MICROBIAL CONTAMINATION OF BUSHMEAT SOLD AT ILE EPO MARKET, ALONG ABEOKUTA-OSHODI MAJOR HIGHWAY, LAGOS STATE

Makanjuola, Olakunle Moses & [2]Oloye, Dare Anthony

Department of Food Science and Technology, Federal Polytechnic, Ilaro, Ogun State
Department of Food Science and Technology, Rufus Giwa Polytechnic, Owo, Ondo State
E-mail: olakunle.makanjuola@federal polyilaro.edu.ng
+2348037136605

ABSTRACT

The microbial contamination of bush-meat sold at Ile-epo market, along Abeokuta-Oshodi highway, Lagos, Lagos State was evaluated using standard analytical procedures. Three samples of smoked bush meat viz. Porcupine, pour rat and squirrels were assessed microbiologically on total viable counts, total yeast counts, total mold counts, total coliform bacteria, with *E-Coli, Salmonella spp, Staphylococcus spp* and *Shigella Spp* as isolated organisms. The results revealed significant differences ($P \leq 0.05$) among the three (3) bush meat samples evaluated in terms of microbial contamination, that is total aerobic microbial viable counts, total yeast and yeast cells. Total mold counts, and total bacteria counts differed ($P \leq 0.05$) greatly among samples. The isolated bacteria; *E-Coli, Salmonella Spp, Staphylococcus Spp* as well as *shigella Spp* showed that high prevalence of these pathogenic organisms poses a threat to public health which could lead to food borne illness and infectious disease as zoonotic disease. Efforts should be made to improve bush meat safety, thereby improving public health, most especially among the teeming consumers of bush meat in Nigeria.

Keywords: Microbial, Contamination, Bush Meat, Market, Highway

INTRODUCTION

Bush meats are consumed by humans. Any meat from wild animals is called bysh-meat and it could be consumed fresh, smoked, salted or sun-dried. Smoked bush-meat is the final product most widespread and readily available in the rural, sub-urban and urban markets in most African settings. (Emelue and Idaewor, 2018; Onadeko, 2004). The benefits and nutrityional sources obtained from bush-meat consumption serves direct impact in the livelihoods and it is a source of income (Cawthorn & Hoffman, 2019).

Most ready-to-eat bush meats sold in the market especially in West Africa are usually those produced locally by drying with smoke and cooking. Hence, the method does not make the meat from microbial attack such as bacteria and fungi or toxic substances produced by these bacteria. It is posing serious health threat or danger to the individual or group of individuals who rely on this type of meat as a source of food, particularly when not adequately cooked before consumption (Ikeh et al., 2021; James & Sam, 2007). Consumers frequently consider bush meat as wholesome, safe alternative to commercially produced meat on sale. Bush-meat carries a risk of harmful substances since animals are often hunted directly from the wild with an unknown health status and preparation methods that may not adhere to proper slaughtering measures (Ahouanse et al., 2023; Benite z-lopaz et al., 2017). Bush-meat connect humans into close contact with wild-life, spreading of food borne and viral diseases as well as new developing infectious diseases. The consumption and the various manipulations of the carcasses of wild animals therefore expose the population to many health risks including infectious diseases, zoonosis that are very dangerous and difficult to control just like the corona virus infection: Covid 19 (Ahouanse et al, 2018; Mufunda et al., 2016; WHO, 2020).

A lot of researches have been carried out on bush-meat in relation to microbial contents and spoilage. Adebiyi et al. (2018) reported the assessment of the effects of air pollution using road-side roasted meats

(suya) as indicators while Ikeh et al. (2021) studied the assessment of microbiological quality associated with ready-to-eat bush-meat sold at rumuokoro market in River State. Also bush-meat consumption in Africa: A microbiological safely challenge was studied by Ahouanse et al. (2023) while public health significance of Zoonotic bacterial pathogens from bush-meat sold in urban markets of Gabon, Central Africa was reported by Bachand et al. (2012). Furthermore, Amponsah et al. (2024) reported the assessing the microbial diversity and proximate composition of smoked-fermented bush-meat from four different bush-meat samples, and Adeyeye et al. (20223) studied the microbial safety and polycyclic aromatic hydrocarbon concentrations of intermediate moisture smoked African giant snail. Therefore, the objectives of this present work are to investigate the microbial contamination of bush-meat sold in a major market in Lagos State as well as insolating and identifying the major bacteria and pathogens present there in.

MATERIALS

Three (3) types of smoked bush-meat; pouch rat, porcupine and squirrel were purchased from vendors at popular ile-epo market, along Lagos-Abeokuta major highway. The samples were collected into zip lock bags and transported hygienically to the Laboratories of the department of Food Science and Technology, Federal Polytechnic, Ilaro, Ogun State for further processing and analysis. All chemicals and reagents used were of analytical grades.

Sample Preparation

25g of each ready-to-eat smoked bush-meat was put in a sterilized conical flask containing 225ml of 1% BPW after which serial dilutions were performed and appropriate dilutions were plated on nutrient, PDA, Sorbitor Mac Conkey (SMAC) and MacConkey (MAC) plates.

Serial Dilution

0.1ml of each sample was pipetted using the micro-pipettes (set at 100μl) into test tubes containing 9ml of 0.1% BPW to obtain 10^{-2}, followed by transferring 0.1ml from 10^{-2} into a new test tube (containing 9ml of 0.1% BPW) to create 10 dilution. The test tubes were then put in the vortex mixer for even mixing. The dilution factor was repeated for 10^{-3}, 10^{-4} and 10^{-5}. The test tubes were properly labelled for ease of identification.

Plating (Spread Plate Technique)

Spread plate techniques were used for plating of inoculum (samples) for the nutrient agar, PDA, SMAC and MacConkey agar plates. About 15-20ml of agar was poured into sterilized petri dishes (observing aseptic methods and conditions), then allowed to cool, set and solidified. 0.1ml of the inoculum directly from dilutions were plated (using pipettes) on to appropriately labelled agar containing petri-dishes for SMAC, PDA, Nutrient agar and Mac Conkey agar. After dispensing, the hockey stick was used to spread the inoculum around the agar and then flamed in the Bunsen burner before spreading.

Sub-Culturing

The plates were checked after, 24 hours for sub-culturing which was to purify the isolated bacterial colonies from mixed cultures to a new and single culture.

Data Analysis

Data obtained were analyzed with analysis of variance (ANOVA). Comparison of means were carried out using Duncan's Multiple Range Test (DMRT) and statistical carried out with statistical platform for social Sciences (SPSS 17.0).

RESULTS AND DISCUSSION

Results

Table 1: The Total Counts (cfu/g) of smoked Bush-meat obtained from Ile-Epo Market in Lagos, Lagos State

Sample	TAMVC	TYC	TMC	TCB	E-coli Spp	Salmonella spp.	Staphylococcus spp.	Shigella spp
BM21	231.0±1.4a	70.5±0.7b	6.0±2.8b	6.0±1.4b	5.0±1.4b	8.5±0.7a	7.0±1.4a	7.5±0.7a
BM22	209.0±1.4b	91.5±2.1a	8.0±1.4a	7.5±0.7a	6.0±1.8a	7.0±1.4b	4.5±2.1c	4.5±0.7c
BM23	162.0±2.8c	51.0±1.4c	4.5±2.1c	6.0±1.4b	4.5±2.1c	6.5±2.1c	6.5±2.1b	5.5±2.1b
p-value	<0.0001	<0.0001	0.0226	0.0131	0.0185	0.0015	0.0171	0.0067

The values are means with standard deviation of replicate determinations (n-3). Means with same or no letter within the column are not significantly ($p>0.05$) different.

Key: BM21 = Porcupine; BM22 = Pouch Rat; BM23 = Squirrel

TAMVC = Total Aerobic Microbial Viable Counts

TYC = Total Yeast and Yeast-like Cells

TMC = Total Mold Counts

TCB = Total Coliform Bacteria

Table 2: Pearson Correlation Matrix

Sample	TAMVC	TYC	TMC	TCB	E-coli Spp	Salmonella spp.	Staphylococcus spp.	Shigella spp
TAMVC	000							
TYC	649	000						
TMC	386	677	000					
TCB	050	388	761	000				
E-Coli	212	404	928	785	000			
Salmonella Spp	673	127	475	100	523	000		

Staphylococci Spp	.026	0.528	182	128	429	696	000	
Shigella spp	363	0.307	158	176	328	799	856	000

DISCUSSION

The result of the microbial analysis is as shown in Table 1. The smoked bush-meat samples were analysed for total aerobic microbial viable counts, total yeast and tyeast-like cells, total mold counts as well as total coliform bacteria. Also, Salmonella Spp, Staphylococcus Spp and Shigella Spp and E-Coli were isolated. Total aerobic microbial viable counts revealed significant differences ($P \leq 0.05$) among the three smoked bush meat evaluated. The values ranged from 162.0 to 231.0 cfu/g. Smoked porcupine had the highest value of 231.0 cfu/g while squirrel had least value of 162.0 cfu/g. The total yeast and yeast-like cells ranged from 51.0 cfu/g to 91.5cfu/g, indicating significant differences ($P \leq 0.05$) among samples. The total mold counts obtained were 6.0cfu/g (porcupine) 8.0cfu/g (pouch) and 4.5cfu/g (squirrel) rtespectively, showing significant difference ($P \leq 0.05$) among treated samples. Total coliform bacteria counts of 6.0 cfu/g, 7.5 cfu/g and 6.0 cfu/g were obtained for porcupine, pouch rat and squirrel respectively, indicating significant differences ($P \leq 0.05$) among samples. E.Coli organisms varied between 4.5 cfu/g and 6.0 cfu/g ($P \leq 0.05$).

The presence of high microbial loads might be due to several factors, among which are bush meat handling methods which includes poor hygienic practices during processing, personal cleanliness of the meat vendors, health status of the animals before being hunted, lack of adequate preservation procedures after smoked as most of these bush meats are commonly displayed for customers without protection. The smoking methods and intensity at times are not adequate enough to ward away contaminants such as microorganisms, flies, cockroaches and the likes. Also, numerous factors such as conditions of evisceration, exposure to ambient temperatures and relative humidity may be responsible for the spoilage of ready-to-eat-bush meat (Ikeh et al., 2021).

Bacteria isolated were salmonella Spp, Staphylococcus Spp and Shigella Spp and E-Coli and these were in agreement with a similar study by Ebabhamiegbeho et al (2011). The result of the isolated bacteria revealed significant differences ($P \leq 0.05$) among samples Salmonella Spp ranged from 6.5 – 8.5 cfu/g; Staphilococcus Spp varied from 4.5 – 7.0 cfu/g; while Shigella Spp ranged from 4.5 – 7.5 cfu/g respectively. According to literature (Ebabhamiegboho et al., 2018), E-Coli was identified signifying that the bush meat had a faecal contamination which could be linked to lack of hiegene during the preparation of the smoked bush meat. Generally improperly smoked bush meat may also carry diseases such as small pox, chicken pox, tuberculosis, measles, yellow fever, rabies etc. This finding furthermore revealed that microbial growth on bush meat after smoking may be due to lack of improper smoking on the part of the handlers/sellers coupled with hygienic and handling procedures adopted as suggested by Abolagba and Iyeru (1998); Soyiri et al. (2008) and Emelue Idaewor (2018).

According to literature (Buisson et al, 2008b; Thakali & MacRae, 2021; Osbjer et al., 2015; Ahouanse et al., 2023), the food we consume may contain substances or pathogen that involve health risk leading to foodborne illnesses and infectious diseases. The substances can unintentionally enter our food during production, processing or preparation, and microorganisms can be introduced from sick animals, processors, other foods or the environment.

The result of Pearson Correlation Matrix in Table 2 indicated the linear relationship between two variables. The values between total aerobic microbial viable count and total yeasts and yeast like cell showed a strong correlation between them. The value of total mold count under TAMVC showed a moderate correlation, while under TVC, showed a strong correlation. The value of total coliform bacteria, under TAMVC revealed a weak correlation, under TVC, a moderate correlation and under TMC, a strong correlation. The value of E-Coli under TAMVC showed a weak Correlation, under TVC, moderate correlation, under TMC, a strong correlation. The value of Salmonella Spp under TAMVC revealed a strong correlation, under TVC, a weak correlation, under TCB, a weak correlation,

under E-Coli showed a strong correlatyion. The value of Staphylococcus under TAMVC showed a weak correlation, undert TVC, Strong correlation under TMC, weak correlation, under TCB showed a weak correlation, under E-Coli, a moderate correlation, under Salmonella Spp showed a strong correlation. The value of Shigella under TAMVC showed a moderate correlation, TVC, a moderate correlation, under TVC, a weak correlation under TCB, a weak correlation, under E-Coli, a moderate Correlation, under Salmonella a strong correlation, under Staphylococcus Spp, a strong correlation.

CONCLUSION

It is evident that bush meat sold in major markets in Lagos State are grossly contaminated with various microorganisms. The bush meat are exposed to the intensity of sun and dust without proper packaging leading to significant microbial loads and poor meat quality. This makes the bush meat a possible source of food borne illness. Although, smoking as a means of preservation tends to increase the shelf life of smoked bush meat, when not properly carried out can result in microbial growth a part from the high prevalence of pathogenic E-Coli that showed that contamination also existed from the slaughter houses or killing location to the vendor's shops or markets.

REFERENCES

Abolagba, O. J. and Iyeru, O. A. (1998). Study of Insect Pest Infecting TYraditionally Processed Fish Sold in Benin-City Metropolis, Nigeria. *Nigerian Journal of Applied Science*. 16:25-29.

Adebiyi, F. M., Sonibare, J. A. Adedosu, T. A., Daramola, A. A., Omode, P.E. and Obanijesu, E. O. (2018). Assessment of the Effects of Air Pollution Using Roadside Roasted Meats (Suya) as Indicators *Environmental Bio indicators* 3: 172-179.

Adeyeye, S. A. O. Bolaji, O. T., Abogunde, T. A. Adesina, T. O. (2022). Microbial Safety and Polycyclic Aromatic Hydrocarbon Concentrations of Intermediate Moisture Smoked African Giant Snail (Achatina achatina) Meat. *Polycyclic Aromatic Compound* 42(7): 4520-4533.

Ahouanse, G. G. A., Issa-Zacharia, and Majaliwa, N. (2023). Bushmeat Consumption on Africa: A Microbiological Safety Challenge. *Asian Food Science Journal*. 22(9):149-157.

Amponsah, A. S., Ankar-Brewod, G. M., Lutterodt, H. E. and Ofosu, I. W. (2024). Assessing the Microbial Diversity and Proximate Composition of Smoked-Fermented Bush meat from Four Different Bush meat samples. *Journal of Biotechnology, Computational Biology and Biotechnology*. 105(1): 6-17.

Bachand, N. Ravel A. Onanga, R. Arsenault J. and Gonzalez, J. P. (2012). Public Health Significance of Zoonotic Bacterial Pathogens from Bush meat sold in Urban Markets of Gabon, *Central Africa Journal of Wildlife Diseases*. 48:785-789.

Benitez-lopez, A., Alkemade, R., Schipper, A. M., Ingram, D. J., Verweij, P. A. and Fikelboom, J. A.J. (2017). The Impact of Hunting on Tropical Mammal and Bird Populations. *Science*. 356:180-183.

Buisson, Y. Marie, J. and Davoust, B. (2008b). These infectious Diseases Imported with Food. Bulletin de (*a Societe de Pathologic Exotique* 101:343-347.

Cowthorn, D. M. and Hoffman, L. C. (2018). The Bush meat and Food Security Nexus: A Global Account of the Contributions, Conundrums and Ethical Collisions *Food Research International* 76: 906-925.

Ebabhamiegbeho, P. A. Nwande, C. F. and Igene, J. O. (2021). Lipid and Microbial Evaluation of Smoke-Dried Grasscutters on Retail. *35 Conference/AGM of the Nigerian Institute of Food Science and Technology Proceedings*.

Emelue, G. and Idaewor, J. (2018). Assessment of Microbial Count Loads of Bushmeats Sold at Different Markets in Benin City, Edo State, Nigeria. *International Journal of Agricultural Science*. 3:20-26.

Ikeh, I. M., Anene, B. C. and Ogbodo, U. A. (2021). Assessment of Microbiological Quality Associated with Ready-To-Eat Bush-meat Sold at Rumuokoro Market in Rivers State. *Abian Journal of Research in Zoology*.

James, O. and San, A. O. (2007). A Fresh look at Bush-meat, Christ Church, *New Zealand*, 1-11.

Mufunda, J. Ndambakuwa, Y., Mu-nodawafa, D. and Kobie, A. (2016). Is A Total Ban on Business and Consumption of Bush-meat A sustainable End Game for Ebola Outbreak in West Africa: But why Now? *Public Health Open Journal* 1:4-7.

Onadeko, S. A. (2004). Home On The Range: Crises, Consequences and Consolations.

Osbjer, K. Bogrist, S. Sokeryo, S., Kannarath, C. San, S. and Davun, H. (2015). Household Practices Related to Disease Transmission Between Animals and Humans in Rural Cambodia. *BMC Public Health*. 15:476.

Soyirin J. N., Agboji, H. K. and Dongdem, J. T. (2008). A Pilot Microbial Assessment of Beef Sold in the Ashaiman Market, A Suburb of Accra, Ghana. *African Journal of Food, Africulture and Nutrition Development.* 8(1):91-103.

Thakali, A., and MacRae, J. D. (2021). A Review of Chemical and Microbial Contamination in Food: What Are the Threats to a Circular Food System? *Environmental Research* 194: 110-635.

WHO (2020). World Health Organization. Retrieved December 1, 2022. https//apps.who.int/iris/bitstream/handle/10665/33/584/WHO-2019-n *Cov-work place 2020. 2-eng.pdf.*