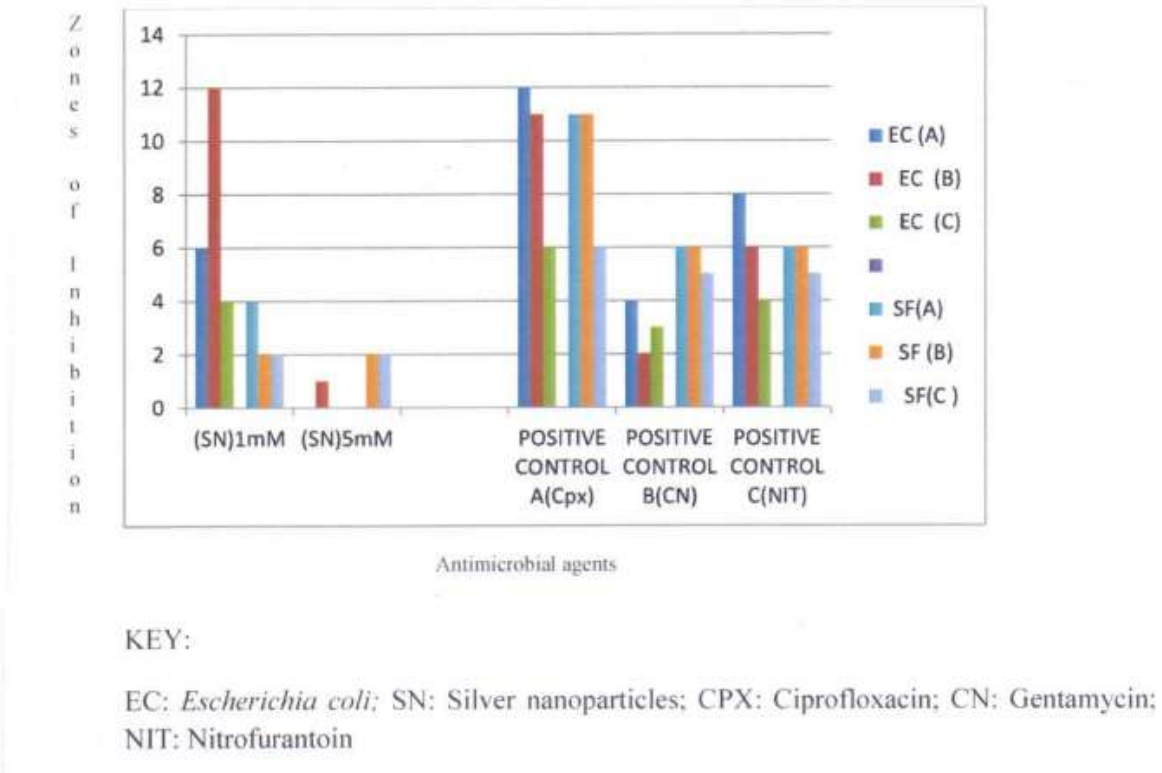

Fig 10.0; Zones of inhibition (mm) of Silver Nanoparticles (1mm and 5mm) and Control Antibiotics against Escherichia coli and *Streptococcus fecalis*.

4. CONCLUSION

This research work was aimed to throw more light on the importance of microorganisms not only for nanoparticles production but also indicates the use of nanoparticles as antibacterial agents. The suggested mechanism for the extracellular biosynthesis of silver nanoparticles by fungi is thought to occur with the involvement of carboxylic group or through nitrate-dependent reductase [12]. The fungus mycelium, upon exposure to the metal salt solution, produces metabolites for its own survival, leading to the reduction of the toxic metal ions to a non-toxic nanoparticle through the catalytic effects of the extracellular enzymes and metabolites of the fungus [15].

The findings of this study thereforedemonstrate the simple, safe, cost-effective and eco-friendly preparation of silver-nanoparticles using the fungi *Aspergillus flavus* and *Alternaria alternata*. The antibacterial activity of the synthesized nanoparticles was exhibited more at lowest concentrations against Gram-negative bacteria. Thus, application of biosynthesized silver nanoparticles may lead to the development of suitable pharmaceutical and other industrial products.

4.1 Recommendation

It is recommended that further studies be done on the synergistic application of nanotechnology and bioinformatics tools in vaccine prediction for tackling antimicrobial resistance.

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Towards a Model for Assessing the Sustainability of Rural Community Networks

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ABSTRACT

Half of the world population is now connected onto the Internet, most of whom are urban dwellers. Rural communities rank very low in terms of connectivity. Financial viability has hindered telecommunications providers from extending services to such areas. Governmental and non-governmental agencies have all been making several initiatives to carry rural communities especially in Africa along. One initiative that has proven successful is the Community Network (CN); an Internet infrastructure built and handed over to the community to run sustainably. About half of the CNs created have failed due largely to failed sustainability plan. This work attempts to study the sustainability plan of Tunapanda Community Network in Kenya, Africa, with a view to modelling the sustainability within the spheres of the various factors that contribute to their success.

Keywords: Community Network, Rural Africa, Awareness, Dynamic system, System modelling

Aims Research Journal Reference Format:
Auwal, A.T., Bukhari, B., Amao, F.A.., Okunoye, A.A., Jean-Paul, C. &. Longe, O.B (2020): Towards a Model for Assessing the Sustainability of Rural Community Networks. Advances in Multidisciplinary Research Journal. Vol. 6. No. 1, Pp 63–68.
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1. INTRODUCTION

Defining sustainability is difficult as it varies by scale and context (Vos, 2007). However a widely accepted definition comes from Keeble (1988). He defined sustainability as the development that meets the need of the present generation without compromising the ability of the future from meeting theirs. Contextualizing this to Community Network (CN), infers that CN can be said to be sustainable if the cost of providing the service to the community does not surpass the financial inflow for offsetting the incurred bills. Studying the factors that ensure sustainability in a CN amounts to seeking insight into the dynamics of the interactions between the various components of the network ranging from the devices to the human component. An excellent tool for getting that insight is the application of systems modelling. System modelling according to (Puliafito & Trivedi, 2019) can be seen as an abstraction of a real system for deriving and analysing its behaviour under different functioning conditions, in terms of performance of the system and its dependability, without the need to refer back to measurements on the real system as a whole or its prototype.

Contextually, modelling a sustainable system will involve an abstraction of the system where parameters that can influence the performance of the system are tweaked differently to have an insight of their effect on the overall sustenance of the system. Community networks are defined as community-based Information and Communication Technology (ICT) organizations created to provide universal access to the Internet and to the use of ICT systems for the promotion of local economy, social development, civic participation and community learning (Longford, 2008) (Gurstein, 1999). This infers that the success of the community network is largely dependent on the sustainability drive of the community. Quite recently there has been a drive to bridge the digital divide in rural Africa using CNs (Rey-Moreno, 2014). It involves setting up the network infrastructure using a seed grant and volunteering man power from the local communities. Ownership and management of the facility is then transferred to the community after the implementation. Issues surrounding sustainability has seen quite a number of these initiatives failing. This paper attempts to create a sustainable model of a CN using parameters from Tunapanda CN; one of the most successful rural community networks in Africa as contained in the report of (Rey-Moreno).

2. RELATED LITERATURES

Community Network (CN) is an information and communication network for the people, by the people (Longford, 2008) serving both the developed world (O'Beirne, 2010) and the developing world (Williams, Falch, & Tadayoni, 2017). Even though there is high need for CNs, they are quite new in Africa with the oldest being Macha Works (van Stam & van Oortmerssen, 2010). Debuting in 2003 in rural community of Macha in Zambia, now there are about 37 CN scattered across Africa (Rey Moreno & Graaf, 2016) with only about half of that number successfully operating (Rey-Moreno, 2014). Reason for this high rate of failure in the African initiatives bothers around sustainability (Rey Moreno & Graaf, 2016). Several attempts have been made at coming up with a sustainability plan for rural CNs in Africa. Williams et al. (2017), in his framework, identified public and private stakeholders that can partner together to ensure successful implementation of CNs in sub Saharan Africa. The research however is centered on provision of the CN infrastructure and dwelled little on its sustainability over time.

Earlier on, Hoffman and De Wet (2011) presented a model that simulated the relationship between market, product, technology and financial variables and their impact on the delivery of broadband service to rural Africa. His emphasis however was on getting a cheaper alternative for implementing the CN and effective accounting of its proceeds. Perhaps discussion on sustainability of telecentres will not be complete without x-raying the excellent work done by Mphahlele and Maepa (2003). This research x-rayed twelve critical factors that affects the sustainability of a telecentre (CN) using information from six telecentres in Limpopo district of South Africa. According to the paper, the telecentres are setup by a government agency as part of the South African drive towards bridging its digital divide. Even though it was successful in South Africa, such initiative from government agency have been known to have high failure rates in lots of countries (Ahmad Nawi, Azizah, & Ibrahim, 2012). More so, (Mphahlele & Maepa) did not present how these factors are interrelated. This paper seeks not only to identify the factors affecting CN sustainability, but it goes further to establish how the identified factors interrelate.

3. METHODOLOGY

Most CNs start up by a generous seed grant from non-governmental and governmental agencies that support community network creation. The received seed grant is used to acquire the necessary infrastructure for the building of the CN. To facilitate easy and seamless handover members of the community are encouraged to volunteer their time in the network buildup for them to acquire requisite skills to be able to maintain the equipment as well as man the day-to-day running of the network. To achieve this, massive awareness campaigns are staged in the form of town hall meetings and roadshows. Additionally the campaigns attempt to get the general community buy-in into the project as its success depends on how much support the project gets from the community. Other factors that can influence the buy-in include culture and belief of the community. After commissioning the community network is expected to sustain itself from its generated revenue. Its ability to achieve sustainability largely depends on the net revenue after the payment of all expenditures (Liabilities) for the month as illustrated in the conceptual model in fig 1.

The model in fig 1 was inspired by a virtual meeting held with a representative of TunapandaNET; A successful CN in Kibera, Kenya . In the meeting the success story of TunapandaNET was showcased and how the various factors interrelate to ensure a sustainable CN.

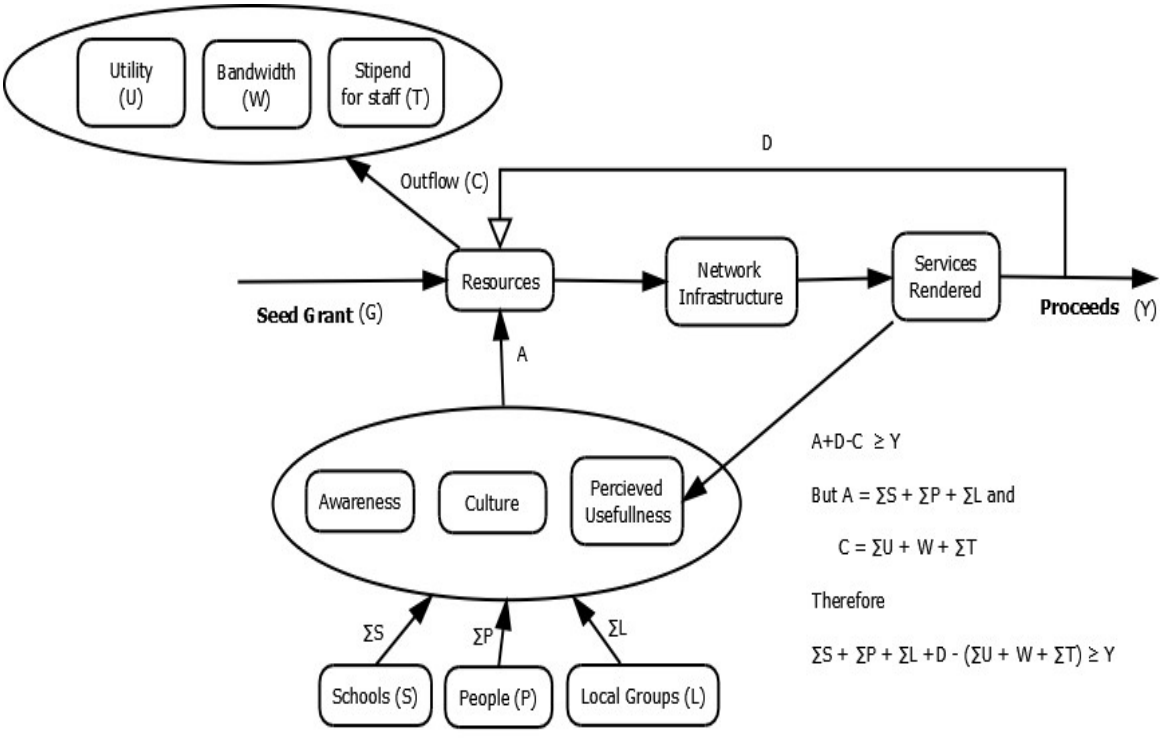

Figure 1: Model of Sustainability for Rural Community Network

Contextualizing the three dimensions of sustainability; Economy, Environment and Social dimension (Moir & Carter, 2012), where the economy is represented by the financial dynamics that depletes and replenish the sink labelled Resources, the environment dimension is represented by the infrastructure and services rendered and the social dimension is analogous to the social and cultural factors that influence the community buy-in into the system.

The overall relationship can thus be captured in equation I as:

$$A + D - C \geq Y ----- (\mathrm{I})$$

Where A = Summation of all cash in-flows into the system
D = Reinjection of the profit made from rendering services to the community
C = Total cost of al expenditures incurred in making the system work
Y = Total profit from services provisioning from the CN

Cash in-flow A is a subject of subscription payment by the three identified category of subscribers;

i. Subscription from schools S
ii. Subscription from individuals P
iii. Subscription from local groups L

Assuming uniform cost of subscription for each category of subscribers, then A can be written as in equation II

$$A = \sum S + \sum P + \sum L ------ (\mathrm{II})$$

Also total cost of expenditure C is the summation of costs of utilities (U) such as electricity and water bill, monthly cost of bandwidth (W) and the monthly wage of the employed workers (T). Thus C can be summarized in equation III as:

$$C = \sum U + \sum T + W ------ (\mathrm{III})$$

Substituting for A and C in equation I will give equation IV

$$\sum S + \sum P + \sum L + D - (\sum U + \sum T + W) \geq Y ----- (\mathrm{IV})$$

In order to factor in awareness, culture and perceived usefulness into equation IV as illustrated in fig (I), we make the following assumptions.

1. The higher the level of awareness within the community the more individuals and groups subscribe to the CN.
2. The more the CN promote the cultural heritage of the community, the more individuals and groups subscribe to the CN.
3. The more the community perceive the usefulness of the CN in their socio-economic lives, the more buy-in the CN gets from the community.

Each of these assumptions can be quantified using empirical research tool to get their values as percentage with values ranging from 0 to 1.

If α= Percentage awareness, β=percentage of cultural influence and Ω=percentage perceived usefulness, the sustainability equation thus becomes:

$$\alpha\beta\Omega(\sum S + \sum P + \sum L) + D - (\sum U + \sum T + W) \geq Y - - - \text{(V)}$$

where $0 \leq \alpha\beta\Omega \leq 1$

Equation (V) will always hold for sustainability of the network. It can be observed that a balance will need to be maintained between the left hand side (LHS) of the equation and its right hand side (RHS). A cumulative sum of the LHS must produce a threshold value that must be at least equal to the RHS for sustainability to hold. A change in one or more components on the LHS will have to be catered for by at least an equivalent change in other components of the LHS to maintain the threshold value that guarantees sustainability.

4. CONCLUSION AND FUTURE WORK

This sustainability model need to be tested with data from the CN scattered across several countries in Africa to test its efficiency. The components that provide data that influence the behavior of the system need not be exactly the same as the ones captured. All that is needed is to identify where it belongs either in in-flow or out-flow and to be placed appropriately for the test to be carried out.
Again there is a need to explore ways of injecting the contributions of awareness, culture and perceived usefulness to be able to complete the model with all factors accounted for.

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Volume 6, 2020 Edition

Content Analyzer for Information Leakage Detedction and Prevention in Android Smart Devices: A Conceptual Approach.

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ABSTRACTS

The advent of android operating system introduced tools to keep track of users' information activities and prevent information leakage which bridged the trust between application developers and consumers. Literature shows that several phenomena had been developed to prevent malicious applications from stealing personal sensitive information from smart phones but there is still the need for efficient solutions. This study proposes a conceptual approach for the development of a contentAnalyzer for information leakage detection and prevention on android-based devices. The concept will help to minimize false positives that will in turn lead to increase in code coverage towards detecting the maximum number of data leaks. The proposed concept combines both static and dynamic analysis, and if implemented will improve checking through the codes in the file activities and vulnerabilities that could be a problem.

Keywords: Android, ContentAnalyzer, Static Analysis, Dynamic Analysis, Information leakage, Information leakage detection, Information leakage Prevention.

Aims Research Journal Reference Format:
Okebule, T., Adeyemo, O.A, Olatunji, K.A. & Awe, A.S. (2020): Content Analyzer for Information Leakage Detedction and Prevention in Android Smart Devices: A Conceptual Approach. Advances in Multidisciplinary Research Journal. Vol. 6. No. 1, Pp 69–80.
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1. BACKGROUND OF THE STUDY

In recent years, handheld devices usage has exceeded that of desktops, while security and privacy concern about data in these devices are increasing exponentially in personal and corporate environment. Android has been the most commonly used operating system in smartphone due to its ease of use in the transferring and receiving of information on various forms. Today, professionals in diverse spheres of life currently prefer to use their personal Smartphones and tablets as the case may be for carrying out corporate work related tasks like email, documents, calendar, corporate apps among others, which has greatly helped in achieving a balance between personal and corporate life [33]. Programs that steal information also known as malicious software affects the user's mobile devices by exploiting the vulnerabilities. It is the major threat to the security of information in a system.

The types of malware that are most commonly used are viruses, worms, Trojans, among others. There is another widespread use of malware which allows malware author to get sensitive information like bank details, contact information among others. Most of the malware that affect mobile devices are embedded into mobile application or files accessed from the mobile device. These programs can destroy or steal sensitive and private information in any system. A lot of advances can be seen these days in the field of smart phones and as the number of users is increasing day by day, facilities are also increasing [33]. Information helps to clear any form of uncertainty and answers the question of "what an entity is" and thus defines both its essence and nature of its characteristics. Information relates to both data and knowledge, as data represents values attributed to parameters, and knowledge signifies understanding of a concept.

In terms of communication, information is expressed either as the content of a message through direct or indirect observation and that perceptive can be construed as a message in its own right, and in that sense, information is always conveyed as the content of a message [32]. Information can be encoded into various forms for transmission and interpretation (for example, information may be encoded into a sequence of signs, or transmitted via a signal). It can also be encrypted for safe storage and communication [9].

Leakage is the act or process or an instance of leaking in other words it is something or the amount that leaks. Leakage is premium revenue that is lost, often because a policyholder has not been truthful about facts or lifestyle changes or has committed some fraud. Information leakage in this study may be defined as the accidental or unintentional distribution of private or sensitive information to an unauthorized entity that can be caused by negligence or intentional sabotage such as, emails sent to the wrong recipients. Also, asides negligence, it is a universal truth that the motivation to leak sensitive information will exist no matter what countermeasures are taken. The result is that as storage media continually becomes more mobile and smaller in size, more sensitive information is likely to be stored on such media, having a greater likelihood of being lost or stolen [32].

Information Leakage Detection has been described as a situation whereby on-chip malicious circuits are hidden and illegally written to the main memory. It has not been ascertained whether data fetches and reads are a concern, and if some confidential information are read from the memory, it cannot be leaked to the external world unless it is leaked out on to the memory bus. Often time, there may be no external data interface (e.g., data/network ports) on the chip itself other than the address and data bus [30]. Information leakage prevention (ILP) is a set of vital information security tools intended to prevent unauthorized users from sending sensitive or critical information from a private user's devices. Adoption of Information Leakage Prevention, variously called Information loss prevention, information loss prevention or extrusion prevention, is being driven by significant insider threats and by more rigorous state privacy laws, many of which have stringent information protection or access components. Information Leakage Prevention products use business rules to examine file content and tag confidential and critical information so that users cannot disclose it. Tagging is the process of classifying which data on a system is confidential and marking it appropriately. A user who accidentally or maliciously attempts to disclose confidential information that is being tagged will be denied. For example, tagging might even prevent a sensitive financial spreadsheet from being emailed by one employee to another within the same corporation.

Recent studies revealed that malicious applications exists on them. These malicious applications will leak private information without user's authorization. A good example is, TaintDroid shows that among 30 popular third-party Android applications, there are 68 instances of potential misuse of users' private information. In light of these privacy-violating threats, there is an imperative need to tame these information-stealing smartphone applications [21]. Android requires explicit permission applications installed to ensure the user is aware of the information or access that will be needed to run the application, and by showing these permissions to the end user, and Android delegates, the task to the user for approval when the application is being installed. However, this permission mechanism is too coarse-grained for two main reasons. First, the Android permission mechanism requires that a user has to grant all the requested permissions of the application if he wants to use it, otherwise, the application cannot be installed. Secondly, if a user has granted the requested permissions to an application, there is no mechanism in place to later re-adjust the permission(s) or constrain the runtime application behavior[31]. Given the increased sophistication, features, and convenience of these smart-phones, users are increasingly relying on them to store and process personal information and since these are all private information, the safety of these data is concerned [38].

Recent years have witnessed the rapid spread of smartphones, and Android has emerged as a popular smartphone operating system (OS). Application developers can easily develop an Android application and make it available through a Web site such as Google Play Store. However, an application built with malware is capable of accessing administrative privileges by exploiting vulnerabilities in the Android Operating System, and thus send out illegally collected sensitive information. In particular, a major issue is the widespread emergence of malware which performs unwanted or unexpected processing. Furthermore, applications that are not sufficiently malignant to be blacklisted as malware call application program interfaces (Applications) that collect sensitive information inappropriately. This makes it difficult to ensure transparency when the application handles user information. Malware that targets the Android Operating System is usually intended to illegally collect sensitive information. A mobile device contains a large amount of personal information such as names, addresses, and phone numbers, and this information can be easily obtained by applications using the Android Applications. Moreover, many users are unaware of smartphones' lack of security and built-in anti-malware software. Therefore, there is a possibility of information leakage due to malware, and without the user's knowledge [31].

An Android application is executed in a sandbox; communication with other applications is severely restricted, and requires the use of an intent. Key features such as external communications and the collection of sensitive information requires permissions that are granted by the user. However, the user can neither detect the collection of sensitive information by the application nor determine whether that sensitive information has been leaked [31]. Android has been the most commonly used operating system in smartphone due to its ease of use in the transferring and receiving of information on various forms. Information Leakage, Detection and Prevention (ILDP) is the new rising star in Information security. Since the advent of android Operating System, a lot of tools have been developed to keep track of users' information and activities, and prevent information leakage which bridged trust between applications developers and the consumers. Hence, there is a need to come up with an effective solution in order to address information leakage issues particularly in smartphones. The aim of this study is to develop a conceptual approach of ContentAnalyzer for information leakage detection and prevention on Android Based Devices.

2. RELATED WORKS

[18] develop SCANDAL, a Static Analyzer for Detecting Privacy Leaks in android applications. Static analyzer SCANDAL is a technique for providing a formal, found, and automatic static analysis. It has been referred to as a sound and automatic static analyzer for detecting privacy leaks in Android applications. This tool analyzed 90 popular applications using SCANDAL from Android Market and detected privacy leaks in 11 applications and also analyzed 8 known malicious applications from third-party markets and detected privacy leaks in all 8 applications. The limitation of this model is that, SCANDAL does not fully support reflection-related APIs and the time performance and memory consumption during the analysis is very low and this considered for future works.

[5] Performed system call-centric dynamic analysis of Android applications, using Virtual Machine Introspection. The novelty of CopperDroid lies in its doubting approach to identify interesting OS- and high-level Android-specific behaviors. It reconstructs these behaviors by observing and dissecting system calls and, therefore, is resistant to the multitude of alterations the Android runtime is subjected to over its life-cycle because CopperDroid's has reconstruction mechanisms that are doubting to the underlying action invocation methods, it is able to capture actions initiated both from Java and native code execution. Using this technique, it successfully triggered and disclosed additional behaviors on more than 60% of the analyzed malware samples. This qualitatively demonstrates the versatility of CopperDroid's ability to improve dynamic-based code coverage. The limitation of this tool is that, CopperDroid system call tracking would not provide any behavior insights if was not combined with Binder information and automatic (complex) Android objects reconstruction.

[28]designed DroidSafe for static information flow analysis tool that reports potential leaks of sensitive information in android applications. DroidSafe combines a comprehensive, accurate, and precise model of the android runtime with static analysis design decisions that enable the DroidSafe analyses to scale to analyze this model and by a combination of analyses together can statically resolve communication targets identified by dynamically constructed values such as strings and class designators. DroidSafe's reporting is defined by the source and sink calls identified in the Android API. An attacker could exfiltrate API-injected information that is not considered sensitive by DroidSafe, or via a call that is not considered a sink; and it would not be reported. The analysis does not have a fully sound handling of Java native methods, dynamic class loading, and reflection. Different versions exist of Android, and the system analyze an application in the context of Android 4.4.3.

[33].developed DroidScope, a framework to create dynamic analysis tools for Android malware that trades off simplicity and efficiency for transparency that extends traditional techniques to cover Java semantics. However, the problem of analyzing Android applications is not simple as how to capture behaviors from different language implementations. It is hard to conduct effective analysis without considering Android's specific security mechanism. Permission Event Graph, which represents the temporal order between Android events and permission requests, is proposed to characterize unintended sensitive behaviors. However, this technique could not capture the internal logic of permission usage, especially when multiple emissions are intertwined.

3. System Architecture

In this section we describe the proposed conceptual approach. We start by presenting an architectural overview of modules contained in it and a presentation of its main components and functions.

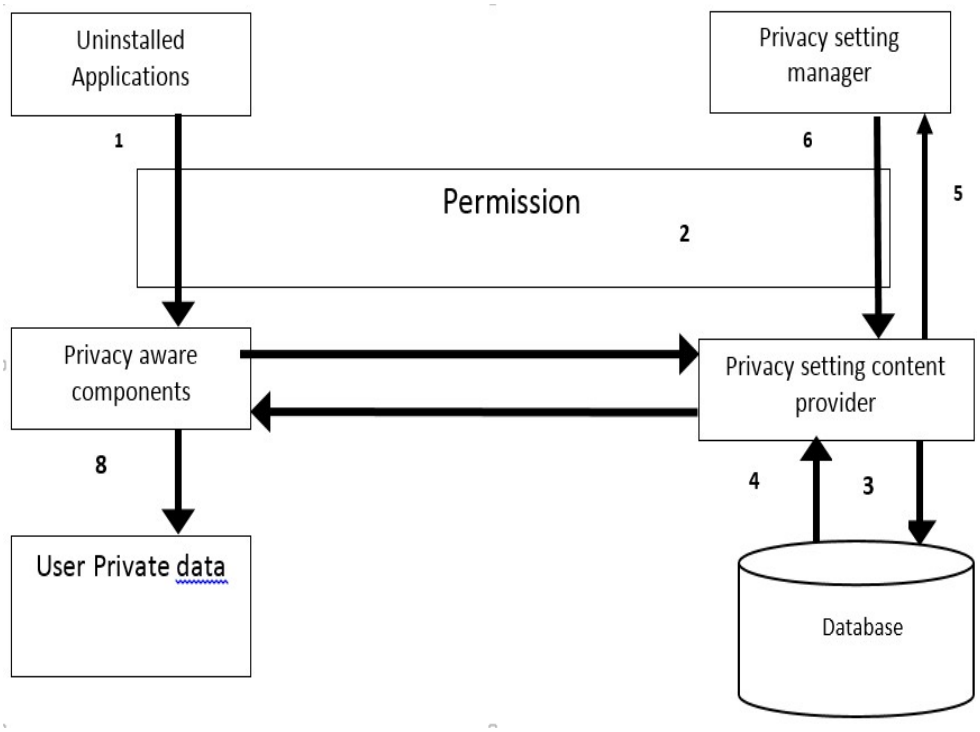

Figure 3.1 A Conceptual Approach of ContentAnalyzer for Information Leakage Detection and Prevention on Android Based Devices.

Research has shown that for any system to be effective, efficient and reliable, modularity is a concept that must be seriously taken into consideration during the implementation of such systems. The system architecture consist of three main modules, each constituted by various elements that worked together to make the system perform flawlessly.

3.1 Privacy Setting Content Provider

The first module is the privacy setting content provider, which is a privileged component to manage the privacy settings for untrusted applications. In the meantime, it also provides an Application Programming Interface that can be used to query the current privacy setting for an installed application. The privacy setting content provider is tasked to manage a local SQLite database that contains the current privacy settings for untrusted applications on the phone. It also provides an interface through which a privacy-aware component can query the current privacy settings for an untrusted app, the privacy-aware component will provide the input that is the package name of the requesting application and the type of private information it is trying to acquire.

Once received, the privacy setting content provider will use the package name to query the current settings from the database. The query result will be an app-specific privacy setting regarding the type of information being requested.

3.2 Privacy Setting Manager

The second module is the privacy setting manager, which is a privileged application that a mobile user can use to manage or update the privacy settings for installed applications. Therefore, it acts as the Policy Administration Point (PAP). The privacy setting manager is a standalone Android application that is signed with the same certificate as the privacy setting content provider in which manager will be given the exclusive access to the privacy setting.

The manager provides the visual user interface and allows the user to specify the privacy settings for untrusted applications. In particular, the manager application includes two activity components. The default one is Privacy Setting Manager Activity, which when activated displays a list of Installed applications. The phone user can then browse the list and click an application icon, which starts another activity called App Privacy Setting Activity and passes the app's package name. When the new activity is created, it queries the privacy setting content provider for the current privacy settings and displays the results to the user.

3.3 Privacy-Aware Components

The third component is privacy-aware module, including those content providers or services that are enhanced in a privacy-aware manner to regulate the access to a variety of user's personal information, including contacts, call log, and so on. These privacy-aware components are designed to cooperate with the first component. In particular, once they receive requests from an application to access private data they manage, they will query the privacy settings, and response to the requests according to the current privacy settings for the application. When an application tries to read a piece of private data, it sends a reading request to the corresponding content provider. The content provider is aware of the privacy requirement. Instead of serving this request directly, it holds the request and makes a query first to the privacy setting content provider to check the current privacy settings for the application (regarding the particular reading operation).

The privacy setting content provider in turn queries its internal policy database that stores user specifications on privacy settings of all untrusted applications, and returns the query result back to the content provider. If this reading operation is permitted (stored in the policy database), the content serves the access request and returns normal results to the app. This may include querying its internal database managed by the content provider. However, if the reading operation is not permitted, the privacy setting option report unauthorized.

3.4 Sequence Diagram

Figure 3.2 shows the sequence of the system and it consists basically three modules as explained:

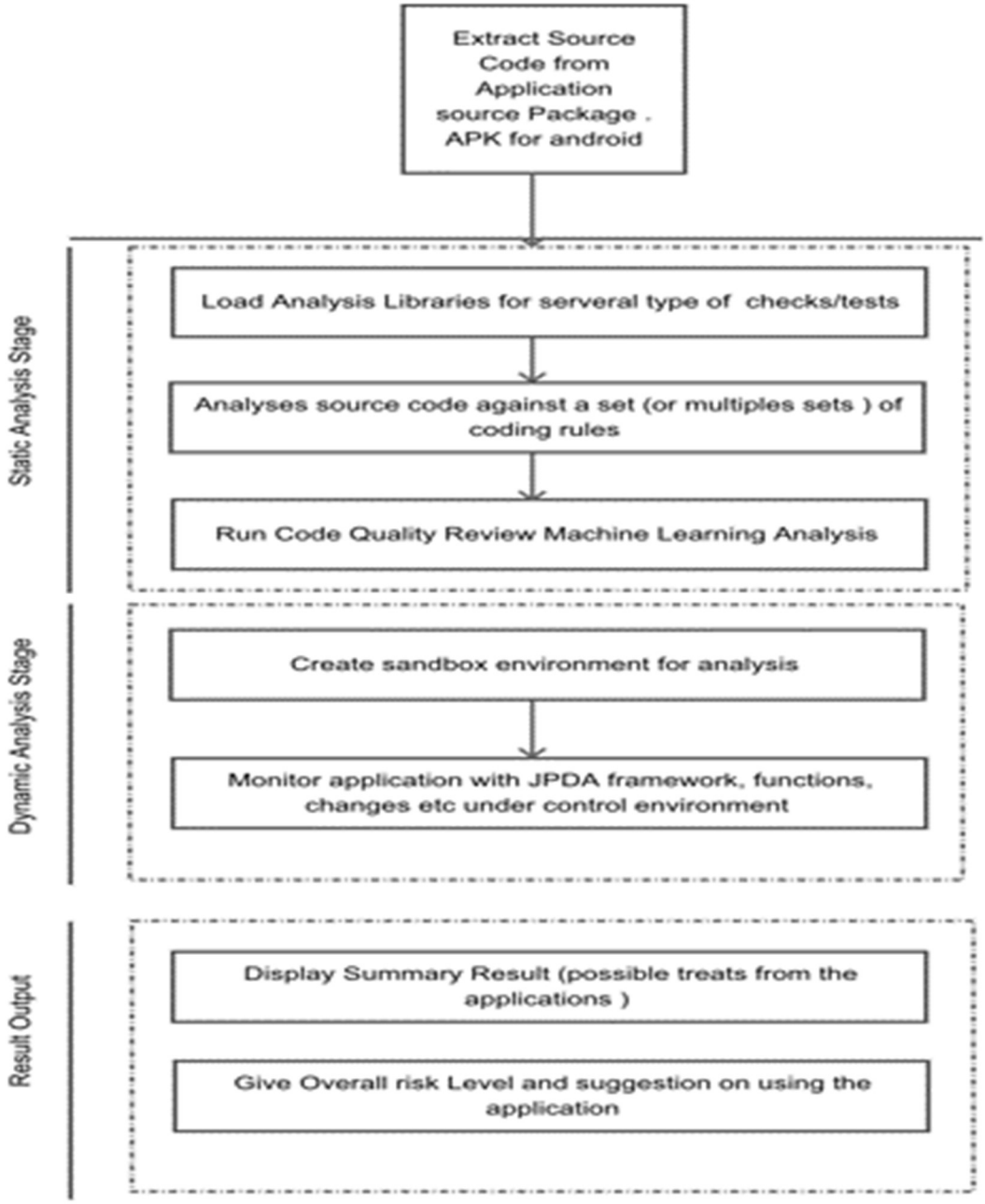

Figure 3.2: Sequence Diagram of the Conceptual Approach.

This system has three stages namely static Analysis stage, Dynamic Analysis Stage and the Report Stage. Each stage output will be an input to the next stage. Each stage runs independently and pass its result to the next one. There will be a code extraction process before the first stage, the last stage will provide the result of the whole analysis and the category of the application.

3.2.1 The Extraction process

This process does reverse engineering to the apk architecture and structure, the intention of this process is to understand (so as to re-build the source code) the buildup of the entire code base and to focus on the part that is relevant for the static analysis stage . The output of this process are details on the architecture of the applications, details of the broken down of the structure, provide information about its functionality and collect technical indicators. The proposed process comply with Android's security architecture and user data privacy is maintained. [18].

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3.2.2 Static Analysis Stage

Static malware analysis is fairly straightforward and fast. It ensures security and safety of the android devices because of its ability of detecting malicious file without viewing or running, the actual code or without execution, this stage takes the input from the extraction stage. The static analysis stage has some already loaded check libraries (Rules for identifying malicious code or software). It runs the input from the extraction process against these set of rules to detect if there are suspicious instructions files etc. This phase covers both the checks/test and the multiple set operations. Still within the static Analysis stage, there is a code quality review process to examine the code quality which could also be a treat to the devices. One of the important issues about code quality is how easy it is for humans to read and understand the code, and an important measurement for this is the complexity measurement. It is not a trivial task to detect the quality of the code, since it depends on both functional requirements, structural requirements, and complexity. For basic static code analysis, 15-20 rules are used [18].

3.2.3 Dynamic Analysis Stage

Dynamic analysis techniques involve running the malware and observe its behaviour on the system. Typically, malwares have abilities to change several sorts of things on the compromised device, it actually run on a host device such behaviours includes variable modifications, accesses to api calls. Since mobile devices allow easy-to-use, touch-sensitive, and anywhere-anytime access to its resources, some of the resources being monitored includes but not limited to SMS, MMS, Bluetooth, e-mail, Network traffic, file modification and other services that may pose serious threats and lead to financial losses and privacy leakages[27].

In Dynamic analysis one can monitor what network traffic they are sending and receiving, with what kind of Uniform Resources Location (URL) or server they are communicating, you can also check that after installation app is trying to reboot or if it is trying to change some internal file format or trying to run some privileged instruction. The sandbox environment will prevent the application from actually infecting production systems; many such sandboxes are virtual systems that can easily be rolled back to a clean state after the analysis is complete.

So, dynamic analysis consists of monitoring the following behaviors:

- Volatile Memory: Malware can overflow buffers and use the abandoned memory locations to gain access to the device. By capturing and analyzing the device memory, it is possible to determine whether and how the malware uses the memory. Observation of these behaviours can give valuable information about software's intention, which is difficult to be gathered by other detection schemes.
- Registry/configuration changes: Changes in the registry may be an evidence toward dynamic analysis. Malwares often change registry values to gain persistent access to the system.
- File activity: Malware may also add, alter, or delete the files. So by monitoring file activities, valuable information about the malicious behavior can be obtained.
- Processes/services: Malware may disable AV engines to fulfill their functions, jump to other processes to obstruct analysis, or install new services to obtain persistent access to the system.
- Network connection: Monitoring the network connections is the essential part of dynamic analysis to detect the malware's existence. Destination IP addresses, port number, and protocol can be analyzed in order to detect malware's interaction with the command-and-control (C&C) server.

3.2.4 The Result State

The result phase displays a summary of the threats by the applications, the code quality review. This stage also presents the overall risk level of the application and suggestion on what the user can do. Also if user should disable some of the application's access to the devices recourses.

4. APPLICABILITY OF THE CONCEPT.

Below are the application areas where the proposed conceptual approach can be adopted.

4.1 Banking and Financial Services

This concept will aid the development of security in the bank by preventing invasions that uses personal information (e.g., Social Security numbers, bank account information and credit card numbers) to pose as another individual. This may include opening a credit account, draining an existing account, filing tax returns or obtaining medical coverage.

4.2 Electoral Voting:

This concept will assist, if well implemented, it will go a long way in preventing vote rigging which normally occurs as a result of multiple voting and other interferences during election voting. All this has really affected the integrity of elections. Hence, the concept will attempt to provide solution to this problem.

4.3 Student Result Processing

If this concept is used, it will allow generation of accurate and error free student results information by preventing unauthorized access into the server housing. Also, preventing unauthorized access that can effect changes in grades of students which may occur as a result of student or staff mischievous act of changing marks or grades on the result sheet.

5. CONCLUSION

In this paper, we presented the conceptual architectural design and the sequence for information leakage detection and prevention on android-based devices. We believe that if this concept is implemented, false positives will be minimized and in turn lead to increase in code coverage to detect the maximum number of data leaks. Furthermore, this concept could enhance the capacity for the developed contentAnalyser to detect and prevent more information leakages on smartphones than previously considered works. The extent of the implementation of this concept in the development of a ContentAnalyser for smart phones will also allow for various debate and sensitization in the disciplines and the body of knowledge of computer science. This work proposed a concept that can lead to the solution stated in statement of the problem. As future work, this approach needs a more specific way of systematization, perhaps through the sophisticated software. Additionally, the used assumptions in this contribution must face well-grounded scientific evaluations in order to ensure their stability since the described approach is conceptual and has not been evaluated yet.

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A Systematic Review of Machine Learning Classification Approach for Suicide Ideation Detection

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ABSTRACTS

Suicide is a global health issue that is responsible for several deaths among young children and adults. Suicide can easily be handled if it is detected early. To address this issue several approaches have been used, which are clinical method and machine learning with feature engineering or deep learning for automatic detection of suicide ideation based on an individual social media messages. This paper aims to survey different methods used for suicide ideation detection. Some of the domains of machine learning applications used for suicide ideation detection were also reviewed based on their data sources like questionnaires, electronic health records suicide notes, and online user contents. Several specific tasks and datasets are introduced and summarized to facilitate further research. Finally, this paper summarizes the limitations of current work and provide an outlook for further research directions.

Keywords: Systematic Review, Machine Learning, Classification, Suicide Ideation Detection

Aims Research Journal Reference Format:
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1. BACKGROUND OF THE STUDY

There is an extensive literature on suicide risk assessment, management, prediction and treatment for young adults between the undergraduate ages range of 18-29. Suicide risk assessment has been on the forefront of most literature as most mental health professionals are of the view that mental health is predominantly the only cause of suicide. While most researchers believe on this some others believe that some environmental factors (such as sexual abuse, trauma, economic problems, academic stress, etc) can trigger these mental problems and make an individual susceptible to suicide. Most literature are of the view that the first point of call for every suicidal case is to assess suicide risk factors in individuals and based on that predict those who might develop suicide ideation. While these works in some cases, it fails in others as some people have taken their lives months after contact with mental health professionals (Carrigan & Lynch, 2003).

These have undermined the importance of questionnaire and interview methods which is the most recommended approach for psychological evaluation of suicidal cases in hospitals.

Several Machine Learning approaches have been used to predict suicide ideation based on the information extracted from social media. While this is viable the major limitation is that it addresses the immediate cause of suicide as expressed in the suicide notes rather than the remote cause which is an accumulation of many other factors like loss of loved one, relationship and financial issues, trauma, abuse, etc. Most of these issues manifest in a way of sleep deprivation, loss of interest in pursuing ones passion, social isolation, etc. Most of the risk factors associated with suicide and approaches used by many literatures for suicide ideation prediction are shown in the section that follows.

2. SUICIDE IDEATION DETECTION METHODS

Suicide detection has drawn the attention of many researchers due to an increasing suicide rate in recent years and has been studied extensively from many perspectives. The research techniques used to examine suicide also span many fields and methods, for example, clinical methods with patient-clinic interaction (Venek V. , Scherer, Morency, A, & Pestian, 2017) and automatic detection from user-generated content (mainly text) (O'Dea, et al., 2015), (Ji S. , Yu, Sai-fu Fung, Pan, & Long, 2018). Machine learning techniques are widely applied for automatic detection.

2.1. Content Analysis

Social media provides a platform through which millions of users can connect to share ideas, express their feelings and perform some other activities. With the pull of information generated by social media users on a daily basis one can easily predict their behavioral pattern and be able to make an informed decision regarding their suicidal intents. Many researchers have explored social media contents for suicide risk assessment and detection. Shaoxiong et al. (2018.) explained how supervised learning algorithm can be used for early detection of suicide ideation through exploration of user-generated online contents. Vioulès et al (2018) presented a new approach for quantifying suicide warning signs on individual based on suicide related tweeter posts. Their approach identifies a sudden change in a user's online behavior using natural language processing and martingale framework.

Research has shown that there is a connection between social media communication and the desire by vulnerable individuals to commit suicide (Colombo, Burnap, Hodorog, & Scourfield, 2016). Colombo et al. (2016) studied the characteristics between users and the propagation of their suicidal contents. Their result shows a tightly-coupled virtual community based on the high degree of reciprocal connectivity between the authors of suicidal contents and other studies of Twitter users. Coppersmith et al. (2016) performed an exploratory data analysis of the language pattern and emotions surrounding the suicide attempts of Twitter users who have attempted to take their lives in the past. Masuda et al. (2013) used logistic regression approach to determine user characteristics (both social media related and non-social media related) that contributes to suicide ideation. Their result shows that the number of communities a user belongs, the intransitivity (i.e. paucity of triangles including the user), and the fraction of suicidal neighbors in the social network, contributed the most to an individual suicide ideation.

Li et al. (2016) developed a poison-based model that extracts stressor events from teen's stressful moments using their social media posts. Li's approach even though provided a good ground for research on stressful period and stressor event detection it still has some limitations which is the fact that microblogging platforms lacks sufficient facilities and data required to adequately detect stressful events and stressors in individuals.

2.2. Clinical Method

Over the years researchers have developed psychological suicide risk assessment methods that are based on contact with individuals either through interview or questionnaire for example suicide probability scale (Bagge & Osman, 1998), Depression anxiety Stress Scales-21 (Crawford & Henry, 2003), Adult Suicide Ideation Questionnaire (Fu, Liu, & Yip, 2007) Suicide Affective Behaviour-Cognition Scale (Harris, et al., 2015), etc. These methods even though are effective and professional but are not all encompassing as the interview (Scherer, Pestian, & Morency, 2013) and questionnaire methods (Venek V. , Scherer, Morency, A, & Pestian, 2017) used may put some suicidal population at disadvantage as they might either not be able to access the resources or lack the motivation to use them (Zachrisson, Rodje, & letun, 2006; Essau, 2005). On a second note research has suggested that interview and questionnaire method of suicide risk assessment might have some negative impact on individuals showing depressive symptoms (Harris & Goh, Is suicide assessment harmful to participants? findings from a randomized controlled trial, 2016).

2.3. Feature Engineering

The suicidal intent of an individual can be predicted from his or her social media post through text based suicide classification. The texts and data used in suicide predictions can take different forms and features. Machine Learning and Natural Language Procession (NLP) provides useful approach in the manipulation of data and text for extraction of useful information about individuals and their suicidal ideation.

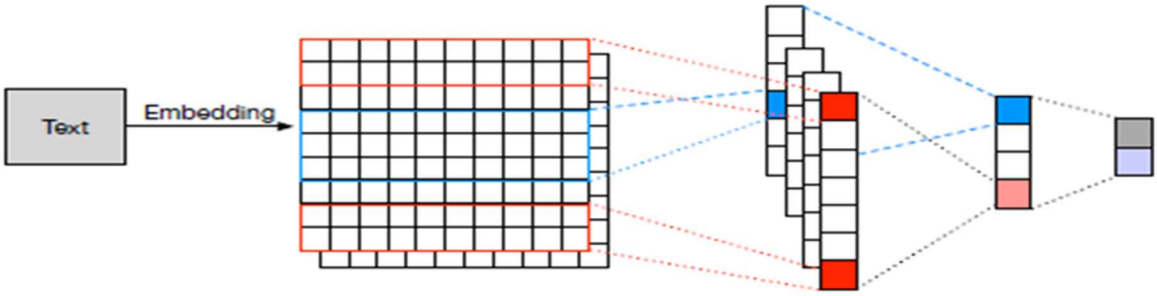
2.3.1. Tabular Features: Tabular data such as questionnaire and structured statistical contents extracted from websites serves as tools for suicidal ideation detection through classification or regression. Many researches have been conducted using tabular features for statistical analysis of questionnaire or tabular data for suicidal ideation detection. Masuda et al. (2013) applied logistic regression using age, gender, community number, homophily and registration period variables to determine the characteristics of user's on and outside social network that might influence their suicide ideation. They found that community, neighbor, intransitivity and social network has great influence on an individual's suicidal ideation. Chattopadhyay et al (2007) applied regression analysis on suicide scenario factors using Pierce Suicide Intent Scale (PSIS). They extracted the risk factors in a tabular form using questionnaire responses gotten from the concerned individuals. Delgado-Gomez, et al. (2012) compared five multivariate techniques with regard to their accuracy in the classification of suicide attempt. These techniques were applied on questionnaire responses from international personal disorder examination screening and Homes-Rahe social readjustment rating scale. Chattopadhyay (2012) used Beck's suicide intent scale (BSIS) to structure data gotten from patient's data sheet for mathematical modeling (using Multilayer Feed Forward Neural Network) method of suicide intent estimation.

2.3.2. General Text Features: Unstructured text consists of features (like knowledge-based features, syntactic features, N-gram features, context and class-specific features) which can be extracted in different forms for use in feature engineering for suicide ideation detection. Many authors have demonstrated how feature engineering can be employed in unstructured text for suicide ideation detection. Wang et al. (2012) showed how a rule-based algorithm can be applied on suicide notes for the extraction of syntactic and lexical patterns for sentiment classification. Liakata et al. (2012) used hybrid approach for detection of emotion in suicide notes. Pestian et al. (2010) used information extracted from patient's suicide notes to understand the patients thought. Abboute et al. (2014) described how suicide related vocabularies can be extracted from Tweeter for prediction of tweets with suicidal contents. Braithwaite et al. (2016) performed a validation check on the use of Machine Learning on Twitter data with a view of suicide prevention. Okhapkina et al. (2017) explained methods that can be adapted for the extraction of Destructive Informational Influence on social network.

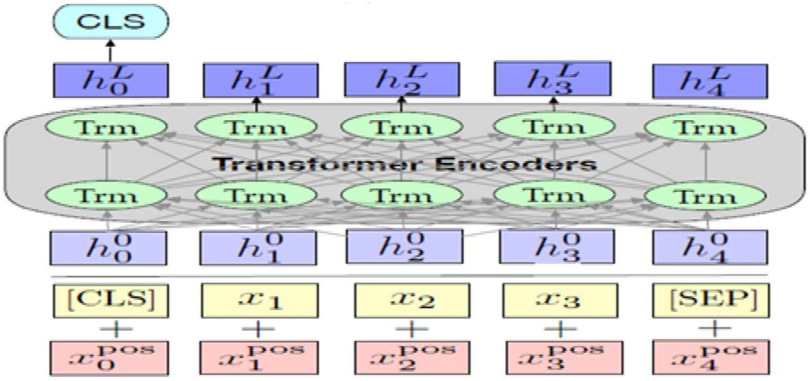
2.3.3. Affective Characteristics: Computer Scientists and Mental health professionals have focused their research on affective characteristics of suicidal and non-suicidal individuals as the level of divergent in this trait puts them in the category of being suicidal or not. Many authors have used different means to detect the emotions of an individual in social media. Ren et al. (2016) showed how complex emotion topic (CET) model can be used to detect emotions from social media blogs by employing eight emotion categories and five levels of emotion intensities. Liakata et al. (2012) proposed a hybrid model to detect emotion from suicide notes. Pestian et al (2010) proposed a model to understand a patient's suicidal thought based on the information gotten from his or her suicide note. Their result shows relatively higher classification accuracy in favor of the model as against the trainees and health care professionals.

2.4. Deep Learning

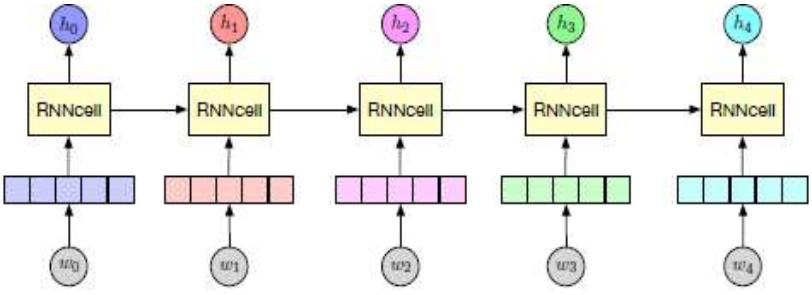
Deep learning has gained wide popularity in many application domains such as computer vision, Natural Language Processing (NLP), crop classification, and medical diagnoses. Its popularity is based on its ability to work on unlabeled and unstructured data. Deep learning has been used extensively by many suicide researchers for suicide ideation detection and prevention. The three popular deep neural networks as shown in figure 1a, 1b, 1c are 1) convolutional neural networks (CNNs), recurrent neural networks (RNNs), and bidirectional encoder representation from transformers (BERT). The online text streams used for suicide ideation detection are usually encoded in vector form using word2vec (Mikolov, Chen, Corrado, & Dean, 2013) and GloVe (Pennington, Socher, & Manning, 2014) the two popular word embedding techniques. The user posts encoded in (2018) were done using user-level CNN with 3, 4, and 5 filter window set. Ji et al. (2018.) applied LSTM and CNN for encoding and classification of user posts for suicide ideation detection. Their model relied on manual labeling of users posts, which in most scenarios are limited in application due to decentralization of the training. In that case semi-supervised or unsupervised learning would be the most suitable method.



(a) CNN



(b) RNN



(c) BERT

Fig. 1: Deep neural networks for suicidal ideation detection

Deep learning has been used to assess suicide and mental risks in individuals. Adrian et al. (2017) presented a deep learning framework for estimating suicide and mental health risk using user's social media texts. Manas et al. (2019) proposed a Convolutional Neural Network (CNN) based suicide risk prediction using Reddit posts. On a similar note Morales et al. (2019) used deep learning approach to predict suicide risks on individuals based on their posts on Reddit online community.

Matero, et al. (2019) applied open-vocabulary and theoretical features in support forum for suicide risk assessment. They proposed model that separates languages used in suicide specific context from languages used in other forums.

Several approaches have been employed to gain a better performance and prediction efficiency on deep learning for text classification and suicide ideation detection. Gaur et al. (2019) enhanced the performance of their CNN model by representing texts based on suicide related concepts and external knowledge bases. Coppersmith et al. (2018) used GloVe and bidirectional LSTM for capturing text with the highest information sequence.

3. SUICIDE IDEATION DETECTION DOMAIN

Different machine learning techniques have been applied in wide range of suicide ideation detection. The success of any technique depends on the validity and source of the data. Machine learning can be applied on dataset from a wide range of domains, for example questionnaire, electronic health records (EHRs), suicide notes and online user contents. Text messages was used in (2018.) for suicide risk identification. Suicide prevention has been tackled by some researchers using software applications. Berrouiguet et al. (2016) proposed an e-health mobile application for the suicidal patients to access and report their medical conditions to the mental health care providers. Meyer et al (2017) developed a tool called e-pass that helps medical professional detect suicide ideation in patients. Shah et al. (2019) studied the use of profanity, death and other suicide related words in social media videos as behavioural markers for prediction of suicide ideation in individuals.

3.1. Questionnaire

Mental health assessment and disease classifications in mental health cares are based on the following tools: the International Personality Disorder Examination – Screening Questionnaire (IPDE-SQ), International Classification of Diseases version 10 (ICD-10) and Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV). The testimonies of mental patients and the traits of their mental condition can be accessed using the above tools. The tools guide the mental health professionals in the formulation of interview questions and questionnaires for evaluation of patients with mental conditions or suicide intents.

Delgado-Gomez et al. (2011) compared Barrat's impulsiveness scale version 11 and international personality disorder evaluation screening questionnaire (IPDE-SQ) for their discriminative ability in suicide ideation prediction using Support Vector Machine (SVM). They found that the items in IPDE-SQ have better discriminative ability than items in BIS-II. Delgado-Gomez, et al. (2012) compared the application of five multivariate techniques (linear regression, stepwise linear regression, decision trees, Lars-en and support vector machines) on Holmes-Rahe social readjustment rating scale and the international personal disorder examination screening questionnaire. Harris et al. (2014) studied how the online behavior of suicide-risk individuals differed from non-suicide risk individual using Suicide Behaviours Questionnaire – Revised (SBQ – R). The SBQ – R assesses suicidal behavior based on the following four main attributes: lifetime suicidal behavior, past-year suicidal ideation, disclosing suicidal plans and perceived likelihood of future suicide.

Sueki (2015) carried out a survey to understand how tweeter log of young internet users can help in predicting suicide in individuals by studying the relationship between suicides related tweets and suicide behavior. The questionnaire in his research was analyzed using logistic regression.

3.2. Electronic Health Records

Electronic health record (EHR) are vital digital medical information (like diagnoses, medications, treatment plans, allergies, emergency visits, history, demographic information, etc) kept about a patient that can enable health care providers make vital decisions about the patient. It provides volume of medical information that can be utilized for suicide ideation detection using machine learning techniques. Utilizing this tool for suicide attempt prediction is usually challenging due to data sparsity, record heterogeneity and variation in clinical series. Sometimes healthcare policies review might influence the recording procedure and affect the utility of the tool for suicide attempt prediction.

Suicide risk prediction using EHR has attracted several research efforts. Tran et al. (2013) proposed a machine learning framework that tackles suicide risk prediction using feature extraction, feature selection, risk classification and risk calibration procedure. They applied bank of multi-scale convolutional filter on features generated from the patient's clinical history.

There are several works of predicting suicide risk based on EHRs (Hammond, Laundry, OLeary, & Jones, 2013; Walsh, Ribeiro, & Franklin, 2017). Tran et al. (2013) proposed an integrated suicide risk prediction framework with a feature extraction scheme, risk classifiers, and risk calibration procedure. Explicitly, each patient's clinical history is represented as a temporal image. Iliou et al. (2016) proposed a data preprocessing method to boost machine learning techniques for suicide tendency prediction of patients suffering from mental disorders. Nguyen et al. (2016) explored real-world administrative data of mental health patients from the hospital for short and mediumterm suicide risk assessments. By introducing random forests, gradient boosting machines, and DNNs, the authors managed to deal with high dimensionality and redundancy issues of data. Although the previous method gained preliminary success, Iliou et al. (2016) and Nguyen et al. (2016) have a limitation on the source of data which focuses on patients with mental disorders in their historical records. Bhat and Goldman-Mellor (2017) used an anonymized general EHR dataset to relax the restriction on patient's diagnosis-related history and applied neural networks as a classification model to predict suicide attempters.

3.3. Suicide Notes

Suicide notes are the written notes left by people before committing suicide. They are usually written on letters and online blogs and recorded in audio or video. Suicide notes provide material for NLP research. Previous approaches have examined suicide notes using content analysis (Pestian, et al., 2012) , sentiment analysis (Pestian, et al., 2012; Wang, Chen, Tan, Wang, & Sheth, 2012) , and emotion detection (Liakata, Kim, Saha, Hastings, & Rebholzschuhmann, 2012). Pestian et al. (2012) used transcribed suicide notes with two groups of completers and elicitors from people who have a personality disorder or potential morbid thoughts. White and Mazlack (2011) analyzed word frequencies in suicide notes using a fuzzy cognitive map to discern causality. Liakata et al. (2012) employed machine learning classifiers to 600 suicide messages with varied length, different readability quality, and multi-class annotations.

Emotion in text provides sentimental cues of suicidal ideation understanding. Desmet et al. (2013) conducted a fine-grained emotion detection on suicide notes of 2011 i2b2 task. Wicentowski and Sydes (2012) used an ensemble of maximum entropy classification. Wang et al. (2012) and Kova˘cevi´c et al. (2012) proposed hybrid machine learning and rule-based method for the i2b2 sentiment classification task in suicide notes.

In the age of cyberspace, more suicide notes are now written in the form of web blogs and can be identified as carrying the potential risk of suicide. Huang et al. (2007) monitored online blogs from MySpace.com to identify at-risk bloggers. Schoene and Dethlefs (2016) extracted linguistic and sentiment features to identity genuine suicide notes and comparison corpus.

3.4. Online User Content

The widespread use of mobile Internet and social networking services facilitates people's expressing their life events and feelings freely. As social websites provide an anonymous space for online discussion, an increasing number of people suffering from mental disorders turn to seek for help. There is a concerning tendency that potential suicide victims post their suicidal thoughts on social websites like Facebook, Twitter, Reddit, and MySpace. Social media platforms are becoming a promising tunnel for monitoring suicidal thoughts and preventing suicide attempts (Robinson, et al., 2016) Massive user-generated data provide a good source to study online users' language patterns. Using data mining techniques on social networks and applying machine learning techniques provide an avenue to understand the intent within online posts, provide early warnings, and even relieve a person's suicidal intentions.

Twitter provides a good source for research on suicidality. O'Dea et al. (2015) collected tweets using the public API and developed automatic suicide detection by applying logistic regression and SVM on TF-IDF features. Wang et al. (2016) further improved the performance with effective feature engineering. Shepherd et al. (2015) conducted psychology-based data analysis for contents that suggests suicidal tendencies in Twitter social networks. The authors used the data from an online conversation called #dearmentalhealthprofessionals.

Another famous platform Reddit is an online forum with topic-specific discussions has also attracted much research interest for studying mental health issues (Choudhury & De, 2014) and suicidal ideation (Bashir, 2016). A community on Reddit called SuicideWatch is intensively used for studying suicidal intention (Choudhury & De, 2014), (Ji S. , Yu, Fung, Pan, & Long, 2018.). Choudhury et al. (2014) applied a statistical methodology to discover the transition from mental health issues to suicidality. Kumar et al. (2015) examined the posting activity following the celebrity suicides, studied the effect of celebrity suicides on suiciderelated contents, and proposed a method to prevent the high-profile suicides.

Many pieces of research (Huang, et al., 2014), (Huang, et al., 2015) work on detecting suicidal ideation in Chinese microblogs. Guan et al. (2015) studied user profile and linguistic features for estimating suicide probability in Chinese microblogs. There also remains some work using other platforms for suicidal ideation detection. For example, Cash et al. (2013) conducted a study on adolescents' comments and content analysis on MySpace. Steaming data provides a good source for user pattern analysis.

Vioul`es et al. (2018) conducted user-centric and post-centric behavior analysis and applied a martingale framework to detect sudden emotional changes in the Twitter data stream for monitoring suicide warning signs. Ren et al. (2016) use the blog stream collected from public blog articles written by suicide victims to study the accumulated emotional information.

4. SUMMARY AND CONCLUSION

Applications of suicidal ideation detection mainly consist of four domains, i.e., questionnaires, electronic health records, suicide notes, and online user content. Table II gives a summary of categories, data sources, and methods. Among these four main domains, questionnaires and EHRs require self-report measurement or patient-clinician interactions and rely highly on social workers or mental health professions. Suicide notes have a limitation on immediate prevention, as many suicide attempters commit suicide in a short time after they write suicide notes. However, they provide a good source for content analysis and the study of suicide factors. The last online user content domain is one of the most promising ways of early warning and suicide prevention when empowered with machine learning techniques. With the rapid development of digital technology, usergenerated content will play a more important role in suicidal ideation detection. Other forms of data, such as health data generated by wearable devices, can be very likely to help with suicide risk monitoring in the future. TABLE I: Summary of studies on suicidal ideation detection from the views of intervention categories, data and methods

Table I: Summary of studies on suicidal ideation detection from the views of intervention categories, data and methods

Categories	self-report examination (Venek V. , Scherer, Morency, Rizzo, & Pestian, 2017) face-to-face suicide prevention (Scherer, Pestian, & Morency, 2013) automatic SID 2.3.2, 2.3.3, 2.3.4
Data	questionnaires 2.3.1 suicide notes 2.3.3 suicide blogs 2.3.3 electronic health records 2.3.2 online social texts 2.3.4
Methods	clinical methods (Sikander, et al., 2016), (Just, et al., 2017), (Jiang, Wang, Sun, Song, & Sun, 2015) mobile applications (Tighe, et al., 2017) content analysis 2.2.1 feature engineering 2.2.2 deep learning 2.2.3
Critical issue	suicide factors (Hinduja & Patchin, 2010), (Joo, Hwang, & Gallo, 2016), (Vioulès, Moulahi, Azé, & Bringay, 2018), (C, Nock, & K, 2014) ethics (Andrade, de Pawson, Muriello, Donahue, & Guadagno, 2018), (McKernan, Clayton, & Walsh, 2018), (Linthicum, Schafer, & Ribeiro, 2019) privacy (Andrade, de Pawson, Muriello, Donahue, & Guadagno, 2018)

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Eradication of Violence and Terrorism at Universities With Reference to Islamic and International Law Perspectives

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ABSTRACTS

By this conference paper which titled "Eradication of violence and terrorism with reference to Islamic Education perspective" the research will intent to discuss: definition of terrorism, highlighting its type providing the legal framework that governing terrorism, explaining the characteristics of university student terrorism, the role of Islam to specify the lawful and unlawful terrorism and setting some strategies formulated by specialist in Islamic education to combat and eradicate domestic or international terrorism in Nigeria universities.

Keywords: Eradication, Violence, Terrorism, Universities, Islamic and International Law Perspectives

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PREAMBLE

This paper will examine the terrorist as prohibited threats exposes it's types, including strategies stated by scholars in the field of education on how to control terrorism either nationally or internationally.

1. DEFINITION OF TERRORISM ITS TYPES-

According to Garner who define terrorism and classified into three types-(1)

- **Terrorism**: defined as the use of threat of violence to intimidate.(2)
- **Cyber terrorism:** defined as terrorism committed by using a computer to make unlawful attacks and threat of attack against computers, networks and electronically stored information and actually causing the target to fear or experience to harm.(3)

(1) Bryan A. Garner: Black Law Dictionary, eight edition, Thomson, West (1990) ppi 1512-3
(2) Garner: (bid) p. 1513.
(3) Garner: (bid) p. 1513.

- **Domestic terrorism**: defined as terrorism that occurs primarily within the territorial jurisdiction.[4] it also defined as: terrorism that is carried out against one's own government of fellow citizen.[5]
- **International terrorism**: defined as terrorism that occurs primarily outside the territorial jurisdiction of United State, or that transcends national boundaries by the means in which it is carried out, the people it is attended to intimidate, or the place where the perpetrators operate or seek asylum.[6]

2.THE LEGAL FRAMEWORK OF INTERNATIONAL AND DOMESTIC TERRORISM

There are various national criminal acts prohibiting and stating penalties on acts assume terrorist, Nigeria Saudi Arabia, Britain, Canada, France, Sudan, Malaysia, Germany and most of global countries formulating domestic criminal laws for combating terrorism. Moreover, United Nations testifying various international conventions and treaties to combat international terrorism in particular convention for protection internationally protected persons, convention for protection maritime navigation, treaty for protection acts against highjacking air planes, treaty for combating financing terrorist organization. Every convention or treaty including definition to international terrorism. Let me provide some quotations to those definitions in this regard:

2.1 International convention for the suppression of the financing of terrorism, 1999

This convention provide definition of terrorism according to article 2 as follows:
(1) Any person commits an offence within the meaning of this Convention if that person by any means, directly or indirectly, unlawfully and willfully, provides or collects funds with the intention that they should be used or in the knowledge that they are to be used, in full or in part, in order to carry out:

a. An act which constitutes an offence within the scope of and as defined in one of the treaties listed in the annex; or
b. Any other act intended to cause death or serious bodily injury to a civilian, or to any other person not taking an active part in the hostilities in a situation of armed conflict, when the purpose of such act, by its nature or context, is to intimidate a population, or to compel a government or an international organization to do or to abstain from doing any act.

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(4) Bryan A. Garner: Black Law Dictionary, eight edition, Thomson, West (1990) ppi 1512-3
(5) Garner: (bid) p. 1513.
(6) Garner: (bid) p. 1513.

2.2 Convention on offences and certain other acts committed on board aircraft signed at Tokyo, on 14th September, 1963 (Tokyo Convention)

According to article 1 providing the definition of international terrorism against aircraft to be read as follows: This convention shall apply in respect of offences committed or acts done by a person on board any aircraft registered in a contracting state, while that aircraft is in flight or on the surface of the high seas or of any other area outside the territory of any state. For the purposes of this convention, an aircraft is considered to be in flight from the moment when power is applied for the purpose of take-off until the moment when the landing run ends. This convention shall not apply to aircraft used in military, customs or police services.

2.3 Convention for the suppression of unlawful seizure of aircraft signed at the Hague, of 16 December 1970 (The Hague Convention 1970)

According to article 1 providing the definition of unlawful seizure of aircraft to be read as follows:

- Any person who on board an aircraft in flight:
- Unlawfully, by force or threat thereof, or by any other form of intimidation, seizes, or exercises control of, that aircraft, or attempts to perform any such act, or is an accomplice of a person who performs or attempts to perform any such act commits an offence.

2.4 Convention on the prevention and punishment of crimes against international protected persons, 1973

According to article 2 providing the definition of attacking against internationally protected persons to be read as follows:

- The intentional commission of: a murder, kidnapping or other attack upon the person or liberty of accommodation or the means of transport of an internationally protected person likely to endanger his person or liberty; a threat to commit any such attack; an attempt to commit any such attack; and an act constituting participation as an accomplice in any such attack shall be made by each state party a crime under its internal law.

2.5 International convention against the taking of hostages signed at new York on 18 December 1979

According to article 1 providing the definition of unlawful taking of hostages to be read as follows:

- Any person who seizes or detains and threatens to kill, to injure or to continues to detain another person (hereinafter referred to as the "hostage") in order to compel a third party, namely, a state, an international intergovernmental organization, a natural or juridical person, or a group of persons, to do or abstain from doing any act as an explicit or implicit condition for the release of the hostage commits the offence of taking of hostages ("hostage-taking") within the meaning of this convention.

2.6 Convention for the suppression of unlawful acts against the safety maritime navigation signed at Rome, 10 March 1988

According to article 3 providing the definition of unlawful acts against the safety maritime to be read as follows:

Any person commits an offence if that person unlawfully and intentionally: Seizes or exercise control over a ship by force or threat thereof or any other form of intimidation; or performs an act of violence against a person on board a ship if that act is likely to endanger the safe navigation of that ship; or destroys a ship or causes damage to a ship or to its cargo which is likely to endanger the safe navigation of that ship; or places or causes to be placed on a ship, by any means whatsoever, a device or substance which is likely to destroy that ship, or cause damage to that ship or its cargo which endangers or is likely to endanger the safe navigation of that ship; or destroys or seriously damages maritime navigational facilities or seriously interferes with their operation.

2.7 International convention for the suppression of terrorist bombings (New York: 12 JANUARY 1998)

According to article 2 providing the definition of bombing as terrorist acts to be read as follows:

Any person commits an offence within the meaning of this convention if that person unlawfully and intentionally delivers, places, discharges or detonates an explosive or other lethal device in, into or against a place of public use, a stage or government facility, a public transportation system or an infrastructure facility;

- With the intent to cause death or serious bodily injury; or with the intent to cause extensive destruction of such place, facility or system, where such destruction results in or is likely to result in major economic loss.
- Any person also commits an offence if that person attempts to commit an offence as set forth in paragraph 1 of the present article.
- Any person also commits an offence if that person: participates as an accomplice in an offence as set forth in paragraph 1 or 2 of the present article; or organizes or directs others to commit an offence as set forth in paragraph 1 or 2 of the present article; or in any other way contributes to the commission of one or more offences asset forth in paragraph 1 or 2 of the present article by a group of persons acting with a common purpose; such contribution shall be intentional and either be made with the aim of furthering the general criminal activity or purpose of the group or be made in the knowledge of the intention of the group to commit the offence or offences concerned.

3.0 EFFECTS OF TURORISM IN NIGERIA UNIVERSITIES ACCORDING TO SPECIALIST IN THE FIELD OF ISLAMIC EDUCATION:

Terrorism causing very fatal dangerous consequences such as follows:(7)

1. Clashes:

   Clashes are the common terrorism in Nigerian University. different political parties clash with each other on different minor reasons like on hoisting flag. chalking, banners and on sitting places etc.

2. **Bomb Blast:**
   Bomb blast is a serious major act of terrorism in Nigerian Universities. It is an unbearable action in any education institution. Nigerian Universities has to face these disguising attacks. It becomes the causes of injury of different student.
3. **Threatening Teachers:**
   Threatening teachers is an openly terrorism in Universities of Nigeria. students have links with different political parties to threat teachers on different situations and conditions like short of attendance and illegal way to sit in examination hall.
4. **Cancellation Of Interruption During Teaching Learning Process:**
   Classes are also going on in Nigerian Universities. Due to different events of political and religious parties like rallies, clashes, protests and conflicts become the reason for classes cancel. Students who are ambitious and willing to get education in some Universities of Nigeria suffer a lot. It is an example of terrorism because these political parties want massive crowd of students in their events. For that purpose they do not feel ashamed to cancel classes.
5. **Paper Postponement:**
   Paper postpone is also a kind of terrorism in some Universities of Nigeria. Students prepare their mind for paper but different streeful elements become a reason to postpone papers.
6. **Stress on Students:**
   In University of Nigeria terrorism is present in shape of stress on students as well. Student have to attend different events of parties unwillingly. Their way of conversation capture students and invite them to join their parties.
7. **Cheating:**
   Cheating is another source of terrorism in some Universities of Nigeria. It snatches the right of studious students who really struggle to achieve education. Students have to face this act in some Universities of Nigeria.
8. **Favoritism:**
   Favoritism between students is terrorism in classrooms of in some Universities of Nigeria. It comes from teacher side. It creates differentiation among students. It effects psychologically on students performance during studies. Like if a teacher has any sort of favor with any political party he/she gives priority to them.
9. **Chalking:**
   Chalking on different walls, paths, classes, stairs are terrorism as well. It creates religious, linguistics and caste differences between students. It develops anger which shown by terrorism.

4.0 SUGGESTED STRATEGIES BY SPECIALIST IN ISLAMIC EDUCATION.

The following strategies and recommended by educationalist[8]

1. Students should be drawn away from the act of terrorism.
2. Education should build a strong foundation of students.
3. Counseling should be provided to students.
4. Motivation should be created by teachers to enhance a positive attitude.
5. Justice in behavior, attitude academic activities should be to all students.
6. Psychological satisfaction should be providing to students.
7. Frustration should be decreased due to fulfillment of their rights.
8. Solution should be given to students according to their problems.
9. Discrimination should not be done with the students.
10. Administration should play its role strictly to stop terrorism.
11. Healthy co-curricular activities should be arranged by University.
12. Learning and to get education should be the main purpose of students only in the university.
13. Stratification should not be developed among students.
14. Students and teachers should obey rules and regulations of university.
15. Different political groups should be stay away from the university.
16. Students and teacher should have a strong relationship.

5.0 THE ROLE OF SHARIAH LAW FOR ERADICATION OF TERRORISM

5.1 DEFINITION OF TERRORISM IN ISLAMIC JURISPRUDENCE

It derived, from the Arabic word: rahab which means: to threat [9]

- The noun is “Rahbatan or irhab” or terrorism.
- Technically defines as: terrorist is one who causes fear and threats to other for acquiring political dimensions[10]

<u>Tpes of terrorist according to Islamic shariah law:</u>

There are three types stated in Islamic jurisprudence.[11]

- The first type: When the terrorists having no reasonable or rational justification they will be adapted as criminal and arm robbers
- The second type: Those who abuse the companions of the holy prophet they adapted as political deserters or Bughat”.

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(7) See Act no (18) of United States Criminal Act section 2331.
(8) Garner: (bid) p. 1513.
(9) See Act no (18) of United States Criminal Act section 2331.
(10) Rizwana Muneer(2012):To study the role of education to over come terrorism in Univeristy of Karachi published Interdisciplinary journal of contemporary research in business pp 439-461
(11) Rizwana Muneer (ibid)pp459

- The third type: Those who organize demonstrations and disobedience using their opinion on reasonable rational justification these also adapted as"Bughat" or political opposition leaders.
- The first type: When the terrorist having no reasonable or rational justification they will be adapted as criminal and arm robbers
- The second type: Those who abuse the companions of the holy prophet they adapted as political deserters or Bughat".
- The fourth types: Those mobilize, enlist persons by recruiting them to attempt over throw the administrative existing system of the government for a acquiring political ends or achievement, they are adapted as criminal and terrorist.

6.0 DISCRIPTIONS OF TERRORISM ACCORDING TO TEXT OF HOLY QURAN AND SUNNAH:

With referencing to Quranic and sunnah text they state three descriptions to terrorist acts such as follow:

6.1THE FIRST IS AN IDEAL TERRORISM: is Ismamically recommended for the political existing system, the implication is that the state government should be very powerful economically, deplomaterically, with very strong combatant military forces. It's the desirable power which required in whole Muslim states and that described in Holy Quran when the Almighty Gods says: (12)

SURAH AND AL-ANFAL
"Against them make ready yours strength to the utomost of your power, including steeds of war, to strike terror into (the hearts of) the enemies, and others besides, whom ye may not know, but whom Allah doth know. Whatever ye shall spend in the causes of Allah, shall be rapid unto you, and ye shall not be treated unjustly"

6.2 The second terrorism: The fear from Al-might God, we should observe the Al-mighty and fear him in all our behavior, worshiping and dealing with others, it is the type of fear which mentioned in various Holy Quran chapters such as: verse No (12) of Anfal, (40) of Baggaret, (90) of Anbiya (32) of Qassas,

6.3 The Third type of terrorists,: Is the one which prohibited and it described and codified as an offense. And stated in verse No (18) of surat Al-kaf.

With reference to Sunnah: There are various sunnah, text narrated by, Muslim, Nasai, ibn maja, Abadawod and Aldarimi implying the fair of Al- mighty God.(13)

(12) Verse No (60) The Holy Quran, Text translation and commentary by Abdullahi yousif Ali, Amama corporation Brentawood Mary Land (1989).
(13) D.A.Y, Winsik (1943): Al-murajam Al-mufahrasli Al-fath Al-Hadith Al-Nabawi, published by Breel laden, p.212.

7.0 CONDIFICATION OF CRIMINAL LAWS AND PARTICIPATION TO ADOPT INTERNATIONAL AND REGIONAL CONVENTIONS TO FIGHT AGAINST TERRORISM

The federal government may required to sign multi literal and bilateral treaties and initiate judicial principals to fight against terrorism.
The judiciary in the federal republic of Nigeria with collaboration with the attorney General, police and Army could initiate the following principles to fight against terrorism: (14)

- Creating a judicial framework that allows substantial international co-operation among judicial authorities;
- Increasing signatures and ratifications of relevant instrument s and encouraging members states to reconsider existing reservation.
- Reinforcing various forms of mutual co-operation in the criminal field.

  - Stepping up the fight against money laundering in the criminal field;
  - Security just compensation for victims of terrorism.
  - Building on the fundamental principle that it is both possible and necessary to fight terrorism while respecting human right, fundamental freedoms and the rule of law.
  - Exploring ways to reduce tensions existing in contemporary societies.
  - Promoting inter-cultural and inter-religious dialogue .
  - Carrying out activities in the fields of education, youth and the media.
  - Ensuring the protection of monitories.
  - Prevent terrorism by measures taken at national level and through international co-operation.
  - Establish as criminal offences acts, such as public provocation, recruitment and training, that may lead to the commission of acts of terrorism.
  - In order to prevent and combat money laundering and the financing of terrorism more effectively, the convention facilitates interalia extradition and matual assistance arrangement.
  - Ensure the protection and compensation of victims of terrorism.
  - Rapid tracing of property or bank accounts and the rapid freezing of funds.
  - Quick access to financial information or information on assets held by criminal organization.
  - Setting-up of financial intelligence units in each party to exchange information on suspected cases of money laundering and terrorist financing in order ultimately to confiscate assets.
  - Special investigation techniques
  - Protection of witness and collaborators of justice
  - International co-operation on law enforcement.
  - Assessment of the effectiveness of national judicial systems in their response to terrorism.

(14) Action against terrorism expert PDF Editor trial

8. CONCLUSION

Islam as religion containing various principles and directives to determine human rights, obligations and right of rulers and ruled, illustrating classification of lawful and unlawful threat or terrorism and codified just and reasonable criminal law with efficient provisions governing the whole criminals.

Hence, the paper suggesting measures to authorize both of political and educational leaders to initiate policies and strategies to suppress terrorism.

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