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FOREWORD

I warmly welcome all and sundry to the volume 3 issue 1 of Federal Polytechnic – Journal of Pure and Applied Sciences (FEPI-JOPAS) which is a peer reviewed multi-disciplinary accredited Journal of international repute. FEPI-JOPAS publishes full length research work, short communications, critical reviews and other review articles. In this issue, readers will find a diverse group of manuscripts of top-rated relevance in pure and applied science, engineering and built environment. Many of the features that you will see in the Journal are result of highly valuable articles from the authors as well as the collective excellent work of our managing editor, publishing editors, our valuable reviewers and editorial board members.

In this particular issue, you will find that Joseph and Adebanji provided innovative technology on light traffic control system. Ogunkoya and Sholotan engaged standard method for microbiological assessment of shawarma from Igbesa metropolis for possible microbial contamination. Ilelaboye and Kumoye unveiled the effect of inclusion of different nitrogen source on growth performance of mushroom. Ogunyinka et al utilized Fletcher Reeves conjugate gradient method as a robust prediction model for candidates' admission to higher institutions. Omotola and Fatunmbi examined the impact of thermal radiation with convective heating on magnetohydrodynamic (MHD), incompressible and viscous motion of non-Newtonian Casson fluid. Aako and Are meticulously investigated factors affecting mode of delivery using binary dummy dependent models. Abiaziem and Ojelade successfully synthesized biologically active silver nanoparticles using *Terminalia catappa* bark as the eco-friendly source.

In addition, Olowosebioba et al. assessed the rectifying effects of various diodes in power supply units using multisim circuit design software programme. Olujimi et al. successfully accomplished the use of fingerprint based biometric attendance system for eliminating examination malpractices with enhanced notification. Alaba reported the nutritional status assessment of school age children (6-12 years) in private primary school in Ilaro. Muhammed-lawal et. al. assessed the execution and effect of corporate social responsibilities and return to marketing. Awolola and Sanni's research was about achieving quality of engineering education and training in Nigeria using Federal Polytechnic, Ilaro as the case study. Oladejo and Ebisin expatiated on virtual laboratory as an alternative laboratory for science teaching and learning.

Finally, Aneke and Folalu investigated the prospect and problems of the hotels in Ilaro, Ogun State.

I would like to thank and extend my gratitude to my co-editors, editorial board members, reviewers, members of FEPI-JOPAS, especially the Managing Editor, as well as the contributing authors for creating this volume 3 issue 1. The authors are solely responsible for the information, date and authenticity of data provided in their articles submitted for publication in the Federal Polytechnic Ilaro – Journal of Pure and Applied Sciences (FEPI-JOPAS). I am looking forward to receiving your manuscripts for the subsequent publications.

You can visit our website (https://www.fepi-jopas.federalpolyilaro.edu.ng) for more information, or contact us via e-mail us at fepi.jopas@federalpolyilaro.edu.ng.

Thank you and best regards.

E-Signed
Prof. Olayinka O. AJANI

FEPI-JOPAS VOLUME 3 ISSUE 1 TABLE OF CONTENTS

FEPI-JOPAS VOLUME 3 ISSUE 1 TABLE OF CONTENTS

FEPI-JOPAS VOLUME 3 ISSUE 1 TABLE OF CONTENTS

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MICROBIOLOGICAL ASSESSMENTS OF "SHAWARMA" A READY TO EAT STREET FOOD IN IGBESA, OGUN STATE, NIGERIA

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Abstract

The quality of "sharwama", a ready-to-eat food sold in Igbesa metropolis, Ogun state was assessed for possible bacterial contamination. Hundred and twenty shawarma samples were obtained from four different sites which include food service centers and roadside vendors. The samples were prepared and analyzed using standard procedures. The mean counts of heterotrophic isolates, coliform, *Staphylococcus* and *Salmonella Shigella* ranged from 20 x 10^4 to 40 x 10^4cfu/g, 10 x 10^3 to 18 x 10^3cfu/g, 10 x 10^4 to 15 x 10^4cfu/g and 14 x 10^3 to 21 x 10^3cfu/g respectively. Eight bacterial genera that include *Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella* spp., *Enterobacter* spp., *Shigella* spp., *Salmonella* spp., and *Proteus* spp. were isolated from the food samples. The presence of enteric organisms and *Staphylococcus aureus* in the samples showed a high rate of contamination which might be as a result of bad food handling practices and faecal contamination from the processors. Enforcement of sanitary and hygienic measures during processing and packaging of ready-to-eat food should be done.

Key Words: ready-to-eat food, isolates, enteric, sharwama, contamination, sanitary

INTRODUCTION

Foods are nutritious matters that are ingested either in solid or liquid form that in turn provide energy, improved health, and alleviate disease after their metabolism. Foods that are free from contaminants are essential for human health. According to World Health Organization (2000), world health is hinged on the availability of safe food. However, foods are usually contaminated with spoilage or pathogenic microorganisms. The pathogens possess the ability to cause disease with varying degrees of injuries and even death, especially, if the means of production, storage, and distribution enhance the survival and proliferation of the organisms. Furthermore, their presence in foods cannot be detected with human sense organs. Eaten-as-sold foods (EAS) are beverages, fermented vegetables or baked foods ingested as prepared without additional cooking or heating, and sold along the street, parks, or resource centres. According to Powers and Barrow (1999), EAS takeaways account for sales of a huge source of food service outputs. These foods are now popular in developing countries due to economic changes, population growth, and urbanization.

According to Mensah, Yeboah-Manu, Owusu-Darko, Ablordey, (2002), several factors that are associated with foodborne diseases arising from the consumption of EAS foods are abound but not limited to poor storage facilities, lack of hygienic practices, transportation of cooked foods in contaminated vehicles, poor cooking methods, heating of food at temperatures that support and enhance the growth of microbes, poor manufacturing or handling. EAS foods have been attributed to outbreak of various foodborne diseases (Gilbreth, Call, Wallace, Scott, Chen, & Luchansky, 2005); Gibbons, Adesiyun, Seepersadsingh, & Rahaman, 2006). Factors such as handling, ingredients, processing, packaging materials, and storage play critical roles in the microbiological load of EAS, and these may further influence the proliferation of microbes on EAS foods at sales point (Beuchat & Ryu, 1997; Angelids, Chronis, Papageorgiou, Kazakis, Arsenoglou, & Stathopoulous, 2006).

An increase in adverse health effects resulting from sales of EAS foods in public places with improper hygienic techniques has contributed significantly to the spread of diseases among the populace in many countries (FAO, 1997). One of the major leading factors responsible for contamination of eaten-as-sold food is the time between preparation of the food to when it will be consumed by the customer, others includes; methods of production, handling of the raw materials, and the processor. Several microorganisms of public health concern such as fecal coliform bacteria and *Salmonella* species have been implicated in street foods sold in some African countries (Achinewhu & Amadi, 1996; Gitahi, WAngoh, & Njape, 2012).

According to Omemu and Aderoju (2008) and Sperber (2003), adequate safety control over sales of EAS food by the street vendor has been a major task in developing country like Nigeria due to absence of proper food processing, storage, and distribution know-how, good waste facilities, potable water, and storage tank, thus serving as a medium of potential microbial contamination to the public space.

MATERIALS AND METHODS

Study Location

The study was carried out around Igbesa community in Ado-Odo/Ota Local Government Area of Ogun State. The town has several post-secondary schools and several production companies its environ because of its closest to Ogun State free trade zone. This development has led to springing up of several food centers, roadside food spots, and vendors due to the high influx of humans. The location for sample collection is within a distance of 3km from each other.

Samples Collection

A total of one hundred and twenty (120) shawarma samples were obtained by collecting two (2) samples from four (4) different locations per day (weekdays) for a period of three (3) weeks around Igbesa community. Each day, samples were collected in sterile foil wraps and transported in ice-cooled containers to the laboratory of the Department of Science Laboratory Technology, Ogun State Institute of Technology Igbesa for analysis within one hour after collection.

Bacteria Isolation and Enumeration

The collected samples were homogenized separately by suspending and blending 25g of sharwama from each location in a clean Binatone blender containing 225 ml of sterile distilled water. The resultant homogenates were serially diluted to10^{-5}dilution factor. From the appropriate dilutions, 0.1ml of each sample was plated in duplicate onto different media (Eosine Methylene Blue agar (coliform count), Plate Count agar (Difco, Detroit, USA) (total aerobic plate count)) Salmonella Shigella agar (Salmonella Shigella count) and. Mannitol Salt agar (Staphylococcus count)) using the spread pate technique.

The plates were incubated at 37ºC for 48 h and the total counts were enumerated using the colony counter (Gallenkamp, England). The bacterial counts were recorded as colony-forming units per gram of food sample (cfu/g). Different morphological attributes of the colonies were observed and recorded. Discrete colonies were isolated and purified by sub-culturing on nutrient agar, and the pure cultures were stored on slant at 4ºC for further biochemical characterization. The isolates were classified by comparing their biochemical reactivity with known ones (taxa) as described in Bergey's Manual of Determinative Bacteriology (Holt, Kreig, Sneath, Stanley, & William, 1994) and Cheesbrough, (2006).

RESULTS AND DISCUSSION

Table 1: Bacterial counts of selected EAS foods

Sample location	Heterotrophic Counts (cfu/g)	Coliform Counts (cfu/g)	*Staphylococcus* Counts (cfu/g)	SSB Counts (cfu/g)
A	20×10^4	15×10^3	10×10^4	14×10^3
B	38×10^4	10×10^3	12×10^4	16×10^3
C	40×10^4	18×10^3	15×10^4	21×10^3
D	22 x 104	17×10^3	11×10^4	15×10^3

A, B, C, D denotes locations where the samples are gotten from, SSB = *Salmonella Shigella* count.

Table 2: Morphological and Biochemical characteristics of Bacteria isolate.

code Isolate	Gram	Shape	Motility	Oxidase	Catalase	Citrate	Indole	Sucrose	Lactose	Glucose	Coagulase	Microorganism Identity
SW	+	Cocci	-	+	+	-	-	-	-	-	+	*Staphylococcus aureus*
SC	-	Rod	+	-	+	-	+	+	+	+	NA	*Escherichia coli*
SL	-	Rod	-	-	-	-	-	+	+	+	-	*Klebsiella spp*
SO	-	Rod	+	-	-	-	-	+	+	+	NA	*Enterobacter spp*
SW1	-	Rod	-	-	+	-	+	-	-	-	-	*Shigella spp*
SC2	-	Rod	+	+	+	+	-	+	-	+	NA	*Pseudomonas aeruginosa*
SL3	-	Rod	+	-	+	-	+	+	-	+	NA	*Proteus spp*
SO4	-	Rod	+	-	+	-	-	-	-	+	-	*Salmonella spp*
SP2	-	Rod	+	-	+	-	+	+	+	+	NA	*Escherichia coli*
SD	-	Rod	+	-	+	-	+	+	+	+	NA	*Klebsiella spp*
SG	-	Rod	-	-	+	-	+	-	-	-	-	*Shigella spp*
SL	-	Rod	+	-	-	-	-	+	+	+	NA	*Enterobacter spp*
SO	-	Rod	+	-	+	-	-	-	-	+	-	*Salmonella spp*
SW3	+	Cocci	-	+	+	-	-	-	-	-	+	*Staphylococcus aureus*
SU	-	Rod	+	+	+	+	-	+	-	+	NA	*Pseudomonas aeruginosa*
SB	-	Rod	+	-	+	-	+	+	-	+	NA	*Proteus spp*
SM	-	Rod	+	-	+	-	+	+	+	+	NA	*Escherichia coli*
SD	+	Cocci	-	+	+	-	-	-	-	-	+	*Staphylococcus aureus*
SW	-	Rod	+	-	+	-	-	-	-	+	-	*Salmonella spp*
SV	+	Cocci	-	+	+	-	-	-	-	-	+	*Staphylococcus aureus*

Table 1 above, shows the bacteria load of sharwama samples obtained from the four (4) sites or locations. The heterotrophic counts ranged from 20 x 10^4 to 40 x 10^4 cfu/g. The data reveals that samples n from location C have the highest heterotrophic count (40 x 10^4 cfu/g) followed by location B. *Salmonella Shigella* count also shows a high count across the four locations ranging from 14 x 10^3, 15 x 103, 16 x 10^3, and 21 x 10^3 respectively for location A to D. The high *Salmonella Shigella* count could be due to the fillings like chicken and hot dogs in the sharwama samples. *Salmonella* has been the microorganism associated with poultry products. A similar study carried out in Egypt on Kofta sandwiches did not reveal the presence of *Salmonella* (Dalia, Gamal, Amal, & Fatma, 2013). In another study carried out by Akusu, Kiin-Kabari, & Wemedo, (2016) in Port Harcourt metropolis, Rivers State, Nigeria on EAS vended foods, the *Salmonel*la count (V13 x10^3) was in agreement with this finding, such similarities may be as a result of contamination from the fillings. Table 1 also reveals that coliform count from the sharwama samples ranged from 10 x 10^3 to 15 x 10^3 cfu/g; samples from location C recorded the highest number of coliform, followed by location D. In general, *Staphylococcus* count has the least count that is noticed on samples from location A and it is the highest count from location D. Presence of *Staphylococcus aureus* on the sample at low level does not agree with work of Hemen, Johnson, Odey, Fila, & Ambo, (2012) on two food service centres in a University. *Staphlococcus* count was found to be generally high compared to other microorganism count isolated in samples from site A (7.92 x 10^{13}), but generally high in samples from site B (1.045 x 10^{14}). The low level of *S. aureus* observed in this studies may be to the hygiene practices by the food handlers. According to a study conducted by (Zohreh, Ali, Ali, Ayub, & Ashkan, 2015) in South Africa, which reports the absence of *Staphylococcus aureus*

in many of the street EAS; however, there is the presence of *S. aureus* ranging from 1.9 to 25.2% of the street eaten as sold foods in the study conducted in Latin America cities (in counts above 10^3 cfu/g). The result on microbial load in Table 1 was in line with the work of (Akusu *et al*., 2016). The results (Table 1) showed high heterotrophic counts and coliform counts on all the samples collected from all the locations but was in range on *Salmonella Shigella* count from all the location except for location C that has 21 x 10^3 which is higher than the WHO standards (THB 10 – 16 cfu/g, total coliform 0 – 10/g and SSB count of 20/g) (WHO, 1996).

Table 2 above, shows the different biochemical and morphological features of bacteria isolated from sharwama samples collected from different locations. The table reveals that there were a total of eight genera of bacteria isolated from the food samples. The identified bacteria isolated in this work are similar to the microorganism reported by (Okonkwo, Ogunjobi, Fajobi, Onaja, Babalola, & Adedeji, 2008) and Ajao and Atere (2009). The isolated microbes were *Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Klebsiella, Enterobacter, Shigella,* and *Proteus.*

The presence of *Salmonella, Enterobacter,* and *Escherichia coli* in the Sharwama samples is an indication of faecal contaminant while the presence of *S. aureus* is an indication of environmental contamination and poor handling practices, cross-contamination, or poor hygiene practices by the food handlers and use of contaminated water as reported by (Durgesh, Ranjana, & Varsha, 2008). *Escherichia coli, Enterobacter, Proteus* spp. had been implicated in ready-to-eat foods (Nichols, Little, Mithani, & de Louvois, 1999; Mensah *et al*., 2002; Idowu, 2006; Taulo *et al*., 2008) elsewhere (Fang, Wei, Liao, Hung, & Wang, 2003) reported in their findings that several factors may contribute to the presence of *Escherichia coli* in ready- to eat foods, including poor handling practices by food handlers, or cross-contamination from food contact surfaces or high storage temperature.

Isolation of *Escherichia coli, Salmonella specie*s, and other enteric bacteria is a possible indication of fecal contamination of materials used in its production (Little, Monsey, Nichols, & de Louvois, 1996; Tambekar, Shirsat, Suradkar, Rajankar, & Banginwar, 2007) while the isolation of *Staphylococcus aureus* in all samples is of a practical impact which indicates poor sanitary conditions and lack of portable water as reported by (Ibekwe, Okono, Onunkwo, Dunbraye, Babalola, & Onoja, 2008).

Staphylococcus aureus is a Gram-positive cocci bacterium that has been the major flora of the human body and can get into food samples through cross-contamination or as a result of human contact with food samples and it is an indication of poor hygiene practices of the operators (Garret, 1988; Nichols *et al*., 1999) and their presence in food indicates poor personal hygiene and poor handling practices. *Staphylococcus aureus* contaminated foods can lead to a severe public health hazard as *it* has been identified as a causative agent in many food poisoning outbreaks (Bennett, Yeterian, Smith, Coles, Sassaman, & Mcclure, 1986).

Throughout the chain of food production, food handlers play important roles in ensuring the safety of food during processing, storage, and preparation. Mishandling or lack of good hygiene measures or practices on the part of the food vendors have been reported to introduce pathogens and other contaminants that are of delirious effects to the consumer (WHO, 1989; Greig, Todd, Bartleson, & Micheals, 2007).

CONCLUSION

The findings of this study demonstrated that EAS foods (Sharwama) sold in Igbesa community constitute a potential hazard to human health. The presence of *E. coli, Enterobacter, Staphylococcus,* and *Salmonella* in the eaten-as-sold food samples surveyed in this investigation is a pointer of potential health risk to the customer.

Good hygiene practices such as Good manufacturing practices (GMP), Good handling practices (GHP), and Hazard Analysis Critical Control Point (HACCP) application during food production, processing, and packaging can be used in preventing foodborne illness.

Food handlers should be trained on safety knowledge and practices followed by monitoring and supervision of ready-to-eat foods and various channels of distribution by relevant authorities.

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