Prevalence and Antibiogram of Bacteria Isolated from Larvae of *Rhynchophorus phoenicis* (African Palm Grub) Sold in Port Harcourt Metropolis

Chibuike P.M*., Barika P.N. and Chinda H.W.

Department of Microbiology, Rivers State University,
P.M.B. 5080, Nkpolu-Oroworukwo, Port Harcourt, Nigeria
*Corresponding Author: *prince.barika2@ust.edu.ng*

ABSTRACT

Rhynchophorus phoenicis has been implicated to the spread of foodborne illnesses when consumed raw or ready-to-eat. The study was aimed to determine the prevalence and antibiogram of bacteria isolated from larvae of African African palm grub sold in Port Harcourt metropolis. A total of forty (40) samples of raw and ready-to-eat larvae of samples were purchased from Iwofe, Mile 3 and Rumuokoro markets and subjected to standard microbiological procedures such as culturing, isolation and identification. Hundred and seventy (170) bacteria were isolated belonging to the following genera; *Escherichia, Klebsiella, Proteus, Salmonella, Serratia, Pseudomonas, Citrobacter, Staphylococcus* and *Micrococcus.* This study recorded significant population of bacteria from the raw and ready to eat *Rhynchophorus phoenicis* with no significant differences (p≥0.05) across the various markets. In raw samples, the total heterotrophic bacterial counts (THB) ranged from 5.0 ± 0.5 to 5.5 ± 1.1 ($\times10^5$ CFU/g); total staphylococcal counts (TSC) ranged from 1.7 ± 0.3 to 4.3 ± 1.6 ($\times10^4$ CFU/g); total coliform count (TCC) ranged from 1.2 ± 0.2 to 2.3 ± 0.4 ($\times10^2$ CFU/g) and total *Salmonella shigella* counts (TSSC) ranged from 1.7 ± 0.2 to 2.5 ± 0.7 ($\times10^3$ CFU/g). In the Ready-to-eat samples, the total heterotrophic bacterial counts (THB) ranged from 4.9 ± 0.7 to 2.8 ± 0.7 ($\times10^5$ CFU/g); total staphylococcal counts (TSC) ranged from 2.5 ± 0.6 to 4.3 ± 0.4 ($\times10^4$ CFU/g); total coliform count (TCC) ranged from 1.9 ± 0.4 to 2.5 ± 0.8 ($\times10^2$ CFU/g) and total *Salmonella shigella* counts (TSSC) ranged from 1.6 ± 0.8 to 2.6 ± 0.8 ($\times10^3$ CFU/g) in Iwofe and Rumuokoro markets respectively. The prevalence of the bacteria from the raw samples revealed that *Pseudomonas aeruginosa* (18.9%) had that highest occurrence and *Klebsiella oxytoca* (2.8%) had the least prevalence. In the Ready-to-eat samples, *Staphylococcus aureus* (32.3%) was the most prevalent bacteria and *Pseudomonas aeruginosa* (6.5%) had the least occurrence. Generally, the result of the susceptibility pattern of the bacterial isolates revealed that *Escherichia coli, Klebsiella oxytoca, Proteus mirabilis, Salmonella enterica, Serratia marcescens Pseudomonas aeruginosa* and *Citrobacter freundii* were resistant to Chloramphenicol, Sparfloxacin, (100%) and sensitive to Perfloxacin and Ofloxacin (100%) while *Staphylococcus aureus* and *Micrococcus luteus* were resistant to Chloramphenicol (100%) and sensitive to Levofloxacin, Rifampicin and Levofloxacin (100%). The multiple antibiotic resistance index revealed that all the bacterial isolates had a MAR index greater than 0.2. These findings suggest the potential public health risks associated with the consumption of larvae of African palm grubs in Port Harcourt Metropolis. Implementation of food safety measures are recommended to ensure the safety of consumers.

Keyword: *Rhynchophorus phoenicis*, Prevalence, Antibiogram Larvae, Port Harcourt

Introduction

Food is an essential resource needed for the survival of the human body to enhance the normal functioning of the system as well as growth. As such, food plays an essential role in human lives, thus, a high level of food safety is needed to ensure safety from diseases or dangers that may come from foods (Braide and Nwaoguikpe, 2011). Insects provide a variety of uses and benefits ranging from Agriculture to medicine, industries and research. They have been reared for food, feed, silk production and dye making.

Recently, a lot of attention has been drawn worldwide to the usefulness of insects in the food and feed industry because of their nutritional contents and environmental sustainability (Van-Huis *et al.*, 2013) Many parts of the world use insects for food and the use of insects for food is becoming attractive, constituting an emerging new area of study. For these reasons a lot of entrepreneurs have sprung up in Africa in response to development, but in

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Nigeria only few entrepreneurs are interested in engaging in insect farming due to information gap. Insect is tipped worldwide as a recognized food (Van-Huis, 2015; Dobierman *et al.,* 2017). In Africa, insect eating has been part of our menu for centuries (Ebenebe *et al*., 2017). They are also reared for feed formulation for domestic animals and pets (Banjo *et al*., 2006). *Rhynchophorus phoenicis* is superior to chicken, beef and fish in terms of nutrition with a proximate composition of 23.44% crude protein, 3.35% crude fibre, 54.20% ether extract and 5.01% of carbohydrate (Alamu *et al*., 2013). The edible insects not only play an important role in traditional diets but are also an excellent source of protein in traditional dishes in Africa; they are rich in protein, fats, and fibre. Animal protein foods are better sources of bioavailable nutrients like zinc and iron, and for many years, has been a major source for meeting human protein and micronutrient requirements.

Consumption of insects has recently received more attention because of their promising potential for contributing to livelihoods and mitigating food security problems around the world. The choice of edible insects as alternative food sources arises from its richness in protein, minerals and nutritional benefit they offer to human (Nowak *et al.*, 2016)

There is an information gap about the nutritional benefits of the raw and ready-to-eat African palm grub (*Rhynchophorus phoenicis*) and the variety of bacteria present in the raw and ready-to-eat African palm grub which causes infection in the human body when these grubs are consumed, Hence, there is need to understanding the prevalence and antibiogram of bacteria isolated from larvae of African palm grub (*Rhynchophorus phoenicis*) sold in Port Harcourt metropolis.

Plate 1: An image of the edible larvae of *Rhynchophorus phoenicis* (african palm grub)

Plate 2: An image of the ready-to-eat larvae *Rhynchophorus phoenicis* (African palm grub)

Materials and Methods

Description of Study Area
The samples were bought from stationary vendors in the three different markets within Port Harcourt metropolis.

Table 1: Sampling Stations and their Coordinates

Sampling Station	GPS Coordinates
Iwofe Market	4.8171ºN, 6.95440 º E
Rumuokoro Market	4.4676 º N, 7.0011 º E
Mile 3 Market	4.8042 º N, 6.9924 º E

Sample Size Determination

Sample size was calculated using the formula according to (Naing *et al*., 2006)

n= Z^2p (1-p)/d^2 (Naing *et al*., 2006), and a confidence level of 95 %

where, n= sample size

Z = Z statistic for level of confidence

P = expected prevalence or proportion

d = precision

Therefore, P = 2.4% (0.024)

d = 0.05

z = 1.96 (for the level of confidence of 95 %, which is conventional, z value is 1.96).

thus, $1.96^2 \times 0.024(1-0.024)/0.05^2$ =36

A minimum of thirty-six (36) fresh and ready-to-eat African palm grub was supposed to be used but was increased to forty (40) sample for better data analysis.

Sample Collection

A total of forty (40) samples of fresh and roasted (ready-to-eat) *Rhynchophorus phoenicis* (African palm grub) was purchased from Bayelsa suya vendors in Iwofe, Mile 3 and Rumuokoro markets. The samples were aseptically collected and packaged in sterile zip lock bags and transported to microbiology laboratory Rivers State University for bacteriological analysis. The examination of the samples was carried out less than 24 hours after purchasing the samples.

Microbiological Analyses
Bacterial Enumeration

The enumeration of the total heterotrophic bacteria was carried out using nutrient agar while the total coliform and faecal coliform counts were performed on MacConkey and Eosin methylene blue respectively. The stock analytical unit was done by weighing 10g of the edible part of the raw and ready-to-eat African palm grub and homogenizing in 90ml of sterile normal saline for enumeration, isolation and identification. Ten-fold serial dilution was performed subsequently by pipetting 1ml of the samples into 9ml of sterile normal saline up to six (6) dilutions.

About 0.1 aliquot of the appropriate dilutions (10^1 and 10^2) was inoculated in duplicates onto already prepared sterile plates of nutrient, MacConkey and Eosin Methylene Blue agar using the spread plate technique and incubated at 37ºC and 44.5ºC (Faecal coliform count) for 24hours after which the plates were counted and recorded. Representative colonies were described and sub-cultured onto nutrient agar plates and incubated at 37ºC for 24hours to obtain pure cultures (Taylor, 2008)

Preservation of Pure Culture

The pure cultures were stored in 10% (v/v) glycerol suspension at -4ºC as a cryo-preservative agent to prevent the damage of the pure cultures during drying for further analysis.

Isolation and identification of the Bacterial Isolates

The bacteria isolates were isolated based on their morphological and cultural characteristics such as colour, size, margin, shape, texture and elevation. The bacterial isolates were further identified through biochemical such as Catalase, Oxidase, Citrate Utilization test, Methyl red, Indole test, Voges Proskauer test, and sugar fermentation and ABIS online identification tool (Cheesbrough, 2005)

Antibiotic Susceptibility Technique

The Kirby Bauer disk diffusion method was used on sterile Mueller-Hinton agar to assess the antimicrobial susceptibility profiles of the isolates to conventional antibiotics. Standardization of the *Salmonella* isolates was conducted by adjusting to 0.5 McFarland turbidity standards (x10^8 cells). The swab was deepened into suspension and streaked over the surface of the agar plates, rotating the agar plate 60º to ensure appropriate distribution of the inoculum. The plates were air dried for 3–5 min.

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Conventional antibiotics disk (Oxoid™) impregnated with Septrin (30μg), Chloramphenicol (30μg), Sparfloxacin (10μg), Ciprofloxacin (30μg) Amoxicillin (30μg), Augmentin (10μg), Gentamicin (30μg), Pefloxacin (30μg), Tarivid (10μg) and Streptomycin (30μg), Ciprofloxacin (10μg), Norfloxacin (10μg), Amoxil (20μg), Gentamicin (10μg), Ampiclox (20μg), Streptomycin (30μg), Rifampicin (20μg), Erythromycin (30μg), Chloramphenicol (30μg) and Levofloxacin (20μg), were aseptically placed on the surface of the inoculated agar plate with sterile forceps. The disk was pressed down to make full contact with the surface of the agar. The plates were then incubated for 24 hours at 33 to 35ºC in an inverted position. The zones of inhibition were measured in millimeter (mm) and compared to (CLSI, 2017).

Determination of Multiple Antibiotic Resistance (MAR) index

According to Krumperman, (1985), multiple antibiotic resistance refers to bacterial isolates' resistance to three or more different antibiotics. Multiple antibiotic resistance (MAR) index was determined by using the formula MAR = a/b, where ''a'' represent the number of antibiotics to which the test isolates depicted resistance and ''b'' refers to the total number of antibiotics to which the test isolate has been tested for susceptibility

Data Analysis

The data obtained was analyzed using analysis of variance (ANOVA) to test for significance and where differences occur Duncan multiple range test was used to separate the means using the Statistical Package for Social Science (SPSS) version 27 (Bewick *et al.*, 2004).

Results

Generally, the study recorded significant population of bacteria from the raw and ready to eat *Rhynchophorus phoenicis* with no significant difference ($p \leq 0.05$) across the various markets (Table 1). In raw samples, the total heterotrophic bacterial counts (THB) ranged from 5.0 ± 0.5 to 5.5 ± 1.1 ($\times 10^5$ CFU/g); Total staphylococcal counts (TSC) ranged from 1.7 ± 0.3 to 4.3 ± 1.6 ($\times 10^4$ CFU/g); total coliform count (TCC) ranged from 1.2 ± 0.2 to 2.3 ± 0.4 ($\times 10^2$ CFU/g) and total *Salmonella shigella* counts (TSSC) ranged from to 1.7 ± 0.2 to 2.5 ± 0.7 ($\times 10^3$ CFU/g) in Iwofe and Rumuokoro markets respectively. In the Ready-to-eat samples, the total heterotrophic bacterial counts (THB) ranged from 2.8 ± 0.7 to 4.9 ± 0.7 ($\times 10^5$ CFU/g); Total staphylococcal counts (TSC) ranged from 2.5 ± 0.6 to 4.3 ± 0.4 ($\times 10^4$ CFU/g); total coliform count (TCC) ranged from 1.9 ± 0.4 to 2.5 ± 0.8 ($\times 10^2$ CFU/g) and total *Salmonella shigella* counts (TSSC) ranged from 1.6 ± 0.8 to 2.6 ± 0.8 ($\times 10^3$ CFU/g) in Iwofe and Rumuokoro markets respectively.

The prevalence of the bacteria from the raw samples revealed that *Pseudomonas aeruginosa* (18.9%) had that highest occurrence followed closely by *Micrococcus luteus* (17.9%) and *Klebsiella oxytoca* (2.8%) had the least prevalence. In the Ready-to-eat samples, Staphylococcus aureus (32.3%) was the most prevalent bacteria and *Pseudomonas aeruginosa* (6.5) had the least occurrence from the forty (40%) samples analysed in this study. The result of the susceptibility pattern of the bacterial isolates revealed that *Escherichia coli* was resistant to Chloramphenicol, Sparfloxacin, Augmentin and Streptomycin (100%) and sensitive to Septrin, Ciprofloxacin, Amoxicillin, Gentamicin, Perfloxacin and Ofloxacin (100%). *Klebsiella oxytoca* were resistant to Chloramphenicol, Sparfloxacin,

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Augmentin, Amoxicillin and Gentamicin and sensitive to Perfloxacin, Ofloxacin, Streptomycin, Septrin and Ciprofloxacin (100%). *Proteus mirabilis* were resistant to Chloramphenicol, Sparfloxacin, Septrin, Augmentin and Amoxicillin (100%) and sensitive to Perfloxacin, Ofloxacin, Streptomycin, Gentamicin and Ciprofloxacin (100%). *Salmonella enterica* were resistant to Chloramphenicol, Sparfloxacin, Augmentin and Amoxicillin (100%) and sensitive to Perfloxacin, Ofloxacin, Streptomycin, Septrin, Gentamicin and Ciprofloxacin (100%). *Serratia marcescens* were resistant to Sparfloxacin, Septrin and Gentamicin (100%) and sensitive to Perfloxacin, Ofloxacin, Streptomycin, Ciprofloxacin, Chloramphenicol, Augmentin and Amoxicillin (100%). *Pseudomonas aeruginosa* was resistant to all the antibiotics which includes; Sparfloxacin, Septrin, Gentamicin, Perfloxacin, Ofloxacin, Streptomycin, Ciprofloxacin, Chloramphenicol, Augmentin and Amoxicillin (100%) while *Citrobacter freundii* were resistant to Chloramphenicol, Augmentin, Amoxicillin, Sparfloxacin and Ciprofloxacin (100%) but were susceptible to Septrin, Gentamicin, Perfloxacin, Ofloxacin and Streptomycin (100%). *Staphylococcus aureus* was resistant to Norfloxacin, Gentamicin, Streptomycin Erythromycin, Chloramphenicol (100%) and sensitive to Amoxil, Rifampicin, Ampiclox, Levofloxacin and Ciprofloxacin (100%). *Micrococcus luteus* were resistant to Amoxil, Ampiclox and Chloramphenicol (100%) and sensitive to Norfloxacin, Gentamicin, Streptomycin, Erythromycin, Rifampicin, Levofloxacin and Erythromycin (100%). The multiple antibiotic resistance index revealed that all the bacterial isolates had a MAR index greater than 0.2.

Table 2: Bacterial Population of Raw *Rhynchophorus phoenicis* from various Markets (Cfu/g)

Markets	THB x10^5	TSC x10^4	TCC x10^2	TSSC x10^3
Iwofe	5.5±1.1[a]	4.3±1.6[a]	1.2±0.2[a]	2.5±0.7[a]
Mile 3	5.5±0.4[a]	1.7±0.3[a]	1.7±0.3[a]	1.9±0.4[a]
Rumuokoro	5.0±0.5[a]	2.3±0.4[a]	2.3±0.4[a]	1.7±0.2[a]

*Means with similar superscript down the group showed no significant difference (P>0.05)
KEY: THB- Total Heterotrophic Bacteria, TSC- Total *Staphylococcal* Count, TCC- Total Coliform, Count, TSSC- Total *Salmonella-Shigella* Count

Table 3: Bacterial Population of Ready-To-Eat *Rhynchophorus phoenicis* from various Markets:

Markets	THB x10^5	TSC x10^4	TCC x10^2	TSSC x10^3
Iwofe	2.8±0.7 [a]	2.5±0.6 [a]	2.5±0.8 [a]	1.6±0.8 [a]
Mile 3	4.9±0.7 [a]	3.3±0.4 [a]	2.4±1.4 [a]	2.6±0.8 [a]
Rumuokoro	4.1±1.5 [a]	4.3±0.4 [a]	1.9±0.4 [a]	2.6±0.9 [a]

*Means with similar superscript down the group showed no significant difference (P>0.05)
KEY: THB- Total Heterotrophic Bacteria, TSC- Total *Staphylococcal* Count, TCC- Total Coliform, Count, TSSC- Total *Salmonella-Shigella* Count
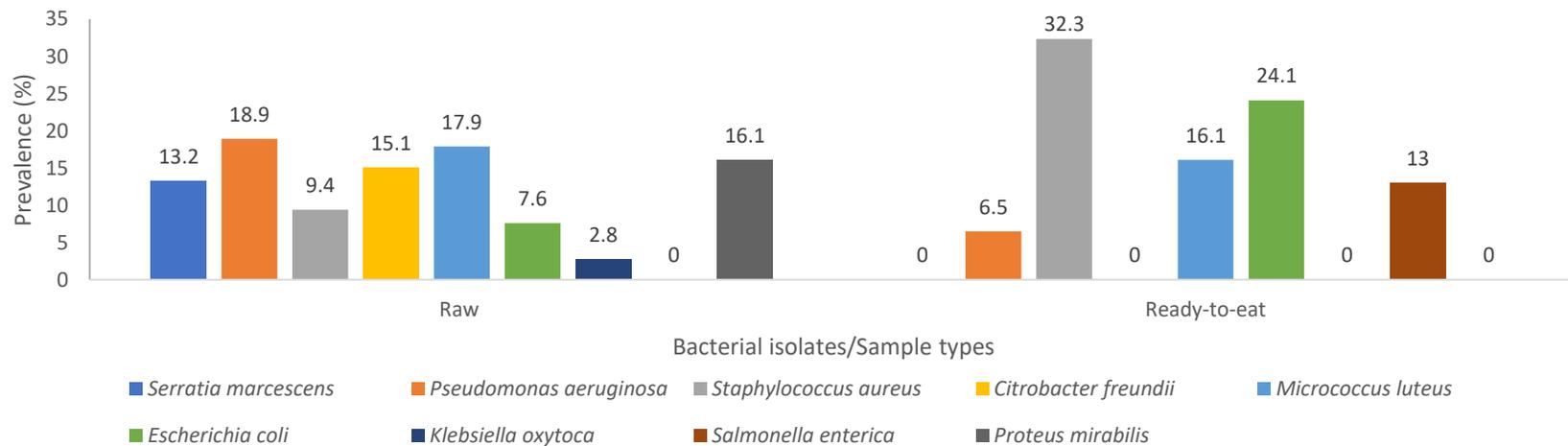

Figure 1: Prevalence of the Bacteria in the Raw and Ready-to-Eat *Rhynchophorus phoenicis*

Table 4: Susceptibility Pattern of Gram-negative Bacteria isolated from *Rhynchophorus phoenicis*

Antibiotics	*Escherichia coli* n (%) =23		*Klebsiella oxytoca* n(%) =3		*Proteus mirabilis* n (%)=15		*Salmonella enterica* (%)=8	n	*Serratia marcescens* (%)=14	n	*Pseudomonas aeruginosa* n (%)=24		*Citrobacter freundii* n (%)=16	
	R	S	R	S	R	S	R	S	R	S	R	S	R	S
ST (30µg)	0	23(100)	0	3(100	15(100)	0	8(100)	0	14(100)	0	24(100)	0	0	16(100)
CH (30µg)	23(100)	0	3(100)	0	15(100)	0	8(100)	0	0	14(100)	24(100)	0	16(100)	0
SP (10µg)	23(100)	0	3(100)	0	15(100)	0	0	8(100)	14(100)	0	24(100)	0	16(100)	0
CPX (10µg)	0	23(100)	0	3(100)		15(100)	0	8(100)	0	14(100)	24(100)	0	16(100)	0
AM (30µg)	0	23(100)	3(100)	0	15(100)	0	8(100)	0	0	14(100)	24(100)	0	16(100)	0
AU (10µg)	23(100)	0	3(100)	0	15(100)	0	8(100)	0	0	14(100)	24(100)	0	16(100)	0
CN (30µg)	0	23(100)	3(100)	0	0	15(100)	0	8(100)	14(100)	0	24(100)	0	0	16(100)
PEF (30µg)	0	23(100)	0	3(100)	0	15(100)	0	8(100)	0	14(100)	24(100)	0	0	16(100)
OFX (30µg)	0	23(100)	0	3(100)	0	15(100)	0	8(100)	0	14(100)	24(100)	0	16(100)	0
S (30µg)	23(100)	0	0	3(100)	15(100)	0	0	8(100)	0	14(100)	24(100)	0	0	16(100)

Key: ST- Septrin, CH- Chloramphenicol, SP-Sparfloxacin, CPX- Ciprofloaxcin, AM-Amoxicillin, AU-Augmentin, CN- Gentamicin, PEF-Perfloxacin, OFX-Ofloxacin, S- Streptomycin, Note: The bacterial isolates were not intermediately susceptible to any antibiotics

Table 5: Susceptibility Pattern of Gram-positive Bacteria isolated from *Rhynchophorus phoenicis*

Antibiotics	*Staphylococcus aureus* n (%)=30		*Micrococcus luteus* n (%)=37	
	R	S	R	S
LEV (20µg)	0	30(100)	0	37(100)
CPX (10µg)	0	30(100)	0	37(100)
NB (10µg)	30(100)	0	0	37(100)
CN (10µg)	30(100)	0	0	37(100)
AMX (10µg)	0	30(100)	37(100)	0
S (30µg)	30(100)	0	0	37(100)
RD (20µg)	0	30(100)	0	37(100)
E (30µg)	30(100)	0	0	37(100)
CH (30µg)	30(100)	0	37(100)	0
APX (20µg)	0	30(100)	37(100)	0

KEY: LEV- Levofloxacin, CPX- Ciprofloxacin, NB- Norfloxacin, CN- Gentamicin, AMX- Amoxil, S- Streptomycin, RD- Rifampicin, E- Erythromycin, CH- Chloramphenicol, APX- Ampiclox Note: The bacterial isolates were not intermediately susceptible to any antibiotics

Table 6: Multiple Antibiotic Resistance (MAR) Index

Bacterial Isolates	Raw				Ready-to-eat			
	0.1	0.2	0.3	0.4	0.2	0.3	0.4	0.5
Escherichia coli n=23	0(0.00)	3(13.04)	0(0.00)	18(78.26)	0(0.00)	2(8.69)	0(0.00)	0(0.00)
Klebsiella oxytoca n=3	0(0.00)	1(33.33)	2(66.67)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)
Proteus mirabilis n=15	0(0.00)	0(0.00)	10(66.67)	0(0.00)	0(0.00)	0(0.00)	5(33.33)	0(0.00)
Salmonella enterica n=8	0(0.00)	3(37.5)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	5(62.5)	0(0.00)
Serratia marcescens n=14	5(35.71)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	9(64.29)	0(0.00)	0(0.00)
Pseudomonas aeruginosa n=24	24(100))	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)
Citrobacter freundii n=16	0(0.00)	9(56.25)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	7(43.75)
Staphylococcus aureus n=30	0(0.00)	0(0.00)	0(0.00)	15(50)	0(0.00)	15(50)	0(0.00)	0(0.00)
Micrococcus luteus n=37	0(0.00)	15(40.54)	12(32.43)	0(0.00)	10(27.03)	0(0.00)	0(0.00)	0(0.00)

Discussion

Rhynchophorus phoenicis, can harbor various bacteria, including potential foodborne pathogens. These bacteria can be present in significant quantities, potentially posing health risks if consumed (Amadi *et al*., 2014)

The bacterial counts from raw and ready-to-eat larvae of African palm grub Iwofe market were relatively high and the enormous degree of contamination in these ready-to-eat foods may not be unrelated to the processing environment, initial microbial loads, extent of exposure at selling points, and food handling by food vendors (Adebukola *et al*., 2015). High counts of bacteria in ready to eat *Rhynchophorus phoenicis* renders them unfit for man consumption according to ICMSF, (2002) and it is also a pointer of possible presence of associated enteric pathogens which raises a suspicion of poor food handling, poor hygiene during preparation, handling and storage, lack of reheating and improper vending temperatures practice and may represent a risk to the consumers (Adebukola *et al*., 2015).

The contamination of these ready to eat (RTE) sold larvae of *Rhynchophorus phoenicis* can be attributed to a number of factors; Firstly, during sample collection, it was observed that the RTE were poorly covered and this caused insects infestation. Additionally, the non-availability of proper water systems could further pose as a challenge to food vending practices requiring lots of water for hygienic operations, as food vendors are managing very little water at sales point, thereby undermining some sanitary practices such as frequent washing of hands especially after contact with suspicious matter like faeces (Cardinale *et al*., 2015).

Bacteria such as *Staphylococcus aureus, Micrococcus luteus*, *Escherichia coli, Klebsiella oxytoca, Proteus mirabilis, Salmonella enterica, Serratia marcescens Pseudomonas aeruginosa* and *Citrobacter freundii* were isolated in this study and their presence in cooked foods suggest improper and repeated food handling after food processing. This can be as a result of the high intake of pollutants and contaminants from various sources such as soil, water, surface substances that are being discharged into the environment.

The result of the current study is in keeping with that of Amadi *et al*. (2016), who also reported a high prevalence of similar microorganisms in RTE in Rivers State, Nigeria. The presence of these bacteria in RTE larvae of *Rhychophorus phoenicis* is a confirmation that during food preparation and processing, pathogenic bacteria may be transferred to such food items by food handlers both directly or by cross contamination through hands, surfaces, utensils and equipment that have been inadequately cleaned and disinfected between the preparation of different types of food as initially asserted by Toit and Venter (2005).

Antimicrobial resistance from foods is of global concern (Kumar *et al*., 2005; Sampson *et al*., 2020). There were varying degrees of resistance of the bacteria to the commercial antibiotics in this study. Overall, the bacteria (*Staphylococcus aureus, Micrococcus luteus*, *Escherichia coli, Klebsiella oxytoca, Proteus mirabilis, Salmonella enterica, Serratia marcescens Pseudomonas aeruginosa* and *Citrobacter freundii*) were sensitive to Perfloxacin and Ofloxacin (100%) and resistant to chloramphenicol. High degree of sensitivity of different organisms to ofloxacin has been previously reported (Okonko *et al*., 2008; Mordi and Momoh, 2009; Afolabi *et al*., 2017).

According to Harakeh *et al*. (2005) and Guven *et al*., (2010), meals prepared in the street provide a suitable culture medium for most pathogenic bacteria such as *Staphylococcus aureus, Micrococcus luteus*, *Escherichia coli, Klebsiella oxytoca, Proteus mirabilis, Salmonella enterica, Serratia marcescens Pseudomonas aeruginosa* and *Citrobacter freundii* impervious to various antibiotics and transmitted to people via street (ready to eat) foods that are contaminated. The resistance of *S. aureus* to antibiotics is as a result of exopolysaccharide obstruction and their sites inside micro abscesses which reduce the actions of drugs (Gundocan *et al*., 2006). Food handlers and the surrounding that harbour antibiotic resistant bacteria strains transfer their resistant genes to the sustenance likely because of their poor cleanliness and sanitation or the misuse of antibiotic administrations.

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Conclusion

The study revealed the presence of potential food pathogens such as *Staphylococcus aureus, Micrococcus luteus*, *Escherichia coli, Klebsiella oxytoca, Proteus mirabilis, Salmonella enterica, Serratia marcescens Pseudomonas aeruginosa* and *Citrobacter freundii* in raw and ready to eat larvae of African palm grub (*Rhynchophorus phoenicis*) and *Staphylococcus aureus* being the most prevalent bacteria revealing sanitary and processing issues. The bacteria isolated had varying susceptibility pattern to the antibiotics and ofloxacin and pefloxacin could be the drug of choice for the treatment of infections arising from the consumption of raw or ready to eat *Rhynchophorus phoenicis.* Proper food safety practices during their processing, handling and preparation should be encouraged. By implementing measures like thorough cleaning and storage, it can minimize the risk of bacterial contamination and keep consumers safe. Additionally, emphasizes are needed for responsible antibiotic use in the farming and rearing of African palm grubs to prevent further spread of antibiotic resistance.

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