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A STUDY ON ANTIBACTERIAL ACTIVITIES OF *ALOE VERA* LEAVES, STEMS AND ROOTS ON SOME SELECTED ORGANISMS

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ABSTRACT

This study is provoked by the paucity of information on the antibacterial or pharmacological activities of *Aloe vera* stems and roots. The antibacterial activity of *Aloe vera* leaf, stem and root extracts on three organisms (*Pseudomonas aeruginosa, Salmonella typhi* and *Proteus mirabilis)* was investigated using agar well diffusion method. The *Aloe vera* leaf extract proved to be most effective. Both *Aloe vera* leaf Cold Water Extract (CWE) and Ethanol Crude Extract (ECE) demonstrated significant antibacterial activity against the sampled organisms. CWE of *Aloe vera* stem showed no antibacterial activity in the bacterial species while ECE had antibacterial activity on *Pseudomonas aeruginosa* and *Proteus mirabilis.* The root CWE and ECE only exhibited antibacterial activity on *Proteus mirabilis*. The stems had no antibacterial activity on *Salmonella typhi* and *Pseudomonas aeruginosa*. The extract with the highest antibacterial properties was ECE of *Aloe vera* roots. There is therefore a need for the inclusion of *Aloe vera* roots in *Aloe vera* antibacterial efficacy studies.

INTRODUCTION

The use of herbs and medicinal plants is a universal phenomenon. Every culture on earth has relied on the huge variety of natural chemistry found in healing plants for their therapeutic properties. Modern medicines have always depended on

herbal remedies for plants as fundamental sources of therapeutic ingredients Etusim (2005).

Aloe vera is one of the oldest healing plants known to man. It is as old as civilization and throughout history it has been used as a popular folk medicine. *Aloe vera* is an ornamental and medicinal plant from a member of liliaceous family. The name was derived from the Arabic '*alloeh*' meaning '*bitter*' because of bitter liquid found in the leaves. It is also known as 'lily of the desert' the plant of immortality and the medicine plant with qualities to serve as alternate medicine Nduka (2003).

Aloe vera is essential with components that are bactericidal such include: saponins, anthraquinones etc. A synergistic action of these components provides a bactericidal effect. Examinations testing various percentage of *Aloe vera* solutions against tissue cultures of four pathogens-*Pseudomonas aerigonosa, Escherichia coli, Proteus mirabilis* and *Salmonella typhi. Pseudomonas aeruginosa* are present in a number of secondary urinary treat infections in men. *E. coli* is a potent bacterium common to the rectal cavity of every living mammal. *Proteus mirabilis* is also common cause of urinary infection in the elderly and young males and *Salmonella typhi* causes illness such as typhoid fever, paratyphoid fever and food borne illness (Ryan and Rayca, 2004). It was noted that all the microorganisms were killed within 24hours of exposure to high levels of Aloe vera (Bruce, 1967)

This work is aimed at:

1. Comparing antibacterial effects of different *Aloe vera* parts on the three bacterial species.
2. Comparing the effects of Ethanol Crude Extract (ECE) and Water Crude Extract (WCE) on the three bacterial species (*Pseudomonas aeruginosa, Salmonella typhi* and *Proteus mirabilis).*

MATERIALS AND METHODS

The present study was designed to evaluate antibacterial activity of *Aloe vera* by using its leaf, stem and root extracts. The study was performed at the Centre for Tropical Disease Research Laboratory, Abia State University Uturu.

Collection of Plant Material

The *Aloe vera* plant used in this work was obtained from Root Crop Research Institute Umuahia Abia state. Its identification was confirmed by Professor Chuks

.I. Ogbonnaya (Ecotaxonomist) from the Department of Plant Science Biotechnology, Abia State University, Uturu.

Test organisms

The test organisms used in this work were *Pseudomonas aeruginosa, Proteus mirabilis* and *Salmonella typi*. The organisms were gotten from the Microbiology Laboratory Abia State University, Uturu. The identified bacteria species were confirmed by Dr. (Mrs.) Nkechi Nwachukwu (Microbiologist) from the Department of Microbiology, Abia State University Uturu.

Culture Media

The culture media used was Muller Hinton Agar. It was manufactured by LS Biotech Company Santiago, USA. This media was prepared on the producer's instruction printed on the container. Specific weight of the powder was obtained in conical flask and reconstituted using specific volumes of distilled water. The conical flasks were properly stopped with cotton wool wrapped in aluminum foil. The flask was then autoclaved to sterilize at 121^0C for 15mins. It was then allowed to cool to about $45\text{-}50^0$ before dispensing into the sterilized Petri-dish and left to gel on the flat surface. The Petri-dish was left overnight in the incubator before use for sterility.

PROCESSING OF PLANT MATERIAL

The *Aloe vera* leaves, stems and roots were washed with distilled water. After washing, each part was cut to pieces using a sterile knife and was allowed to dry at 105^0c for 4hrs in a hot air oven. The dried material was finally grinded using the method adopted by Arunkunar and Muthuselvam 2009.

EXTRACTION OF CRUDE EXTRACTS

ECW and WCE were prepared using the method adopted by Irshad *et al.,* (2003).

SENSITIVITY TESTING USING ALOE VERA CRUDE EXTRACTS.

The antibacterial activity of *Aloe vera* leaves, stems, and roots extracts was tested using Agar well diffusion technique as described by Agarry *et al.,* (2005). Wells of 5mm diameter were cut on sterile Mueller Hinton agar plates using a cork borer and swabbed with an overnight broth culture of the organism. About 0.1ml of the CWE and ECE of *Aloe vera* leaves, stems, and roots were filled into each of the wells and incubated at 37^oc. Antibacterial activity in terms of zone of inhibition

(mm) was observed and recorded after 24hrs of incubation using the method adopted by Lawrence *et al* (2009).

RESULTS

The antibacterial property of *Aloe vera* leaves, stems and roots extracted using different solvents showed varying degree of response towards the selected pathogen.The zone of inhibition on *Aloe vera* leaf extracts ranged from 14.5mm – 17.5mm being maximum for *Proteus mirabilis* and minimum for *Pseudomonas aeruginosa*. CWE have proved the highest inhibition with *S. tyhpi.* It read 16mm and 16.5mm inhibition for *P. aeruginosa* and *P. mirabilis* respectively. See Table 1.

The maximum inhibition was observed with *Aloe vera* stem (17mm) for *Pseudomonas aeruginosa* using ECE, followed by *Proteus mirabilis* (16mm). No response was observed in ECE for *Salmonella typhi.* CWE has no inhibition. See Table 2. With *Aloe vera* roots, the maximum inhibition was observed in ECE and CWE for *Proteus mirabilis* (21.5mm) (19.5mm) respectively. No response was observed in CWE and ECE for *Salmonella typhi* and *Pseudomonas aeruginosa*. See Table 3.

Table 1: Results for *Aloe vera* Leaf Extracts showing Measurement of zone of inhibition

ORGANISMS	COLD WATER	ETHANOL
Salmonella typi	17mm	16.5mm
Pseudomonas aeruginosa	16mm	14.5mm
Proteus mirabilis	16.5mm	17.5mm

Table 2: Results for *Aloe vera* Stem Extracts Showing Measurement of Zone of Inhibition.

ORGANISMS	COLD WATER	ETHANOL
Salmonella typi	____	____
Pseudomonas aeruginosa	____	17mm
Proteus mirabilis	____	16mm

Table 3: Results for *Aloe vera* Root Extracts Showing Measurement of Zone of Inhibition.

ORGANISMS	COLD WATER	ETHANOL
Salmonella typi	____	____
Pseudomonas aeruginosa	____	____
Proteus mirabilis	19.5mm	21.5mm

DISCUSSION

The present study was undertaken to assay the antibacterial activity of *Aloe vera* leaves, stems and root. The antibacterial activity recorded in this work agrees with the observation of Boudreau and Beland (2006), who observed high antibacterial activities on the ECE on *Aloe vera* leaf. It was used against some human pathogenic bacteria: *Pseudomonas aeruginosa*, *Salmonella typhi*, and *Proteus mirabilis* with two different solvents: CWE and ECE. ECE was most effective than CWE of *Aloe vera* leaves, stems and roots as shown in Table 1. This agrees with the observation of Ahmed *et al.,* (1998) who noted that alcohol extract were better solvents for extraction of anti-microbially active substances compared to water and hexane. Thiruppathi *et al.,* (2010) reported that ethanol exhibited maximum antibacterial activity against all bacterial pathogens used in their work. Similarly, Lawrence *et al.,* (2009) reported that nearly all of the identified components from plants active against micro-organisms are most often obtained through initial ethanol and methanol extraction. This could explain higher antimicrobial activity of ECE observed in this work.

The study also showed that *Aloe vera* leaf extracts has antibacterial activity on *Salmonella typhi*, *Pseudomonas aeruginosa* and *Proteus mirabilis*, stem extracts on ECE of both *Pseudomonas aeruginosa* and *Proteus mirabilis* and root extracts on CWE and ECE of *Proteus mirabilis*. But there was no effect on CWE and ECE of *salmonella typhi* and CWC of both *Pseudomonas aeruginosa* and *Proteus mirabilis* on *Aloe vera* stem and CWE and ECE on *Salmonella typhi* and *Pseudomonas aeruginosa* on *Aloe vera* root. This agrees with the report of Freeman and Mizett (1979) and Prescot *et al.,* (2000) that not all organisms are inhibited at the same rate.

Again, *Proteus miralibis* is most susceptible than the other organisms, this proves that *Proteus mirabilis* infections usually respond better to antimicrobial therapy than those caused by other related organisms. This confirmed that the plant extracts could be used for the treatment of various infections including urinary

infections, Abdominal and wound infections, ulcers, pressure sores, burns, damaged tissues, septicemia and occasionally meningitis and chest infections as these are the common cause of *Proteus Mirabilis* (Chessbrough 2000). Among the three *Aloe vera* parts used, *Aloe vera* leaf of both ECE and CWE were inhibited on the growth of the three organisms. This agrees with the work of Arunkumar and Muthuselvam (2009) and that of Kedarnath *et al.,* (2012).

While there is paucity of information on the roots and stems of crude extracts of *Aloe vera*, the observation of no inhibition on *Salmonella typhi* by both ECE and CWE from root and stem is remarkable. However water extract of stem which showed no inhibition in *Pseudomonas aeruginosa* and *Proteus mirabilis* turned out to give 17mm and 16mm inhibition respectively with ECE. Again the high inhibition exhibited on *Proteus mirabilis* showed that the roots and stem of *Aloe vera* as well contain potent antibacterial properties. This finding however, may contribute to further research on screening other antibacterial components in *Aloe vera* stems and roots and provide a basis for application of *Aloe vera* stems and roots in treatment of infective diseases.

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