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Full Length Research Article

# ANTIMICROBIAL PATTERN OF *RICINUS COMMUNIS CRUDE* EXTRACTS ON BACTERIA ISOLATED FROM *MUSA PARASIDICA*

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**ABSTRACT**
This research was done to determine the antimicrobial activity of castor oil plant parts (seed and leaves) on spoilage microorganisms of plantain fruits and vis-a-vis standard antibiotics. Plantain fruits were subjected to spoilage for 7days.The spoilage bacteria were characterized and identified using conventional and modern methods. The organisms isolated include: *Corynabacterium* sp., *Staphylococus aureus* and *Proteus vulgaris*. Castor oil plant (*Ricinus communis*) leaf and seed were extracted using ethanol and water. The phytochemical analysis of plant extracts were also carried out. The antimicrobial activities of the ethanol and aqueous extracts were tested on the isolates at different concentrations (100mg/ml, 150mg/ml, 200mg/ml and 250mg/ml). The extracts were effective on the bacterial isolates with range of Minimum inhibitory concentration (MIC) values from 25.0mg/ml -100.0mg/ml, *Staphylococcus aureus* at 12.5mg/ml – 100mg/ml and *Proteus vulgaris* at 50mg/ml- 100mg/ml. The aqueous extracts of the leaf inhibited *Corynabacterium* sp., and *Staphylococcus aureus* but it did not inhibit *Proteus vulgaris*. *Proteus vulgaris* was also not inhibited by the aqueous seed extract, *Corynabacterium* sp. and Staphylococcus *aureus* were inhibited only at higher concentrations. Antibiotic susceptibility test showed that *Corynabacterium* sp., was inhibited more by the ethanolic seed extract than it was inhibited by Amoxicillin at the same concentration of 250mg/ml.

**Keywords:** castor oil, phytochemical, antimicrobial, susceptibility, inhibitory

**INTRODUCTION**
There is a growing demand for plant based medicines, health products, pharmaceuticals, food supplements and cosmetics (Zachariah, 2009).

The importance of herbs in the management of human ailments cannot be over emphasized (Boadu and Asase, 2017). It is obvious that the plant kingdom contains an unlimited source of potent principles which are essential in the management of many intractable diseases. Moreover, the active principles of herbal medicines have the benefit of being used together with many other substances that seem to be inactive. Nevertheless, these additional components make the entire plant to be safe and the potency better to the individual and pure active parts (Ada *et al*., 2014).

Medicinal plants generally referred to as plants in which one or more of its parts contains essential phytochemicals that may be exploited for therapeutic purposes, or such that might be used as precursors in chemo-pharmaceutical synthesis (Bentley and Trimen, 2007). The presence of these phytochemicals in plants have been found to be very beneficial to human systems as most food consumed by human often contain less quantity of these biomolecules. Moreover their consumption results in far less side effects when compare to pharmaceutical synthetic drugs (Kennedy and Wightman, 2013).

This renewal of interest in drug obtainable from plant is mainly as a result of the present extensive belief that "herbal medicine" is safe and more dependable than the expensive synthetic drugs, many of which possess unvafourable side effects. Hence, the search for new antimicrobial substances from various sources like medicinal plants. The world health Organization estimates that plant extracts or their active constituents are used as folk medicine in traditional therapies of 80 % of the world's population, over 50 % of all modern clinical drugs are of natural product origin (Erecevit and Kirbag, 2017).
Many plants possess active ingredient that have antimicrobial effect (Khan *et al*., 2011). Compounds such as emetine, berberine and quinine which are derived from plants are very effective for the infectious microbes. Drugs which in recent past had been obtained from natural resources include taxol, camptothecin (anticancerous) and artemisinin (antimalarial). These and many other drugs clearly show that plants serve the potential source of medicine even today (Mahmood and Muhammad, 2013).

An alcoholic extract of the leaf was shown, in laboratory rats, to protect the liver from damage from certain poisons (Uchendu, 2018). The extracts of the leaves of *Ricinus communis* using methanol were used in carrying out the effectiveness of its antibacterial activity against eight pathogenic bacteria in rats and showed antimicrobial properties.
The pericarp of *Ricinus communis* showed central nervous system effects in mice at low doses. At higher doses mice quickly died (Williamson, 2002). A water extract of the root, bark showed analgesic activity in rats (Williamson, 2002). Antihistamine and anti-inflammatory properties were found in ethanolic extract of *Ricinus communis* root bark (Lomash *et al.,* 2010).
Plantain is a familiar tropical fruit which originate from Southwestern Pacific, spread to India by about 600 BC and later on to all over the tropical world. It is probably the ancient cultivated crop in the world. Post-harvest infections/pathologies can lead to severe losses of fruits both in terms of quantity and quality. Fruits microorganisms have no market value.
Some bacteria have been associated with the deterioration of

Plantain (Fajinmi *et al*., 2011).
The emmenagogue effect of ricinoleic acid detected in the castor seed oil frees the flow of menstruation and eases the pain as well as cramps. It is effective in relieving extreme pain during menstruation and opening (Maanasi, 2016). Castor oil promotes the release and flow of the milk and its quantity. The fatty acids in castor bean oil guaranty adequate and regular supply of milk in lactating mothers and multiply the milk quantity as the baby grows. In manufacturing, castor seeds are used to make paints, varnishes, and lubricating oils (WebMD, 2017).
The aim of the study was to determine the antimicrobial effect of leaf and seeds extract of Castor oil plant (*Ricinus communis)* on bacteria isolated from plantains.

## MATERIALS AND METHODS

### Collection of Samples
Two (2) samples of *Musa paradisiaca* were bought from Oja Oba market in Ilorin, Kwara state Nigeria and represented as samples 1 and 2 respectively. The samples were collected in sterile polythene bags and were transferred to the laboratory.

### Collection of Plant Materials
The plant materials used were the leaves and seeds of *Ricinus communis*. Fresh leaves and seeds were collected from University of Ilorin Permanent site, Ilorin Kwara state. The identification was carried out at the herbarium of the Department of Plant Biology, University of Ilorin with voucher number: UILH/001/965.

### Processing of Samples for Spoilage
The plantain (*Musa paradisiaca)* was subjected to spoilage which occurred within 1 week. It was carried out by soaking cotton wool in sterile distilled water and placed in a sterile container. The plantain was then surface sterilized with 70% alcohol and rinsed with sterile distilled water. The spoilt areas were cut out and ground using sterilized mortar and pestle (swabbed with 70% ethanol).

### Identification and Characterization of Isolated Microorganisms
The bacterial isolates were examined in pure culture to identify their colonial morphology, cellular morphology and biochemical characteristics according to the methods of Fawole and Oso, (2007).

### Preparation of Crude Extracts
The fresh leaves and seeds were washed with tap water and then rinsed with distilled water. Washed plant material was air dried and pulverized in mechanical grinder. Powdered plant material was used for the preparation of aqueous and ethanolic extracts.

### Aqueous extraction (Cold water)
The aqueous extracts were obtained using the modified method of Das *et al.,* 2010. Fifty (50) grams of the powdered sample was weighed and dispensed into a sterile conical flask. Two hundred (200) milliliters of sterile distilled water was added to the powder. This was plugged with cotton wool and aluminum foil and placed on an orbit shaker at 190 rev/minute for 48 hours, and filtered with Whatman No. 1 filter paper. The filtrate was concentrated on a water bath at 40˚C. The powder obtained was sterilized using the membrane filtration unit. The sterile filtrate was kept in sterile McCartney bottles and stored at 4˚C until it was required for use.

### Sterility Test of the Plant Extracts
Each of the above extracts (aqueous and ethanolic extracts) was tested for growth or contaminants. This was carried out by inoculating 1ml of each of them on nutrient agar and incubating at 37˚C for 24 hours. The plates were observed for growth. No growth in the extracts after incubation indicated that the extracts were sterile.

### Antimicrobial Susceptibility Testing

### Disc diffusion test
Antibacterial activities of leaf and seed extracts of *Ricunus communis* were carried out by disc diffusion method using the Kirby-Bauer technique (Clinical and Laboratory Standards Institute. 2016).

### Preparation of impregnated discs
Sterile Whatman No. 1 filter paper discs (6mm diameter) were impregnated with the various concentrations (200mg/ml, 150mg/ml and 100mg/ml) of the ethanolic and aqueous leaf and seed extracts respectively.

### Standardization of isolates
The bacterial isolates were first cultured in Nutrient broth for 18 hours prior to use and standardized to 0.5 McFarlands standard ($10^6$cfu/ml). This was used within 15 minutes.

### Phytochemical screening
Phytochemical screening of the crude extracts was carried out using standard methods of Tiwari *et al*., 2011.

Test for saponins: Saponin was tested for using the method of Ejikeme *et al*, 2014.

Test for alkaloid: Alkaloid was tested for using the method of Ejikeme *et al*, 2014.

Test for tannin: Tannin was tested for using the method of Ejikeme *et al*, 2014.

Test for Test for Phenol (Ferric Chloride Test): The extracts were treated with 3-4 drops of 2ml of Ferric Chloride.

Glycosides: The extracts were treated with Ferric Chloride solution and immersed in boiling water for about 5 minutes. The mixtures was cooled and extracted with equal volumes of benzene. The benzene layer was separated and treated with ammonia solution. Formation of rose- pink color in the ammoniacal layer indicated the presence of glycosides.

Test for flavonoid: Flavonoid was tested for using the method of Ejikeme *et al*, 2014.

## RESULTS

### Microorganisms isolated
The bacterial isolates that were associated with the spoilage of plantain *Musa paradisiaca* were: *Corynebacterium* sp., *Staphylococcus aureus* and *Proteus vulgaris*.

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The colonial, cellular morphology and biochemical characteristics are presented in Table 1.

**Table 1:** The cellular, cultural and biochemical characteristics of the bacterial isolates

| Codes | Gram stain | Cell shape | Spore stain | Motility test | Catalase | Coagulase | Oxidase | Citrate | $O_2$ relationship | Indole | Urease | Methyl red | VogesPrasquer | Lactose | Sucrose | Glucose | Tentative Identity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B1 | + | Rod | _ | _ | + | _ | _ | _ | Ae | _ | _ | _ | _ | + | + | + | *Corynebacterim sp.* |
| B2 | + | Cocci | _ | _ | + | + | _ | + | Ae | _ | _ | _ | _ | + | + | + | *Staphylococcus aureus* |
| B3 | _ | Rod | + | + | _ | _ | _ | + | Fa | _ | + | + | + | + | + | + | *Proteus vulgaris* |

KEYS
Ae =Aerobe Fan = Facultative anaerobe **+** = Positive
- = Negative

**Antibacterial Activity of the Extracts on the Bacterial Isolates**
The results of the antibacterial activity of the ethanolic extracts and aqueous extracts against the three bacterial isolates (*Corynebacterium* sp*., Staphylococcus aureus* and *Proteus vulgaris*) are shown in Tables 2-8.

Table 2 shows the activity of the ethanolic leaf extracts of the plant on the different bacterial isolates. The zones of inhibition for the organisms varied according to the concentrations of the plant extract used. The zones of inhibition for *Corynebacterium sp*. ranged from 9.0mm-25.0mm, *Staphylococcus aureus* ranged from 3.0mm-7.0mm while *Proteus vulgaris* zones ranged from 0.0mm-13.0mm respectively.

**Table 2:** Antimicrobial activity of the ethanolic leaf extract of *Ricinus communis* on the different test organisms

| Concentration of the extracts | Zones | Of inhibition in | Millimeters (mm) | |
|---|---|---|---|---|
| (mg/ml) | *Corynebacterium* sp. | *Staphylococcus aureus* | *Proteus Vulgaris* | Control |
| 100 | 9.0 ± 0.6 | 3.0 ± 0 | _ | _ |
| 150 | 15.0 ± 0.8 | 5.0 ± 0.6 | 11.0 ± 1.5 | _ |
| 200 | 19.0 ± 0.3 | 7.0 ± 0.3 | 10.0 ± 0.2 | _ |
| 250 | 25.0 ±1.0 | 4.0 ± 0 | 13.0 ± 0 | _ |

**KEY**
Zones of inhibition in millimeter (mm) in triplicates expressed as Means and Standard Error of means.
- = No zone of inhibition
The activity of the aqueous leaf extracts on the bacterial isolates is presented on Table 3

**Table 3:** Antimicrobial activity of the aqueous leaf extract of *Ricinus communis* on the different test organisms

| Concentration of the extracts | Zones | of inhibition in | Millimeters | (mm) |
|---|---|---|---|---|
| (mg/ml) | *Corynebacterium sp.* | *Staphylococcus aureus* | *Proteus Vulgaris* | Control |
| 100 | 5.0 ± 0.3 | 5.0± 0.3 | _ | _ |
| 150 | 6.0 ± 0.7 | 7.0 ± 0.9 | _ | _ |
| 200 | 7.0 ± 0.3 | 9.0 ± 0.7 | _ | _ |
| 250 | 9.0 ± 0 | 11.0 ± 0.3 | _ | _ |

**KEY**
Zones of inhibition in millimeter (mm) in triplicates expressed as Means and Standard Error of means.
_ = No zone of inhibition
The activity of the ethanolic seed extracts is presented in Table 4

**Table 4:** Antimicrobial activity of the ethanolic Seed extract of *Ricinus communis* on the different test organisms

| Concentration of the extracts | Zones | Of inhibition in | millimeters | (mm) |
|---|---|---|---|---|
| (mg/ml) | *Corynebacterium* sp. | *Staphylococcus aureus* | *Proteus Vulgaris* | Control |
| 100 | _ | 2.0 ± 0.3 | _ | _ |
| 150 | 6.0 ± 0.7 | 3.0 ± 0.3 | 1.0 ± 0.3 | _ |
| 200 | 8.0 ± 0 | 4.0 ± 0.3 | 3.0 ± 0.2 | _ |
| 250 | 5.0 ±0.3 | 5.0 ± 0.3 | 4.0 ± 0.7 | _ |

**KEY**
Zones of inhibition in millimeter (mm) in triplicates expressed as Means and Standard Error of means.
_ = No zone of inhibition
The activity of the aqueous extracts of the seed of *Ricinus communis* on the bacterial isolates is presented in Table 5.

**Table 5:** Antimicrobial activity of the aqueous seed extract of *Ricinus communis* on the different test organisms

| Concentration of the extracts | Zones | Of inhibition in | Millimeters | (mm) |
|---|---|---|---|---|
| (mg/ml) | *Corynebacterium* sp. | *Staphylococcus aureus* | *Proteus Vulgaris* | Control |
| 100 | _ | _ | _ | _ |
| 150 | 1.0 ± 0.3 | _ | _ | _ |
| 200 | 2.0 ±0.3 | 2.0 ± 0.3 | _ | _ |
| 250 | 3.0 ± 0.3 | 3.0 ± 0 | _ | _ |

**KEY**
Zones of inhibition in millimeter (mm) in triplicates expressed as Means and Standard Error of means.
_ = No zone of inhibition

**Antibiotic Susceptibility Pattern**
The antibiotic susceptibility pattern of all the bacterial isolates tested against the selected antibiotics showed that all the bacterial isolates were inhibited by the antibiotics. The zones of inhibition on *Corynebacterium sp.* was highest with Ciproflaxin which had zone of inhibition of 30mm but least wit Amoxycillin with zone of inhibition 0f 15mm.
Ciproflaxin showed the least zone of inhibition on *Staphylococcus*

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*aureus* at 15mm while Tetracycline and Amoxycillin both had same zones of inhibition at 25mm.
On *Proteus vulgaris*, Tetracycline showed the least zone of inhibition at 35mm while Ciproflaxin had the highest inhibition zone at 42mm.

**Table 6:** Antibiotics susceptibility testing on the Isolates

| | Zone of Inhibition of Antibiotics in the Millimeter (mm) | | |
|---|---|---|---|
| **Organisms** | Amoxycillin | Ciproflaxin | Tetracycline |
| ***Corynebacterium sp*** | 15.0 ± 0.3 | 30.0 ± 0.1 | 20.0 ±0.2 |
| ***Staphylococcus aureus*** | 25.0 ± 0.5 | 15.0 ± 0.3 | 25.0 ± 0.4 |
| ***Proteus vulgaris*** | 40.0 ± 0.2 | 42.0 ± 0.5 | 35.0 ± 0.6 |

Zones of inhibition in millimeter (mm) in triplicates expressed as Means and Standard Error of means

**Minimum Inhibitory Concentration (MIC)**
The values obtained on the bacterial isolates from extracts varied from one organism to another. The ethanolic leaf extract (Table 7) of R. *communis* had the lowest minimum inhibitory concentration on *Staphylococcus aureus* at12.50mg/l. *Corynebacterium sp.* had its MIC at 25.0mg/ml, while that of *Proteus vulgaris* was at 50mg/ml which was also the highest on the ethanolic extract of the leaves. *Corynebacterium sp.* and *Staphylococcus aureus* had the same MIC values of 100mg/ml on the aqueous leaf extract (Table 8).The ethanolic seed extract (Table 8) of R. *communis* gave MIC values on *Corynebacterium sp.* at 25mg/ml, while that of *Staphylococcus aureus* was 50mg/ml. The aqueous seed extracts showed no inhibition zones on the test isolates.

**Table 7:** Minimum inhibitory concentrations of *Ricinus communis* leaf extracts (Ethanolic and Aqueous) on the bacterial isolates

| **Isolates** | **Concentrations of the Leaf Extract in mg/ml** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ethanolic Extract | | | | | | Aqueous Extract | | | | | |
| | 3.125 | 6.25 | 12.5 | 25 | 50 | 100 | 3.125 | 6.25 | 12.5 | 25 | 50 | 100 |
| ***Corynebacterium sp.*** | + | + | + | _ | _ | _ | + | + | + | + | + | _ |
| ***Staphylococcus aureus*** | + | + | _ | _ | _ | _ | + | + | + | + | + | _ |
| ***Proteus vulgaris*** | + | + | + | + | _ | _ | + | + | + | + | + | + |

**KEY**
(+) = Growth (No inhibition) ( - ) = No growth (Inhibition)

**Table 8:** Minimum inhibitory concentrations of *Ricinus communis* seed extracts (Ethanolic and Aqueous) on the bacterial isolates

| **Isolates** | **Concentrations of the Leaf Extract in mg/ml** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ethanolic Extract | | | | | | Aqueous Extract | | | | | |
| | 3.125 | 6.25 | 12.5 | 25 | 50 | 100 | 3.125 | 6.25 | 12.5 | 25 | 50 | 100 |
| ***Corynebacterium sp.*** | + | + | + | + | _ | _ | + | + | + | + | + | _ |
| ***Staphylococcus aureus*** | + | + | + | + | _ | _ | + | + | + | + | + | + |
| ***Proteus vulgaris*** | + | + | + | + | + | + | + | + | + | + | + | + |

**KEY**
(+) = Growth (No inhibition) (-) = No growth (Inhibition)

**Phytochemistry of *Ricinus communis***
The ethanolic seed, aqueous leaf and seed extracts showed the presence of flavonoids, alkaloids, saponins, glycosides, tannins, phenols and terpenoids (Table 9).The ethanolic leaf extracts did not possess terpenoids.
The most abundant of the phytochemicals present in all the extracts was saponin followed by glycosides.

**Table 9:** Phytochemicals present in *Ricinus communis* Extracts

| **Phytochemicals** | **Ethanolic leaf extract** | **Ethanolic seed extract** | **Aqueous leaf extract** | **Aqueous seed extract** |
|---|---|---|---|---|
| **Flavonoids** | + | ++ | + | + |
| **Alkaloids** | + | + | ++ | + |
| **Saponins** | +++ | ++ | +++ | +++ |
| **Glycosides** | ++ | + | +++ | ++ |
| **Tannins** | ++ | + | + | + |
| **Phenols** | ++ | + | + | ++ |
| **Terpenoids** | _ | ++ | + | + |

**KEY**
¯ = Absent + = Present in small amount ++ = Moderately present +++ = Heavily present

**DISCUSSION**
A total of three bacterial isolates were identified during the course of this study. The bacterial species isolated include *Corynebacterium* sp., *Proteus vulgaris* and *Staphylococcus aureus*. The presence of these organisms in the fruits was due to several predisposing factors. The organisms might have been present due to contamination from the atmosphere, storage methods, pH, moisture content, and mechanical damage to the peels.

In Table 2 the zones of inhibition for the organisms varied according to the concentrations of the plant extract used. The zones of inhibition for *Corynebacterium* sp. ranged from 9mm-25mm, *Staphylococcus aureus* ranged from 3mm-7mm while *Proteus vulgaris* zones ranged from 0mm-13mm respectively. Higher concentrations result in higher activity, this might be as a result of the ability of high concentration of the extracts to solubilize or extract the phytochemicals better.

The result shows that the ethanolic extracts of the leaves possessed effective antimicrobial activities. It is likely that the active constituents of the leaves were better extracted with ethanol than with water. *Corynebacterium* sp. was most sensitive to the ethanol leaf extract (Table 2) with inhibition zones ranging from 9mm- 25mm while *Staphylococcus aureus* showed the least inhibition zones with the leaf extracts. At higher concentration of ethanolic leaf extract, *Corynebacterim* sp. showed greater susceptibility. Obi and Onuoha (2000) reported that the increase in inhibitory effects as the concentrations of the extract increased might be due to the result of the ethanol extracting most of the active ingredients of the plants.

The activity of the aqueous leaf extracts on the bacterial isolates is shown in Table 3. The results indicate that the aqueous extract inhibited *Corynebacterium* sp. with zones of inhibition ranging from 5mm-9mm. *Staphylococcus aureus* was also inhibited with zones of inhibition ranging from 5mm-11mm. No zones of inhibition were seen when the extracts were tested on *Proteus*

*vulgaris.* This result when compared to the ethanolic extract shows that aqueous extract is not able to solubilize the important constituents responsible for antimicrobial effect thus resulting in a lower range of zone of inhibition.

The ethanolic seed extracts in Table 4 showed that *Corynebacterium* sp. was not inhibited at 100mg/ml, but at the concentrations of 150mg/ml – 250mg/ml zones of inhibition were seen ranging from 5mm-8mm. *Staphylococcus aureus* was inhibited with zones ranging from 2mm-5mm. *Proteus vulgaris* was not inhibited at 100mg/ml concentration but was inhibited at the other concentrations of 150mg/ml, 200mg/ml, 250mg/ml respectively with zones ranging from 1mm-4mm.

The ethanol extracts were found to be more effective than the aqueous extracts. The higher activity of the ethanol extracts vis-a-vis the aqueous extract might be attributed to the presence of higher amounts of polyphenols as compared to aqueous extracts. Furthermore, ethanol was observed to easily penetrate the cellular membrane to extract the intracellular ingredients from the plant material (Tiwari *et. al*., 2011).

*Staphylococcus aureus* used showed moderate susceptibility to the extracts and this might be due to their ability to produce different enzymes and toxins which might have degraded some of the active components of the plants (Tong *et al*., 2015)

*Proteus vulgaris* was most susceptible to the ethanolic leaf extract when compared to other extracts. *Proteus vulgaris* was not inhibited by the aqueous extracts of the seed and leaves at all. This further proofs that water is not active in extraction of important plant component like ethanol. The non-activity or low activity of the aqueous extracts against most bacterial strains investigated in this study is in accordance with previous works which show that aqueous extracts of plants generally show little or no antimicrobial activities. In Koduru *et al.* (2006) work, the water extracts of *Solanuma culeastrum* showed the least zones of inhibition with the selected bacterial strains in comparism with the ethanol and methanol extract (Koduru *et al.,* 2006).

*Corynebacterium sp.* and *Stapylococcus aureus* showed significant susceptibility pattern against all the extracts. *Proteus vulgaris* showed a comparatively reduced susceptibility pattern. Although it was inhibited by the ethanol extract of the leaves, it gave no zones of inhibition with both the aqueous leaf and seed extracts, and a very low inhibition zone with the ethanol seed extract. Thus, the tested plant extracts were not efficient against *Proteus vulgaris*

The findings from this study agrees with that of an earlier study on unfermented extracts of the same plant where *Klebsiellia pneumoniae, Escherichia coli, Proteus vulgari*s and *Staphylococcus aureus* were found to be appreciably susceptible to the extracts *Ricinus comunis* (Jombo and Enenebeaku, 2008). The susceptibility of organisms such as *Staphylococcus aureus* and *Proteus vulgaris* to the extracts of R. *communis* could be of uncommon benefit particularly in the present broad spate of high resistance currently exhibited by these organisms in the treatment of various infections.

The antibiotics showed zones of inhibition with all the test organisms (Table 6). *Corynebacterium* sp. showed zones of inhibition of 15millimeters, 30millimeters and 20 millimeters with amoxicillin, ciprofroflaxin and tetracycline respectively. The zones of inhibition of the ethanolic extracts of the leaf at higher concentrations (150mg/ml, 200mg/ml and 250mg/ml) are almost in the same range with the zones of inhibition showed by the antibiotics which showed that the ethanolic extract of the leaves was efficient for use against *Corynebacterium* sp. *Proteus vulgaris* and *Stapylococcus aureus* were also inhibited by the antibiotics and are more efficient when compared to the extracts.

The Minimum Inhibitory Concentration (MIC) of all the plant extracts on the bacterial isolates (*Corynebacterium* sp., *Staphylococcus aureus* and *Proteus vulgaris*) showed that extracts were more efficient at higher MIC values. The values of the MIC on Table 7 also indicated the extent of effectiveness of the extracts. The ethanolic leaf extract had the least MIC value at 12.5mg/ml and this was on *Staphylococcus aureus*. The ethanolic extract of the leaf extract had MIC values of 50mg/ml on *Proteus vulgaris. Proteus vulgaris* was not inhibited by the very low concentrations of the seed ethanol and aqueous extracts (Table 8).

Generally, with the current spread of antibiotic resistance almost at geometric scale (Olayinka *et al*., 2004) and obvious challenges confronted with by medical practitioners in the treatment of infectious diseases (Taiwo *et al*., 2002), proper attention should be given to such plants to reap the potential antimicrobial benefits inherent in them. In like manner, the actual antimicrobial ingredients need to be extracted and identified, also its tolerable levels in the human body as well as any toxic effects on humans and animal tissues be investigated accordingly.

The preliminary phytochemical screening of *Ricinus communis* extracts as presented in Table 9 revealed an array of rich secondary metabolites such as tannins, terpenoids, alkaloids, flavonoids, phenols, sterols, glycosides. The aqueous extracts was found to be less effective in dissolving the phytochemicals than the ethanolic solvent, hence the reduction in the amounts of phytochemicals present in the aqueous extracts. The aqueous extracts lacked terpenoids. The absence of some phytochemicals might be due to differences in the polarity of the solvents, as the types of solvents used determines the kind of biologically active compounds that can be extracted from the plant materials (Tiwari *et al*., 2011). The differences in the phytochemicals observed in this study and those of other researchers might be attributed to different geographical locations from where the plants were harvested and different extraction procedures employed.

This result is in accordance with the reports of Mahavidyalaya and Osmanabad (2014) that the phytochemical analysis of *Ricinus communis* revealed the presence of some phytochemicals such as flavonoids, tannins, saponins, alkaloids, glycosides and terpenoids.

The inhibitory effects of the plant extracts on the microorganism might be due to the presence of the above phytochemicals.

The use of *Ricinus communis* leaf and seed extracts on plantain might be a prospective method in extending the shelf life and also preserving the plantains from spoilage. This will not only be of economic benefit to farmers and sellers alone but to the world

economy as waste will be greatly reduced. Also, this method of preservation is environmental friendly as plant phytochemicals do not cause environmental hazards.

**Conclusion**

Spoilage of fruits has been a major problem worldwide and with the development of better storage, handling and preservation methods, this can be abated.

The alcohol and water extracts of leaves seeds of *Ricinus communis* were found to be substantially active against the bacterial isolates and this was due to the presence of some important phytochemicals in the various plant extracts. Strains of methicillin resistant *Staphylococcus aureus* (MRSA) commonly complicating post burns infections, which at present appear to be resistant to all the available antimicrobials could be tried against this extract in order to assess their usefulness in that regard (Amani *et al*., 2003).

With more research on this plant, it can become a potential drug that can be used for treatment.

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