# Microbial Assessment of Ready-to-Eat Fried Grasshopper Sold in Jos and its Environs

***Dawang, D.N and Gogwim, F. T***
*Science Department, Plateau State Polytechnic, Barkin Ladi, Nigeria*
*+2348035864362*

**Abstract:** Food is an important basic necessity but its procurement, preparation and consumption are vital for the sustenance of life. Unfortunately it is also a vehicle of disease spread. The aim of this research is to determine the microbial quality of ready- to- eat grasshoppers being sold within Jos and its environs. Two hundred (200) samples were purchased from 10 different locations within Jos and its environs in sterile polythene bags and taken to Microbiology Laboratory of Plateau State Polytechnic, Barkin Ladi for analysis. These samples were ground separately and lg of each of them was homogenized in 100ml of sterile distilled water. One milliliter from homogenate was introduced into 9ml of sterile distilled water and serially diluted into 9 other test tubes. One milliliter from each of the last test tubes from the ten samples was inoculated into 20ml of nutrient agar and incubated at 37°c for 24hrs.The colonies were characterized using standard microbiological and biochemical methods, lg of each of the samples was inoculated on Sabouraud dextrose and incubated for 18- 72hrs (fungal isolation).The fungal isolates were then characterized based on microscopic appearance. Total of 6 genera of bacteria were isolated such as *Bacillus* species, *Lactobacillus* species, *Staphylococcus aureus*, *Proteus* species, *Salmonella* species and *Esherichia coli.* Also, 7 species of fungi were isolated namely, *Aspergillus niger*, *Aspergillus flavus, Aspergillus fumigates, Trichophyton mentagrophyte, Trichophyton rubrum* and Yeast. Both bacteria and fungi isolated are pathogenic and harmful to man because they produce micro toxins. It was concluded that, ready-to-eat grasshopper sold in this study area are unacceptable and unsafe for human consumption.

**Key words:** Ready -to-eat, fried grasshopper, food, microbial contaminants, hawkers, Jos

## Introduction

Food safety is the assurance that food will not cause harm to the consumer when it is prepared and eaten according to its intending use or purpose. Many people fall ill and suffer from serious disorders, long complication or die as a result of eating an unsafe food (WHO, 2001). Food is said to be unsafe when it has been contaminated and this is as a result of mishandling, preparation, processing, using unclean utensils, unclean environment and poor personnel hygiene (*www.slideshare.net/nasreenbegun31542/food-safety-and-hygiene*).

Grasshopper is an insect eaten by humans in Africa. The *Zonocerus variegatus* is normally gathered both in field crops and fallows. It is best consumed after being fried in red oil with salt and pepper and sometime garnished with other spices. It is rich in organic and inorganic substances like fats, protein, minerals like calcium, magnesium and vitamins A, B and C (Banjo *et al.*, 2006). Previous work on the chemical analysis of these grasshoppers had shown them to contain crude protein, crude fibre, crude lipid and array of essential amino acid in the right proportion (Solomon and Umoru, 2008).

Kekeunou *et al.* (2006) reported that the highest diversity of edible insect species is found in the orders- Lepidoptera, Coleoptera and Orthoptera. Grasshoppers are not only found in Africa but in many places around the world and they are eaten as source of food, protein and delicacy.

Food is an important basic necessity, its procurement, preparation and consumption is vital for the sustenance of life. Since grasshoppers are eaten as food, they are prone to be contamination due to poor handling. The diseases on food are common and are persistent problem that result in illness or death. Food borne disease or illness is referred to as food poisoning which is as a result of contamination and this attributes to wide variety of bacteria (WHO, 2001).

In Borno State of Nigeria, giant grasshoppers *Zonocerus variegatus* is widely eaten as a delicacy. These grasshoppers weighing 10 to 15 grams are caught at night during cold weather (November – February) boiled and then roasted. The roasted grasshoppers are then displayed in different markets and sold as meat (Solomon and Umoru,2008).In some countries like Middle East, grasshoppers are boiled in hot water with salt, left on the sun to dry then eaten as snacks (Andrew, 2008).

In Mexico, Chapulines (grasshopper) are usually or mostly consumed in Oaxaca where they are sold as snacks at local spot event and it is a very good source of food and protein in Oaxaca. They are served on skewers in Chinese food markets (Andrew, 2008).

Air and dust have long been recognized as a source of microbial contamination. The air borne microbes are a potential source of microbiological contamination in meat product (Patel, 2009).Air is said to be full of microorganisms, especially bacteria spores. Unfortunately, most of the hawkers expose their foods which can lead to contamination with such

*Corresponding author:
*ademnaan@yahoo.com* ***Dawang, D.N***

microorganisms such as *Bacillus* species, *Penecillium* species and *Staphylococcus aureus*.

Fungi (mould and yeast) are considered as a food borne micro-organisms that can cause diseases when ingested. Fungi that cause food borne diseases include *Aspergillus* species, *Trichophton* species, Mucor and yeast (Paterson and Lima, 2017).

Beside diseases that can be caused by microbial contaminants on grasshoppers, some grasshoppers can pose health problems to humans (Eilenberg *et al.*, 2015). For instance, toxicity of *Z.variegatus* has been linked to alkaloids presence in the body of the grasshopper (Kekeunou *et at.*, 2016)

**Methodology**

Two hundred samples of fried ready to-eat grasshoppers were collected from 10 different locations within Jos and its environs in the year 2012 and taken to Microbiology Laboratory of Plateau State Polytechnic, Barkin Ladi for analysis. These samples were grouped as follows: Group A (Gada Biyu), B (Tudun Wada), C (Terminus Main Market, D (Dadin Kowa), E (Federal Secretariat), F (Kugiya Market),G (Kadima Market), H (Farin Gada Market, I (Bukuru Market) and J(Gyel Market).

Sterile mortar and pestle were used to grind the samples. One gram of each of the samples was weighed using analytical weighing balance. The weighed sample was then poured into 100ml of sterile distilled water and homogenized. One milliliter from homogenate was introduced into 9ml of sterile distilled water and serially diluted into 9 other test tubes. One milliliter from each of the last test tubes from the ten samples was inoculated into 20ml of nutrient agar and incubated at $37^0$c for 24 hours for bacterial isolation. The plates showed different colonies (different shapes and colours) and the colonies were counted using colony counter. Each of the colonies was picked for gram staining and subjected to biochemical tests such as mobility, indole, urease, catalase and coagulase.

**Fungal Isolation**

One gram of each of the grounded sample was inoculated into sabouraud dextrose agar and was incubated at room temperature for 48 hours. Isolates were characterized based on macroscopic and microscopic appearance (Chessbrough, 2003, Ogeleke and Manga, 2008).A drop of lactophenol cotton blue was placed on a clean slide. Using sterile inoculating needle, a small portion of the fungi growth seen after incubation at room temperature was picked and placed on the lactophenol cotton blue and teased gently to spread out in the mounting medium, then covered with a cover slide and then examined using x10 and x40 objective of the microscope.

**Results**

The total viable count of bacteria from the cultured ready to-eat fried grasshoppers are indicated in Table 1 with Group B (Tudun Wada) and F (Kugiya Marke) having the highest total of coliform count of $6.7x10^{11}$cfu/ml, followed by D (Gada Biyu) with $5.6x10^{11}$cfu/ml, A (Dadin Kowa) and C (Terminus Main Market) having $4.6 x10^{11}$cfu/ml, E (Gyel Market) $3.3x10^{11}$cfu/ml, G (Kadima Market $2.1x10^{11}$cfu/ml, H (Farin Gada Market) $1.8x10^{11}$cfu/ml, I (Bukuru Market) $1.2x10^{11}$cfu/ml, and the last Group J (Federal Secretariat) having the least total coliform count of $1.0x10^{11}$cfu/ml.

In the microbial isolation, 6 genera of bacteria were isolated (Table 2). They included *Bacillus Species, Lactobacillus species Staphylococcus aureus, Proteus species, Salmonella species and Esherichia coli. Bacillus* species were found to be highest in appearance in all of the 10 locations followed by *Staphylococcus aureus* and *E.coli* in seven locations, while *Lactobacillus* were found only in six locations. *Proteus* was found in five of the locations and *Salmonella* found in only one location.

Fungi growths were numerous with about 3 genera which included *Mucor species, Aspergillus niger, Aspergillus flavus, Aspergillus fumigates, Trichophyton mentagraphyte, Trichophyton rubrum* and yeast(Table 3). *Aspergillus species* were found to be dominating being found in 6 or 8 of the locations.

***Table 1.Microbial load of ready-to-eat grasshopper per Location***

| | Locations | Total variable count (cfu/ml) |
|---|---|---|
| A | Dadin Kowa | $4.6x10^{11}$ |
| B | Tudun Wada | $6.7x10^{11}$ |
| C | Terminus Main Market | $4.6x10^{11}$ |
| D | Gada Biyu | $5.6x10^{11}$ |
| E | Gyel Market | $3.3x10^{11}$ |
| F | Kugiya Market | $6.7x10^{11}$ |
| G | Kadima Market | $2.1x10^{11}$ |
| H | Farin Gada | $1.8x10^{11}$ |
| I | Bukuru Market | $1.2x10^{11}$ |
| J | Federal Secretariat | $1.0x10^{11}$ |

**Table 2:Bacteria Isolation from ready-to-eat fried g/hopper from Jos and Environ**

| Organism/Location | A | C | J | D | B | F | G | H | I | E |
|---|---|---|---|---|---|---|---|---|---|---|
| *Bacillus species* | + | + | + | + | + | + | + | + | + | + |
| *Lactobacillus species* | + | + | - | + | + | + | + | - | - | - |
| *Staphylococcus aureus* | + | - | - | + | + | + | + | + | - | + |
| *Salmonella* | - | - | - | - | + | - | - | - | - | - |
| *Proteus species* | + | - | - | - | + | + | + | - | - | + |
| *Escherichia coli* | + | + | - | + | - | + | - | + | + | + |

**Key:** + =Present, - =Absent, A=Dadin-Kowa; C=Terminus Main Market; J=Federal Secretariat; D=Gada-Biyu; B=Tudun-Wada; F=Kugiya Market; G=Kadima Market; H=Farin Gada Market; I=Bukuru Market; E=Gyel Market, g/hopper=Grasshopper

**Table3:Fungi Isolation of ready-to-eat fried grasshopper from Jos andEvirons**

| Organism/Location | A | B | D | C | J | F | G | H | I | E |
|---|---|---|---|---|---|---|---|---|---|---|
| *Aspergillus flavus* | + | + | + | + | - | + | + | + | - | + |
| *Aspergillus niger* | + | - | - | + | + | + | - | + | + | - |
| *Aspergillus funigates* | + | + | + | - | + | - | + | + | + | + |
| *Trichophyton rubrum* | + | - | - | + | - | + | - | + | - | + |
| *Trichophyton mentagrophte* | - | + | - | - | + | - | - | + | - | + |
| *Yeast* | - | - | - | + | - | - | - | - | + | + |
| *Mucor Species* | + | + | + | - | - | + | + | - | - | - |

*Key:* + = Present; - =Absent; A =Dadin-Kowa; C=Terminus Main Market;J=Federal Secretariat; D=Gada-Biyu; B=Tudun-Wada; F= Kugiya Market; G=Kadima Market; H=Farin Gada Market; I=Bukuru Market; E= Gyel Market

**Discussion.**

The isolation of microorganisms from ready – to-eat fried grasshoppers gives a good picture of contaminants which may be as a result of poor sanitary and unhygienic handling. This is likely because after the preparation of these grasshoppers, they are left open while hawking around the streets for sell, allowing flies to perch on them, thereby exposing the grasshoppers to contamination by microorganisms carried on the bodies of these flies. Isolation of some of the microorganisms in this study area is similar to those isolated from fried fish from Central Nigeria (Chukwu *et al.*, 2009). Bacterial species like *Proteus* sp., *Escherichia coli*, *Lactobacillus* sp., *Bacillus cereus* and *Staphylococcus* sp. isolated is in line with the earlier isolation of the same organisms by Idowu and Edema (2002) and Akpan and Chinwendu (2007). It was seen that *Bacillus* species is a major contaminant in the samples in this study area is likely due to their easy distribution of spores in the environment and due to the fact that spores can withstand harsh environmental conditions. Nduka (2004) reported that *Bacillus cereus* and *Bacillus subtilies* are agents of food poisoning. This may therefore indicates that consuming these grasshoppers may cause harm to the eaters.

The presence of *Escherichia coli* and *Staphylococcus aureus* in the ready -to- eat fried grasshoppers are harmful to man when ingested even though they are normal flora in human and animal. Their presence in food indicate contamination due to mishandling by human (Assefa *et al.*2015).Also the presence of coliforms like *E.coli* and *Proteus* species in food which are indicators of faecal contamination due to mishandling, unsanitary conditions and in market places where they are exposed to air, dust and flies renders such product unsafe for consumption.

Salmonella in food leads to food poisoning (salmonellosis) and this is a public health concern. It was isolated probably due to contamination from water the food handlers used poor hygienic condition and contaminated utensils (Maizun and Nyi, 2002).

The isolation of fungi such as *Aspergillus flavus, Aspergillus niger* and *Mucor* sp is in conformity with that of Balogun and Fagade (2004). Fungi species like *Aspergillus* species, *Trichophyton* species and *Mucor* from this work is significant as they are known to produce some toxins which are dangerous for human consumption. Their presence may be as a result of improper hygiene and exposure of this food (ready -to-eat fried grasshopper) by the food vendors during which wind carries the spores and transmit these fungi to such exposed food (Lauren *et al.*, 1997, Robert *et al.*, 1984). Some of the microbes outlined here have been isolated from the *Z.variegatus* gut (Idowu and Edema, 2002) and if this assertion is true then the removal of the *Z. variegatus* gut during the processing of the grasshopper for food can reduce the possibility of consumer infection. The validation of the consumption of this

grasshopper formalises a permanent collection for local consumption and for cans industries which invest in the canning of *Z. variegates* as opined by Kekeunou *et al.* (2016). These actions will promote the picking up and reduce spawning in the wild, which will eventually result in reduction of adverse effects on crops and boost agriculture which is one aspect of Nigeria economic diversification of this present government (Kekeunou *et al.*, 2016). Also, the use of edible insects as food and feed can play a significant role in ensuring food security and improving the likelihood of humans especially Africans if properly harnessed (Kelemu *et al.*, 2015).

In conclusion, the presence of these pathogens (bacteria and fungi isolates) in ready-to-eat fried grasshoppers sold and/or consumed in this area make them unsafe for consumption. Therefore, all materials to be used in the storage and for sell of grasshopper should be sterile and the grasshopper sellers should be screened to avoid carriers-transmitting pathogens to food.

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