Acta Scientific Microbiology (ISSN: 2581-3226)

Volume 1 Issue 2 February 2018

Research Article

Antimicrobial Activity of Abdominal Gland Extracts of African Weaver Ants (*Oecophylla longinoda*) on Isolated Microorganisms from Kola Nut Pods

Oladunmoye MK[1], Akinmaye AS[1] and Oladosu TO[2]*

[1]*Department of Microbiology, Federal University of Technology, Akure, Ondo State, Nigeria*

[2]*Department of Biological Sciences, Bells University of Technology, Ota, Ogun State, Nigeria*

***Corresponding Author:** Oladosu TO, Department of Biological Sciences, Bells University of Technology, Ota, Ogun State, Nigeria.

Received: December 07, 2017; **Published:** January 09, 2018

DOI: 10.31080/ASMI.2018.01.0011

Abstract

This research was aimed at evaluating the antimicrobial potency of abdominal extracts of a species of weaver ants (*Oecophylla longinoda*) on microorganisms found on kola nut pods. Ten (10) samples of five infected and five uninfected kola nut pods were gotten from a farm in Ibule Community, Ondo State, Nigeria. Microorganisms were isolated from these samples using standard bacteriological and mycological methods. These microorganisms were identified adopting a series of tests such as Gram staining, colonial morphology and biochemical characterization. The bacterial isolates obtained include *Pseudomonas aeruginosa, Bacillus subtilis, Bacillus cereus, Bacillus polymyxa, Serratia marcescens, Klebsiella oxytoca* and *Aeromonas hydrophila*. While fungal isolates were *Rhizopus stolonifer, Aspergillus niger, Penicillium digitatum, Aspergillus flavus* and *Aspergillus fumigatus*. Microbial isolates were subjected to antibiotic susceptibility testing by using Tetracycline (30 µg), Ofloxacin (30 µg), Gentamicin (20 µg), Chloramphenicol (30 µg), Augmentin (30 µg), Ceftriaxone (30 µg), Nitrofurantoin (300 µg), Cotrimoxazole (25 µg), Ciprofloxacin (10 µg) and Amoxicillin (30 µg), while the antifungal drugs used were Griseofulvin, Ketoconazole, Itraconazole and Clotrimazole. *Pseudomonas aeruginosa* was the most resistant bacterial isolate to commercial antibiotics, while it displayed a great level of susceptibility to the abdominal extracts at the different concentrations tested. This research revealed that extracts from the abdominal region of *Oecophylla longinoda* possess antimicrobial activities beneficial for the protection of kola nut against pathogenic microorganisms.

Keywords: *Oecophylla longinoda*; Kola Nut Pods; Abdominal Gland

Introduction

Kola, which is widely produced in Africa is a member of the family *Sterculiaceae*. It is cultivated to a large degree in Nigeria, Ghana, Ivory Coast, Brazil and the West Indian Islands. Annual production from these countries alone is in excess of 250,000 tons, while the world overall production is above 250,000 tons [1]. Two species of kola, *Cola nitida* and *Cola acuminata* are of major economic importance. Kola is an important economic cash crop to a significant proportion of Nigerian population who are involved in kola farming, trading and industrial utilization. According to Ndagi*., et al.* [2] Nigeria produced the highest quantity of the world's total kola nut production.

Kola nut is used for its numerous benefits such as mastication and stimulation in the tropics, it also has social and traditional advantages as it is being used in many traditional ceremonies in Nigeria. It is being used in the pharmaceutical industries, so also in the production of soft drinks, wines and in confectioneries. The kola nut pod husk is used for animal feeding because of its high nutritive quality.

The kola trees however, play host to many pathogens of various diseases such as brown spot, brown blight, brown root rot and tip blight which are *Pestalotia* spp., *Botryodiplodia theobromae, Armillaria mellea, Phomopsis* spp respectively. *Botrytis* spp, P*aecilomyces variotii, Mucor* spp and *Fusarium* spp, have been reported to be common pathogens associated with diseases of Kola [3].

Studies on the abdominal gland extracts of Weaver ants (*Oecophylla* sp) reveal their antimicrobial properties against some species of bacteria such as *Staphylococcus aureus, Staphylococcus epidermidis, Escherichia coli*, *Vibro cholerae* and fungi such as *Candida albicans* and *Aspergillus niger* [4].

This research hence seeks to investigate and evaluate the antimicrobial potentials of extracts from the gut of weaver ants (*Oecophylla longinoda*) on isolated microorganisms from *Cola acuminata*.

Materials and Methods

Sample collection

Collection of infected and uninfected kola nut pods

Kola nut pods were sampled from a farm in Ibule, Ondo state, Nigeria. They were observed, for normal green colour and shinning back for uninfected samples while signs like black, yellow, brown spot and rough surfaces were used for the selection of infected kola nuts. Samples of infected and uninfected kola nuts pods were collected in clean sterilized covered big plastic containers from the farm and they were transported within one hour of collection to microbiology research laboratory, Department of Microbiology, Federal University of Technology, Akure, Ondo State, Nigeria for microbial analysis.

Collection and preparation of African Weaver ants (*Oecophylla longinoda*)

Large nests of O. *longinoda* were collected from the kola nut trees and put in a glass jar and then anesthetized using chloroform (analytical grade). Adult ants were separated, stored and used for antimicrobial assay.

Sterilization of glassware and other equipment

All the glassware (beakers, conical flasks etc) used were washed thoroughly, rinsed properly with tap water and sterilized in the hot air oven dried at 160°C - 170°C for 2 hours. Forceps and inoculating wire loops were flamed to red-heat and then dipped in 70% ethanol. Laboratory benches and inoculating chambers were thoroughly disinfected with cotton wool swab previously soaked in 70% ethanol before and after laboratory activities to avoid contamination.

Preparation and sterilization of culture media

Each of the medium was prepared aseptically according to the manufacturer's specification in a conical flask plugged using non-absorbent cotton wool wrapped with aluminum foil. All media were autoclaved at 121°C for 15 minutes and allowed to cool to 45°C before plating. The poured plates were left at room temperature (28.0 ± 2.0°C) to solidify.

Preparation of samples of infected and uninfected kola nuts for microbiological analysis

Samples collected from the farm were thoroughly washed in sterile distilled water one after the other and air-dried. One gram (1g) of each sample was cut and weighed using electronic weighing balance, it was crushed in a crucible and serial dilution was carried out.

In serial dilution, the crushed sample that was weighed was dispensed carefully into 10 ml of sterilized test tube containing sterile distilled water to make dilution of 10^{-1}. One milliliter (1 ml) from this tube was withdrawn using micropipette from the first dilution and dispensed into another 9ml of sterile distilled water to make dilution of 10^{-2}. This procedure was repeated till dilution factor of 10^{-7} was attained following the method of Fawole and Oso [5].

Isolation of bacteria from infected and uninfected kola nut pods

Bacteriological examinations were carried out using standard methods for bacterial identification, 1 ml each of dilution 10^{-1}, 10^{-3}, 10^{-5} and 10^{-7} was pour plated on Nutrient agar, the plates were inverted and incubated at 37°C for 24 hours after which the plates were examined for growth.

Characterization of bacterial isolates

The bacterial colonies that developed on all media plates were subcultured by streaking on a freshly prepared nutrient agar plates until pure colonies were obtained according to the conventional procedure as highlighted by Fawole and Oso [5]. Colonial characteristics of the discrete bacterial colonies such as colour, shape, pigmentation and opacity on nutrient agar were observed and noted; also, growth characteristic on selective and differential media was observed and recorded. Discrete bacterial colonies that developed were cultured on agar slants and incubated at 37°C for 24 hours, growth was observed and the slants were stored in the refrigerator to preserve the bacterial isolate prior to biochemical

Biochemical characterisation of bacterial isolates

Different tests were carried out on isolates, which include; Gram reaction, Spore staining, Coagulase, Motility, Oxidase, Indole production, Methyl red, Voges Proskauer, Sugar fermentation, Citrate utilization, Catalase test and test for H_2S gas production [5].

Characterization of fungal isolates

This was carried out based on the morphological and microscopic examination of the colonies according to the method of Fawole and Oso [5].

Antimicrobial susceptibility test

Antibiotic resistance of bacteria was determined by the disc diffusion method with the use of Mueller-Hinton agar, according to the Kirby-Bauer's method. The suspension of the test organism in nutrient broth was matched with 0.5 McFarland turbidity standards to give concentration of 1.5×10^8 CFU/ml, 0.5 ml of the suspension was transferred to prepared Mueller-Hinton agar and spread with a sterilized glass spreader. The surface of the agar was allowed to dry and antibiotic discs were aseptically picked and gently placed on the surface of agar media by the use of sterile forceps. The inoculated plates were incubated at 37°C for 18 hours, after incubation, a clear zone of no growth in the immediate vicinity of an antibiotic disk was measured and recorded as zone of inhibition. The following antibiotics and their concentrations in parentheses were used; Tetracycline (30 µg), Ofloxacin (30 µg), Gentamicin (20 µg), Chloramphenicol (30 µg), Augmentin (30 µg), Ceftriaxone (30 µg), Nitrofurantoin (300 µg), Cotrimoxazole (25 µg), Ciprofloxacin (10 µg) and Amoxicillin (30 µg) [6].

Antifungal susceptibility test was carried out using agar well diffusion, mycelial growth suspension was marched with McFarland turbidity standards, Potato dextrose agar plates were inoculated with fungal isolates and wells of approximately 10 mm were bored using a sterile cork borer and 100 µl of 40 mg/ml of different antifungal drugs were added to the wells aseptically. The zones of inhibition were measured after 72 hours incubation at 24°C, The following antifungal drugs were used; Griseofulvin, Ketoconazole, Itraconazole and Clotrimazole

Antimicrobial susceptibility assay of abdominal glands of African Weaver ants (*Oecophylla longinoda*)

Evaluation of Antimicrobial potency of the extracts from the abdominal region of weaver ant was carried out using agar well diffusion. The method of Evans and Vidhu, 2015 was employed. Abdominal glands of ants were dissected out, homogenized in Dimethylsulphoxide (DMSO) and diluted into three different concentrations in such a way that 100 µl homogenate contained glands of 3, 6 and 12 ants respectively. The homogenate was neutralized to pH 7 prior to assay. The concentration of 3 ants per 100 µl was labeled 'A', 6 ants per 100 µl was labeled 'B' and 12 ants per 100 µl was labeled 'C'. The antimicrobial property was assayed for both fungal and bacterial isolates. DMSO was used as negative control while ketoconazole was used as positive control for antifungal assay, while, ciprofloxacin was used as positive control for antibacterial assay.

Results

Morphological and biochemical characterization of bacterial isolates from infected and uninfected kola nut pods

Morphological and biochemical characterization of isolated bacteria were presented in table 1. Total number of seven different bacterial species were identified and they are; *Pseudomonas aeruginosa, Bacillus cereus, B. subtilis, B. polymyxa, Serratia marcescens, Klebsiella oxytoca* and *Aeromonas hydrophila*.

Gram reaction	Cell shape	Oxidase	Catalase	MR	VP	Citrate	Starch hydrolysis	Glucose	Mannitol	Sucrose	Lactose	Indole	Motility	H_2S	Probable bacteria
-	Rod	+	+	-	-	+	ND	-	+	-	-	-	+	-	*Pseudomonas aeruginosa*
+	Rod	-	+	-	+	+	+	+	+	+	-	-	+	-	*Bacillus cereus*
+	Rod	-	+	-	+	+	+	+	+	+	-	-	-	-	*Bacillus subtilis*
+	Rod	-	+	-	+	-	+	+	+	+	-	-	-	-	*Bacillus polymyxa*
-	Rod	-	+	-	+	-	ND	+	+	+	-	-	+	-	*Serratia marcescens*
-	Rod	-	+	-	+	+	ND	+	-	-	+	+	-	-	*Klebsiella oxytoca*
-	Rod	+	+	+	+	+	ND	+	+	+	+	-	+	+	*Aeromonas hydrophila*

Table 1: Biochemical characterization of bacterial isolates from infected and uninfected kola nut pods.

Key: -: Negative to the Test; +: Positive to the Test; ND: Not Determined; MR: Methyl Red; VP: Voges Proskauer; H_2S: Hydrogen Sulphide Gas Production

Morphological and microscopic characterization of fungal isolates from infected and uninfected kola nut pods

Result of morphological and microscopy characterization are reported in table 2. Five different species of fungi were identified and they are; *Rhizopus stolonifer, Aspergillus niger, Penicillum digitatum, Aspergillus flavus* and *Aspergillus fumigatus.*

Occurrence and distribution of bacteria and fungi in infected and uninfected kola nut pods

Table 2 revealed the occurrence and distributions of microorganisms isolated from infected and uninfected kola nut pods. The most occurring bacteria are *Pseudomonas aeruginosa* (6) and *Bacillus cereus* (5) while fungi are *Penicillum digitatum* (4), *Rhizopus stolonifer, Aspergillus flavus* and *Aspergillus fumigatus* (3). *Pseudomonas aeruginosa* is present in all the infected kola nut pods, *Serratia marcescens* was seen only in two of the infected kola nut pods and *Aeromonas hydrophila* was seen in only one of the uninfected kola nut pod. It was also observed that all infected and uninfected kola nut pods had at least two different bacteria. Fungi isolates varied from sample to sample. A total of 26 and 15 different bacteria and fungi were isolated respectively.

Antibiotic susceptibility patterns of bacteria isolated from infected kola nut pods

The result of antibiotic susceptibility test is shown in figure 1. The result revealed different antibiotic susceptibility patterns, *Pseudomonas aeruginosa* was less susceptible to all the antibiotics, however, other bacterial isolated from infected kola nut pods were susceptible to all the antibiotics used. *Bacillus cereus, B. subtilis,*

Isolates	Infected					Uninfected					Total
Bacterial isolates	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	
Pseudomonas aeruginosa	+	+	+	+	+	-	-	-	+	-	6
Bacillus cereus	+	-	-	-	+	+	-	+	-	+	5
Bacillus subtilis	-	+	-	-	-	+	+	-	+	-	4
Bacillus polymyxa	-	-	+	+	-	+	+	-	-	-	4
Serratia marcescens	-	+	-	-	+	-	-	-	-	-	2
Klebsiella oxytoca	-	-	+	+	-	-	-	+	-	+	4
Aeromonas hydrophila	-	-	-	-	-	-	-	-	-	+	1
Total	2	3	3	3	3	3	2	2	2	3	**26**
Fungal isolates											**Total**
Rhizopus stolonifer	-	+	-	+	-	-	-	-	+	-	3
Aspergillus niger	+	-	-	-	-	-	+	-	-	-	2
Penicillum digitatum	-	-	+	-	+	+	-	+	-	-	4
Aspergillus flavus	-	-	-	+	+	-	-	-	+	-	3
Aspergillus fumigatus	+	-	-	-	-	-	+	-	-	+	3
Total	2	1	1	2	2	1	2	1	2	1	**15**

Table 2: Occurrence and distribution of bacteria and fungi in infected and uninfected kola nut pods.

Key: A: Sample from first location, B: Sample from second location, C: Sample from third location, D: Sample from forth location, E: Sample from fifth location, -: Organism is not present, +: Organism is present

B. polymyxa, Serratia marcescens and *Klebsiella oxytoca* were highly susceptible to ceftriaxone, gentamicin, ofloxacin and ciprofloxacin and there was no difference (p>0.05) between their susceptibility patterns to ciprofloxacin. It also revealed that the susceptibility of *Bacillus* spp. are higher compared with other bacteria isolated.

Figure 1: Antibiotic susceptibility patterns of bacteria isolated from infected kola nut pods.

Key: AUG: Augmentin; CRO: Ceftriaxone; NIT: Nitrofurantoin; GEN: Gentamicin; OFL: Ofloxacin; AMX: Amoxicillin; CPX: Ciprofloxacin; TET: Tetracycline; COT: Cotrimoxazole; CHL: Chloramphenicol

Antibiotic susceptibility patterns of bacteria isolated from uninfected kola nut pods

Susceptibility patterns of bacteria isolated from uninfected kola nut pods revealed different antibiotic susceptibility patterns (Figure 2). *Pseudomonas aeruginosa* was not susceptible to any of the antibiotics except ciprofloxacin (1 ± 0.57 mm) and the zone of inhibition to ciprofloxacin is significantly (p ≥ 0.05) low compared to other bacterial isolates. *Bacillus cereus, B. subtilis, B. polymyxa, Klebsiella oxytoca* and *Aeromonas hydrophila* isolates showed varying susceptibility patterns to different antibiotics. However, all bacterial isolates were highly susceptible to ceftriaxone, gentamicin, ofloxacin and ciprofloxacin. There was no significant (p ≥ 0.05) difference in the susceptibility patterns of *Bacillus* spp. to all antibiotics except Augmentin, Amoxicillin and Tetracycline.

Figure 2: Antibiotic susceptibility patterns of bacteria isolated from uninfected kola nut pods.

Key: AUG: Augmentin; CRO: Ceftriaxone; NIT: Nitrofurantoin; GEN: Gentamicin; OFL: Ofloxacin; AMX: Amoxicillin; CPX: Ciprofloxacin; TET: Tetracycline; COT: Cotrimoxazole; CHL: Chloramphenicol

Antifungal susceptibility patterns of isolated fungi from kola nut pods

Antifungal susceptibility patterns of the fungi isolated from infected and uninfected kola nut pods are not different; therefore susceptibility patterns of the representative fungal isolates are presented in figure 3. The result revealed that all the fungal isolates (*Rhizopus stolonifer, Aspergillus niger, Penicillum digitatum, Aspergillus flavus* and *Aspergillus fumigatus*) were less susceptible to griseofulvin. Fungal susceptibility to ketoconazole and itraconazole were significantly (p ≤ 0.05) higher than other antifungal drugs.

Figure 3: Antifungal susceptibility patterns of isolated fungi from kola nut pods.

Antifungal activity of abdominal gland extract of weaver ants (O. *longinoda*) on fungi isolated from kola nut pods

Antifungal activity of abdominal gland extract of weaver ants on fungi isolated from kola nut pods is presented in table 3. The result revealed that commercial antifungal (ketoconazole) had high antifungal property by showing high zone of inhibition against all fungal isolates. Abdominal gland extract of weaver ants showed antifungal activity at different concentrations except at A (abdominal glands from three ants) against *Rhizopus stolonifer*, there is a significant (p ≤ 0.05) difference in the antifungal activity of all concentrations (A,B, C) against fungal isolates, antifungal activity increased with increase in concentration of abdominal gland extract. Abdominal glands from twelve ants showed a higher antifungal activity against all fungal isolates and the zone of inhibition ranged from 5.00 ± 0.58 mm against *Aspergillus niger* to 28.00 ± 1.15 mm against *Aspergillus fumigatus*.

Antibacterial activity of abdominal gland extract of weaver ants (*O. longinoda*) on bacteria isolated from kola nut pods

The result of antibacterial activity of abdominal gland extract of weaver ants is shown in table 4. The result revealed that commercial produced higher zone of inhibition against all the isolated bacteria than all concentrations of abdominal gland extracts of weaver ants. Different concentrations of abdominal gland extracts showed significant (p ≤ 0.05) inhibition against the isolated bacteria except *Serratia marcescens* and concentration A and B against *Bacillus cereus*. The highest zone of inhibition exhibited by the abdominal gland extract of ant against bacteria was 20.03 ± 0.32 (*Pseudomonas aeruginosa*) when abdominal glands from twelve ants was used.

	Zones of inhibition (mm)				
Fungal isolates	**Ketoconazole (10 mg/ml)**	**A**	**B**	**C**	**DMSO**
Rhizopus stolonifer	33.00 ± 0.57^{ab}	0.00 ± 0.00^{a}	0.17 ± 0.16^{a}	8.67 ± 1.45^{b}	0.00 ± 0.00^{a}
Aspergillus niger	30.50 ± 0.28^{a}	2.16 ± 0.27^{b}	4.17 ± 0.22^{b}	5.00 ± 0.58^{a}	0.00 ± 0.00^{a}
Penicillum digitatum	35.16 ± 1.01^{b}	2.00 ± 0.06^{b}	24.03 ± 1.76^{c}	26.00 ± 0.81^{c}	0.00 ± 0.00^{a}
Aspergillus flavus	34.00 ± 1.96^{ab}	2.00 ± 0.00^{b}	4.37 ± 0.58^{b}	25.00 ± 0.58^{c}	0.00 ± 0.00^{a}
Aspergillus fumigatus	32.00 ± 1.15^{ab}	3.00 ± 0.12^{c}	26.27 ± 0.27^{c}	28.00 ± 1.15^{c}	0.00 ± 0.00^{a}

Table 3: Antifungal activity of abdominal gland extract of weaver ants (O. *longinoda*).

Values are presented as mean ± SE, values in the same column with same superscript are not significantly different according to Duncan's multiple range test at $p \leq 0.05$

Key: A: Abdominal glands from three ants; B: Abdominal glands from six ants; C: Abdominal glands from twelve ants.

	Zones of inhibition (mm)				
Bacterial isolates	**Ciprofloxacin (10 mg/ml)**	**A**	**B**	**C**	**DMSO**
Pseudomonas aeruginosa	26.00 ± 0.69^{b}	1.99 ± 0.52^{b}	3.03 ± 0.08^{b}	20.03 ± 0.32^{f}	0.00 ± 0.00^{a}
Bacillus cereus	25.00 ± 0.57^{b}	0.00 ± 0.00^{a}	0.00 ± 0.00^{a}	18.96 ± 0.54^{ef}	0.00 ± 0.00^{a}
B. subtilis	33.03 ± 0.6^{1}c	0.65 ± 0.29^{ab}	12.86 ± 0.69^{f}	16.00 ± 0.57^{d}	0.00 ± 0.00^{a}
B. polymyxa	36.97 ± 0.08^{d}	4.03 ± 0.32^{c}	7.01 ± 0.31^{d}	8.00 ± 0.12^{b}	0.00 ± 0.00^{a}
Serratia marcescens	20.10 ± 0.83^{a}	0.00 ± 0.00^{a}	0.00 ± 0.00^{a}	0.00 ± 0.00^{a}	0.00 ± 0.00^{a}
Klebsiella oxytoca	38.00 ± 0.53^{d}	6.00 ± 1.15^{d}	8.00 ± 0.34^{e}	18.04 ± 0.48^{e}	0.00 ± 0.00^{a}
Aeromonas hydrophila	20.00 ± 1.15^{a}	1.07 ± 0.64^{ab}	5.00 ± 0.00^{c}	12.00 ± 1.15^{c}	0.00 ± 0.00^{a}

Table 4: Antibacterial activity of abdominal gland extract of weaver ants (*O. longinoda*).

Values are presented as mean ± SE, values in the same column with same superscript are not significantly different according to Duncan's multiple range test at $p \leq 0.05$

Key: A: Abdominal glands from three ants; B: Abdominal glands from six ants; C: Abdominal glands from twelve ants

Discussion

Most of the infected kola nut pods were observed to have non-intact surfaces, which could be an entry point for the pathogenic microorganisms to invade and cause infections with high proliferation rate in the infected kola nut pods. This goes in line with the work of Otuonye [7].

The presence of these fungi on the pods of the uninfected kola nut pods in this study may be as a result of the disease being at the early asymptomatic stage of the infection, also, previous study revealed that the disease symptoms will only develop when conditions are favourable [8].

In this study, it was observed that all antibiotics used did not inhibit *Pseudomonas aeruginosa* as no zone of inhibition was recorded for any of the test antibiotics, this may be that the isolated strain of *P. aeruginosa* was resistant to all antibiotics used. *P. aeruginosa* has complex metabolic capabilities allowing them to thrive in many environments, their ability to form biofilm and other bioactive metabolites makes them to survive in man as an opportunistic pathogen this agrees with the findings of Scales., *et al* [9]. However, all fungal isolates were less susceptible to griseofulvin and this may be as a result of continual use of fungicides on farm.

The abdominal gland extract of *O. longinoda* was found to be effective against various bacterial isolates with varying zones of inhibition, the zone increases with increase in the concentration of extracts and however, the extract was not effective against *S. marcescens* because no zone of inhibition was observed at all concentrations. Varying zones of inhibition against bacteria exhibited by the extracts observed in this study are likely due to the cell wall components and different mechanisms of antibiotic resistance in bacteria Vidhu and Evans [4].

Abdominal gland extract of *O. longinoda* was also found to be effective against all the fungi, it was observed that the zones of inhibition increases with the increase in concentration, however, it was less effective against *Aspergillus niger* and *Rhizopus stolonifer*. The effectiveness of this abdominal gland extract was also reported by Vidhu and Evans [4] they stated that abdominal gland extracts of *O. smaragdina* was effective against Gram-negative *Escherichia coli, S. mutans, K. pneumoniae* and *P. aeruginosa, Gram-positive S. aureus* and *S. epidermidis*, and fungal strains such as *C. albicans* and *A. niger*. This buttresses the antimicrobial effectiveness of abdominal extracts from weaver ants.

Conclusion and Recommendations

Conclusion

This study has been able to reveal that bacterial and fungal species are resident on the pods of both the healthy and infected pods of kola nut, though the microbial load of the infected pods were higher than the uninfected pods. The antimicrobial resistance of certain microorganisms is a major obstacle in disease control. However, the bacterial species with highest resistance to conventional antibiotics was susceptible to treatment with extract from the abdominal gut of *O. longinoda*. Abdominal gland extracts of *O. longinoda* possess antimicrobial property against a wide variety of both bacterial and fungal isolates except *S. marcescens.*

Recommendations

Farmers who have compromised immunity are at risk of infection with multidrug resistant species of *P. aeruginosa* if proper hygiene is not ensured.

The result of this study revealed that abdominal gland extract of *O. longinoda* has antimicrobial property therefore further processing for the production of an antimicrobial agent for agricultural purposes and application in human medicine.

Also, the insect can be reared in a large number and introduce to farm as alternative to the antimicrobial chemical used routinely on farms.

Bibliography

1. Brickell C., *et al*. "The American Horticultural Society Encyclopedia of plants and flowers". D.K. Publishing, New York (2002): 720.

2. Ndagi I., *et al*. "Potentials and Challenges of Kolanut Production in Niger State, Nigeria". *International Scholarly Research Notices: Agronomy* (2012): 492394.

3. Agbeniyi SO and Fawole B. "Effects of curing and pre-storage die treatments on mould of kolanuts". *European Journal of Food Research Technology* 208 (1999): 447-449.

4. Evans DA and Vidhu VV. "Ethnoentomological values of Oecophylla smaragdina (Fabricius)". *Current Science* 109.3 (2015): 572-579.

5. Fawole MO and Oso BA. "Laboratory manual of Microbiology". 5th edition (2004).

6. Clinical Laboratory Standards Institute. Performance Standards for Antimicrobial Susceptibility Testing; Twenty-Fourth Informational Supplement. CLSI document M100-S24 Wayne, PA 34.1 (2014): 50-98.

7. Otuonye AH and Adedeji AR. "Evaluation of selected plant extracts for the control of the storage rot diseases of kola nuts". Annual Report of the Cocoa Research Institute of Nigeria, Ibadan (2006): 29-30.

8. Atanda OO., *et al*. "The quality of Nigerian kola nuts". *African Journal of Food Science* 5.17 (2011): 904-909.

9. Scales BS., *et al*. "Comparative genomics of Pseudomonas fluorescens subclade III strains from human lungs". *BMC Genomics* 16 (2015): 1032-1041.

Volume 1 Issue 2 February 2018