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The Antibacterial Action of Moringa Olelfera on Some Wound and Enteric Pathogens

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ABSTRACT
The antibacterial action of aqueous and ethanol extracts of fresh and dried leaves and seeds of Moringa Oleifera against staphylococcus aureus, streptococcus pyogenes, Escherichia coli, pseudomonas aeruginosa and salmonella typhi isolated from wound infection sites and gastrointestinal tract was evaluated using Agar-gel diffusion by punch method. The minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MCB) of the extracts were also evaluated. Results obtained showed that dried moringa seed ethanol extract manifested the best inhibitory zones ranging from 10-38mm compared with the 14-20mm produced by fresh Moringa Oleifera seed ethanol extract. There was no resistance from any of the test bacteria at the concentration of 500m/ml. It was also observed that both the aqueous and the ethanol extract of Moringa Oleifera exhibited appreciable level of inhibition against the test bacteria though the aqueous extracts were not as effective as the ethanolic extracts.
Keywords: *Pathogen, Wound, Infection, Bacteria, Moringa Oleifera*

INTRODUCTION

Traditional medicine is widespread throughout the world and it can simply be described as the total combination of knowledge and practices, whether explicable or not, used in diagnosing, preventing or eliminating a physical, mental, or social diseases and which may rely exclusively on past experience and observation handed down from generation, verbally or written[1]. The practice of traditional medicine depends exclusively on roots, stems, barks, leaves, flowers, fruits, etc. of the medicinal plants which the World Health Organization (WHO) consultative group has defined as plants whose organs or parts contain substances that can be used for therapeutic purpose, or which are precursors for the synthesis of useful drugs[2]. These medicinal plants, unlike in the orthodox medicine, are eaten raw or even prepared as food[3].

As a matter of fact, one of the medicinal plants that has enjoyed wide use in folk medicine is Moringa Oleifera, which is native to the Western Asia-Minor, Africa and Arabia[4,5]. The moringa tree is cultivated and used as vegetable (leaves,

green pods, flowers, roasted seeds), for spice (mainly roots), for cooking and cosmetic oil (seeds), and as medicinal plant[6].

The plant has a high nutritional value and contains carbohydrates, fats, proteins, and the leaves are rich in vitamins A, B, and C, and minerals[7]. Feeding the high protein leaves of Moringa Oleifera to cattle has been shown to increase weight gain by up to 32% and milk production by 43 to 65%, and the seed contains 30 to 40% oil that is high in Oleic acid[8]. These nutritional, and or chemical components of Moringa Oleifera (M. Oleifera) have enormous medical potentials (being disease-preventive, therapeutic or remedial) which have been long recognized[5]. Even the Indian ancient tradition of Ayurveda believes that the leaves of the Moringa tree prevent about three hundred (300) diseases[9], and nearly every part of the plant including the root, bark, gum, leaf, fruit (pods), flowers, seed, have been used for various ailments in the indigenous medicine [10].

The Moringa Oleifera plant as generally believed, provides a rich and rare combination of zeatin, quercetin, kaempferom and many other phytochemicals, which are very important for its medicinal values in possessing anti-inflammatory, anti-asthmatic and analgesic properties[11], which are largely essential for the therapeutic management of wound infections which occur when bacteria enter a break in the skin. This wound infect is a complication of a wound process arising from the reproduction of pathogenic microorganisms in a wound. These pathogenic microorganisms could be described as normal flora bacteria, such as species of staphylococcus and streptococcus. However, brackish water from wound infections may be due to water-borne vibrio or aeromonas species, while hot tub-associated infections may be caused by pseudomonas aeruginosa. But when wounds are deeper, the possible pathogens would include anaerobes such as bacteroids and clostridium species[12].

Generally, a wound infection can manifest itself by local symptoms, such as suppuration, or by general symptoms, such as fever, dizziness or a fast heart beat, foul odour coming from the wound, blood or purse oozing from the wound or red, swollen and painful site on the body. In all, there are many factors that increase the risk of wound infections, and they include diabetes, cancer, kidney and liver diseases that slow healing. Others include poor blood supply to the wound (due to blocked or narrowed blood vessels), repeated trauma (as injury to a healing wound may increase the risk of infection and delay healing) and weak immune system (which may be weakened by radiation, poor nutrition or certain drugs). Apart from observations, the most common way by which wound infection can be diagnosed in this part of the world is by imaging tests such as x-ray, computerized axial tomography (CT) scan, or magnetic resonance imaging (MRI) which take pictures of tissues in the wound area. Such tests help the care-giver to check if there are foreign objects in the wound [12]. Wound culture can also be carried out, in which fluid or tissue debris is taken from the wound and analyzed in the laboratory for results meant to reveal the particular pathogens (mainly bacteria) present in the wound. But it is most unfortunate that more often, than not, these pathogens have shown resistance to the commonly available drugs used to eradicate them. Efforts are therefore being geared towards the discovery and production of potent and efficacious drugs or substances which could be herbal or natural products, that could be used to manage such wound infections to bring about quick and effective healing. So, considering the medicinal (Phyotochemical) properties of Moringa Oleifera, there is a need to evaluate the antibacterial action of the plant products on enteric and wound infection pathogens with a view to ascertaining the efficacity of certain of the Moringa Oleifera, plant products to eradicate such pathogens.

MATERIALS AND METHOD

The fresh leaves and seeds of Moringa Oleifera were procured and subjected to desiccation process at room temperature for two weeks and then ground into powdered form. They were

thereafter stored separately in air-tight plastic containers and labeled accordingly in readiness for the experiment. Another collection of fresh leaves and seeds were also ground (without drying) and also preserved for use in the experiment.

The extraction process was achieved using 98% ethanol and distilled water as extracting solvents. Then fifty grammes (50g) each of the ground fresh and dried Moringa Oleifera plant parts were respectively dissolved in 500mls of the extracting solvents in one-litre capacity conical flasks, stoppered, and kept for ten days with intermittent shaking. The resultant mixtures were then filtered and the ethanol extracts were concentrated at 40^0C under reduced pressure using rotary evaporator. The distilled water (aqueous) extracts were on the other hand, concentrated in hot oven at 40^0C. The concentrated extracts were then collected in sterile screw. capped bottles and labeled: FMSE (fresh moringa seed ethanol extract), DMSE (dried moringa seed ethanol extract), FMLE (fresh moringa leaf ethanol extract), DMLE (dried moringa leaf ethanol extract), FMSDW (fresh moringa seed distilled water extract), DMSDW (dried moringa seed distilled water extract), FMLDW (fresh moringa leaf distilled water extract), and DMLDW (dried moringa leaf distilled water extract). This was followed by a cautious hunt for bacteria which were gotten and isolated from wound swabs obtained from accident and maternity wards of Abia State University Teaching Hospital, Aba, Nigeria, following the approval of the medical and ethical committee of the hospital. Salmonella typhi were isolated from stool samples. So among the bacteria isolated were streptococcus pyogenes, staphylococcus aureus, pseudomonas aeruginosa, salmonella typhi and Escherichia coli. Pure culture of isolates were then maintained in appropriate media for experimental purposes. The antibacterial assay was then done using the agar-gel diffusion technique as described by Osadebe and Ukwueze[13], in which broth culture of the test isolates (0.1ml) was inoculated by spreading evenly onto the surface of nutrient Agar (NA) plates using a sterile bent glass rod. Seven wells (5.0mm diameter) were then made in the plates using a sterile cork borer. The 5^{th} and 6^{th} wells served as negative control, while the 7^{th} well served as positive control. Sterile distilled water and ethanol were used as negative control, while ciprofloxacin was used as positive control. Then double dilution of the extracts was done to get the various concentration (500mg/ml, 250mg/ml, 125mg/ml, and 63mg/ml) used for the antibacterial assay. Fixed volumes (0.1ml) of the four different concentrations of the extracts were transferred into wells 1- 4 using a sterile pastuer pipette. The control wells were then filled with 0.1ml of distilled water, ethanol and ciprofloxacin respectively, and the plates were left on the bench for 40 minutes for pre-diffusion of the extracts and then incubated at 37^0C for 24 hours. Antibacterial activity of the extracts was determined by measurement of the resulting zone diameters of inhibition (mm) against each test bacterium using a ruler. The experiment was done in triplicates and the mean values of the results were taken as antibacterial activity. The minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) of the potent extracts were then determined using the macro broth dilution techniques of Boron and Fingold[14]. Double dilution was also done here to get the four different concentrations of the extracts. Standardized suspensions of the test organisms were then inoculated into a series of sterile tubes of peptone water containing dilutions (500, 250, 125 and 63mg/ml) of seed and leaf extracts and incubated at 37^0C for 24 hours. The minimum inhibitory concentrations were then read as least concentration that inhibited any visible growth of the test organisms. For the minimum bactericidal concentration determination, a loopful of broth from each of the tubes that did not show any visible growth during minimum inhibitory concentration.

Table 1: The diameter of zone of inhibition of fresh moringa seed ethanol extract (FMSE) on the test organisms.

Test Organism	Different Concentrations Of FMSE				Controls Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	18mm	14mm	0mm	0mm	0mm	0mm	30mm
S. Pyogenes	18mm	0mm	0mm	0mm	0mm	0mm	38mm
E. coli	14mm	0mm	0mm	0mm	0mm	0mm	20mm
S. typhi	20mm	0mm	0mm	0mm	0mm	0mm	41mm
P. aeruginosa	20mm	0mm	0mm	0mm	0mm	0mm	30mm

Distilled water and ethanol = negative control
Ciproxin = positive control.

Table 2: The diameter of zone of inhibition of dried moringa seed ethanol extract (DMSE) on the test organisms.

Test Organism	DMSE Concentrations				Controls Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	38mm	14mm	0mm	0mm	0mm	0mm	40mm
S. Pyogenes	15mm	0mm	0mm	0mm	0mm	0mm	30mm
E. coli	10mm	0mm	0mm	0mm	0mm	0mm	25mm
S. typhi	10mm	0mm	0mm	0mm	0mm	0mm	40mm
P. aeruginosa	15mm	0mm	0mm	0mm	0mm	0mm	30mm

Table 3: The diameter of zone of inhibition of fresh moringa seed ethanol extract (FMLE) on the test organisms**.**

Test Organism	FMLE Concentrations				Controls Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	22mm	6mm	0mm	0mm	0mm	0mm	30mm
S. Pyogenes	18mm	0mm	0mm	0mm	0mm	0mm	30mm
E. coli	22mm	7mm	0mm	0mm	0mm	0mm	24mm
S. typhi	15mm	8mm	0mm	0mm	0mm	0mm	40mm
P. aeruginosa	16mm	10mm	0mm	0mm	0mm	0mm	29mm

Table 4: The diameter of zone of inhibition of dried moringa leaf ethanol extract (DMLE) on the test organisms**.**

Test Organism	DMLE Concentrations				Controls Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	10mm	0mm	0mm	0mm	0mm	0mm	25mm
S. Pyogenes	20mm	0mm	0mm	0mm	0mm	0mm	30mm
E. coli	12mm	0mm	0mm	0mm	0mm	0mm	30mm
S. typhi	12mm	0mm	0mm	0mm	0mm	0mm	35mm
P. aeruginosa	18mm	0mm	0mm	0mm	0mm	0mm	32mm

Table 5: The diameter of zone of inhibition of fresh moringa seed distilled water extract (FMSDW) on the test organisms.

Test Organism	FMSDW Concentrations				Controls		
					Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	0mm	0mm	0mm	0mm	0mm	0mm	20mm
S. Pyogenes	6mm	0mm	0mm	0mm	0mm	0mm	30mm
E. coli	0mm	0mm	0mm	0mm	0mm	0mm	26mm
S. typhi	10mm	0mm	0mm	0mm	0mm	0mm	35mm
P. aeruginosa	0mm	0mm	0mm	0mm	0mm	0mm	36mm

Table 6: The diameter of zone of inhibition of dried moringa seed distilled water extract (DMSDW) on the test organisms.

Test Organism	DMSDW Concentrations				Controls		
					Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S aureus	26mm	6mm	0mm	0mm	0mm	0mm	32mm
S. Pyogenes	12mm	0mm	0mm	0mm	0mm	0mm	26mm
E. coli	10mm	7mm	0mm	0mm	0mm	0mm	18mm
S. typhi	14mm	8mm	0mm	0mm	0mm	0mm	30mm
P. aeruginosa	20mm	10mm	0mm	0mm	0mm	0mm	32mm

Table 7: The diameter of zone of inhibition of fresh moringa leaf distilled water extract (FMLDW) on the test organisms.

Test Organism	FMLDW Concentrations				Controls Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	0mm	0mm	0mm	0mm	0mm	0mm	20mm
S. Pyogenes	28mm	0mm	0mm	0mm	0mm	0mm	30mm
E. coli	10mm	0mm	0mm	0mm	0mm	0mm	28mm
S. typhi	20mm	0mm	0mm	0mm	0mm	0mm	30mm
P. aeruginosa	0mm	0mm	0mm	0mm	0mm	0mm	35mm

Table 8: The diameter of zone of inhibition of fresh moringa leaf distilled water extract (DMLDW) on the test organisms.

Test Organism	DMLDW Concentrations				Controls Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	0mm	0mm	0mm	0mm	0mm	0mm	20mm
S. Pyogenes	10mm	0mm	0mm	0mm	0mm	0mm	21mm
E. coli	0mm	0mm	0mm	0mm	0mm	0mm	20mm
S. typhi	0mm	0mm	0mm	0mm	0mm	0mm	32mm
P. aeruginosa	20mm	0mm	0mm	0mm	0mm	0mm	30mm

Table 9a: The minimum inhibitory concentration (MIC) of fresh moringa seed ethanol extract (FMSE) on the test organisms.

Test Organism	FMSE Concentrations				Controls Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	-	-	+	+	+	+	-
S. Pyogenes	-	-	+	+	+	+	-
E. coli	-	-	+	+	+	+	-
S. typhi	-	-	+	+	+	+	-
P. aeruginosa	-	-	+	+	+	+	-

Table 9b: The minimum bactericidal concentration(MBC) of fresh moringa seed ethanol extract (FMSE) on the test organisms.

Test Organism	FMSE Concentrations				Controls Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	-	-	+	+	+	+	-
S. Pyogenes	-	-	+	+	+	+	-
E. coli	-	-	+	+	+	+	-
S. typhi	-	-	+	+	+	+	-
P. aeruginosa	-	-	+	+	+	+	-

Table 10a: The minimum inhibitory concentration (MIC) of dried moringa seed ethanol extract (DMSE) on the test organisms.

Test Organism	DMSE Concentrations				Controls		
					Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	-	-	+	+	+	+	-
S. Pyogenes	-	+	+	+	+	+	-
E. coli	-	+	+	+	+	+	-
S. typhi	-	+	+	+	+	+	-
P. aeruginosa	-	+	+	+	+	+	-

Table 10b: The minimum bactericidal concentration(MBC) of dried moringa seed ethanol extract (DMSE) on the test organisms.

Test Organism	DMSE Concentrations				Controls		
					Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	-	-	+	+	+	+	-
S. Pyogenes	+	+	+	+	+	+	-
E. coli	-	+	+	+	+	+	-
S. typhi	-	+	+	+	+	+	-
P. aeruginosa	+	+	+	+	+	+	-

Table 11a: The minimum inhibitory concentration(MIC) of fresh moringa leaf ethanol extract (FMLE) on the test organisms.

Test Organism	FMLE Concentrations				Controls		
					Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	-	-	+	+	+	+	-
S. Pyogenes	-	+	+	+	+	+	-
E. coli	-	-	+	+	+	+	-
S. typhi	-	-	+	+	+	+	-
P. aeruginosa	-	-	+	+	+	+	-

Table 11b: The minimum bactricidal concentration(MBC) of fresh moringa leaf ethanol extract (FMLE) on the test organisms.

Test Organism	FMLE Concentrations				Controls		
					Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S aureus	-	+	+	+	+	+	-
S. Pyogenes	+	+	+	+	+	+	-
E. coli	-	+	+	+	+	+	-
S. typhi	-	+	+	+	+	+	-
P. aeruginosa	-	+	+	+	+	+	-

Table 12a: The minimum inhibitory concentration(MIC) of dried moringa leaf ethanol extract (DMLE) on the test organisms.

Test Organism	DMLE Concentrations				Controls		
					Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	-	-	+	+	+	+	-
S. Pyogenes	-	-	+	+	+	+	-
E. coli	-	+	+	+	+	+	-
S. typhi	-	+	+	+	+	+	-
P. aeruginosa	-	+	+	+	+	+	-

Table 12b: The minimum bactericidal concentration(MBC) of dried moringa leaf ethanol extract (DMLE) on the test organisms.

Test Organism	DMLE Concentrations				Controls		
					Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	-	+	+	+	+	+	-
S. Pyogenes	-	+	+	+	+	+	-
E. coli	+	+	+	+	+	+	-
S. typhi	+	+	+	+	+	+	-
P. aeruginosa	+	+	+	+	+	+	-

Table 13a: The minimum inhibitory concentration(MIC) of fresh moringa seed distilled water extract (FMSDW) on the test organisms.

Test Organism	FMSDW Concentrations				Controls		
					Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	+	+	+	+	+	+	-
S. Pyogenes	-	+	+	+	+	+	-
E. coli	+	+	+	+	+	+	-
S. typhi	-	+	+	+	+	+	-
P. aeruginosa	+	+	+	+	+	+	-

Table 13b: The minimum bactericidal concentration(MBC) of fresh moringa seed distilled water extract (FMSDW) on the test organisms.

Test Organism	FMSDW Concentrations				Controls		
					Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	+	+	+	+	+	+	-
S. Pyogenes	+	+	+	+	+	+	-
E. coli	+	+	+	+	+	+	-
S. typhi	+	+	+	+	+	+	-
P. aeruginosa	+	+	+	+	+	+	-

Table 14a: The minimum inhibitory concentration (MBC) of dried moringa seed distilled water extract (DMSDW) on the test organisms.

Test Organism	DMSDW Concentrations				Controls		
					Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	-	+	+	+	+	+	-
S. Pyogenes	-	+	+	+	+	+	-
E. coli	-	+	+	+	+	+	-
S. typhi	-	+	+	+	+	+	-
P. aeruginosa	-	+	+	+	+	+	-

Table 14b: The minimum bactericidal concentration (MBC) of dried moringa seed distilled water extract (DMSDW) on the test organisms.

Test Organism	DMSDW Concentrations				Controls		
					Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	+	+	+	+	+	+	-
S. Pyogenes	+	+	+	+	+	+	-
E. coli	+	+	+	+	+	+	-
S. typhi	+	+	+	+	+	+	-
P. aeruginosa	+	+	+	+	+	+	-

Table 15a: The minimum inhibitory concentration(MIC) of fresh moringa leaf distilled water extract (FMLDW) on the test organisms

Test Organism	FMLDW Concentrations				Controls		
					Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	+	+	+	+	+	+	-
S. Pyogenes	-	-	+	+	+	+	-
E. coli	-	+	+	+	+	+	-
S. typhi	-	+	+	+	+	+	-
P. aeruginosa	+	+	+	+	+	+	-

Table 15b: The minimum bactericidal concentration(MBC) of fresh moringa leaf distilled water extract (FMLDW) on the test organisms

Test Organism	FMLDW Concentrations				Controls		
					Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	+	+	+	+	+	+	-
S. Pyogenes	-	+	+	+	+	+	-
E. coli	-	+	+	+	+	+	-
S. typhi	+	+	+	+	+	+	-
P. aeruginosa	+	+	+	+	+	+	-

Table 16a: The minimum inhibitory concentration(MIC) of dried moringa leaf distilled water extract (DMLDW) on the test organisms

Test Organism	DMLDW Concentrations				Controls Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	+	+	+	+	+	+	-
S. Pyogenes	-	-	+	+	+	+	-
E. coli	+	+	+	+	+	+	-
S. typhi	+	+	+	+	+	+	-
P. aeruginosa	-	+	+	+	+	+	-

Table 16b: The minimum bactericidal concentration(MBC) of dried moringa leaf distilled water extract (DMLDW) on the test organisms

Test Organism	DMLDW Concentrations				Controls Negative		Positive
	500mg/ml	250mg/ml	125mg/ml	63mg/ml	Distilled water	Ethanol	Ciproxin
S. aureus	+	+	+	+	+	+	-
S. Pyogenes	+	+	+	+	+	+	-
E. coli	+	+	+	+	+	+	-
S. typhi	+	+	+	+	+	+	-
P. aeruginosa	+	+	+	+	+	+	-

DISCUSSION

The results of the study revealed that both the aqueous and ethanol extracts of Moringa Oleifera leaves and seeds exhibited antibacterial effect against all the test organisms; though the test organisms showed different levels of sensitivity to the extracts ranging from sensitive, intermediate to resistant. The results also showed that the four ethanolic extracts (FMSE, DMSE, FMLE and DMLE) had inhibitory effect against S.aureus, B. Subtilis, E.coli, S.pyogeues, S.typhi and P. aeruginosa respectively. In all, the ethanol extracts of the seeds and leaves of the Moringa Oleifera were found to be more effective than the aqueous extracts. This may be due to the fact that the active phytochemical constituents of the plant

parts were better or more extracted with ethanol than with water, and this is in consonance with the reports of Ogunjobi and Nnadozie [15], and Ezeigeka et al[16] that there was a higher antimicrobial activities of ethanol extracts of plant parts than the aqueous extracts.

Again, when the antibacterial efficacy of fresh and dried moringa seeds was compared, it was observed that dried moringa seeds produced more inhibitory activity than the fresh seeds, and as shown in table 4, DMSE inhibited the growth of S.aureus with a zone diameter of 38mm, as against the highest zone diameter of 20mm produced by FMSE against S.typhi and P.aeruginosa respectively (see table 3). The dried moringa seeds are therefore confirmed to be more effective than the fresh seeds. This, however, may be due to the reduction in water content of the dry seeds, thereby making the antibacterial components to be more concentrated. On the other hand, a comparison drawn between the antibacterial activities of fresh and dried Moringa Oleifera leaves showed that the fresh leaf was more effective than the dried one, and so, as shown in table 5, FMLE extract inhibited the growth of S. aureus with zone diameter of 22 mm, while the highest zone diameter of inhibition produced by DMLE extract was 20mm, against S.pyogenes (table 6).

The successful inhibition of these organisms by the extracts is a welcome development especially when considering the level of multi-resistance these bacteria have developed against conventional antibiotics over the years, and this is an indication that the extracts can be used in the treatment of infectious caused by these organisms.

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