Minireview Article

Bushmeat Consumption in Africa: A Microbiological Safety Challenge?

ABSTACT:

OBJECTIVE: This review analyzed the microbiological safety of bushmeat consumed in Africa over the past decades.

METHODOLOGY: Studies mainly focused on large animals like antelopes and smaller ones like grasscutter. Most microbes studied were similar to those in domestic animal meat, except for rare pathogens. Sampling, lab methods, and microbe prevalence varied among studies.

RESULTS: All studies confirmed the presence of zoonotic pathogens dangerous to humans. Consequently, more investigations are needed, especially for chronic and severe diseases, as few studies have addressed bushmeat's microbiological safety in Africa.

CONCLUSION: Efforts should be made to improve bushmeat safety and public health. Policies must be developed and implemented to ensure hygienic and legal bushmeat production in Africa.

KEYWORDS: Meat safety, foodborne, pathogens, public health, Bushmeat

INTRODUCTION

Bushmeat is the name given to raw, smoked or cooked meat from wild animals (Brodie et McIntyre 2019; Cawthorn & Hoffman, 2015). These bushmeats have been prized for a long time all over the world and mainly in Africa where they constitute a real source of protein, but also of income for several populations, in particular for those living near forests (Ngama, 2015; Nielsen et al., 2017). Although the consumption of bushmeat contributes a lot to food security, with the various activities around it. Bushmeat consumption is also subject to two major problems: the degradation of biodiversity, but also that of public health (Dell et al., 2020; Djagoun et al., 2018; Ngama, 2015; Nielsen et al., 2017). Bushmeat is often blamed for cases of food-borne diseases and other zoonoses (Changula et al., 2014; Mossoun et al., 2017). It is well established that food-borne zoonoses can pose a threat to human health, as pathogens can be present in products intended for human consumption, either through product from an infected animal or through cross-contamination with urine or feces.

Some bush animals can also serve as a reservoir for certain diseases that can be transmitted from animals to humans (zoonosis). However, the consumption itself may transmit zoonosis, the handling and cutting of bush meat could act as the causal factor (Van Vliet et al., 2017). In Africa, very few studies have provided information on microbiological analyzes in order to know the health status of its handled and consumed bushmeat (Makelele et al., 2015). The recent epidemiological crises linked to the Lassa, Ebola and Covid 19 viruses showed that particular attention must be paid to what concerns pathogenic bacteria, particularly in Africa. This article is part of an analysis of scientific publications on the microbiological safety of bushmeat in Africa.

BUSHMEAT CONSUMPTION TODAY IN AFRICA

Bushmeat consumption in Africa has increased due to factors such as food insecurity, demographic changes, cultural practices, taste preferences, and perceived medicinal value (Chabi-Boni et al., 2019; Dell et al., 2020; Katani et al., 2019). Even during the Ebola crisis, countries like Nigeria and Liberia showed a continued preference for bushmeat (Akani, Dendi, et al., 2015; Ordaz-Németh et al., 2017). Surveys indicate that consumption patterns vary by gender, age, and location, with some individuals regularly consuming bushmeat while others abstain (Luiselli et al., 2020). Understanding these consumption patterns is crucial for effective monitoring of the bushmeat production chain.

RISKS AND DANGERS ASSOCIATED WITH THE CONSUMPTION OF BUSHMEAT

The food we consume can contain substances or pathogens that pose health risks, leading to foodborne illnesses and infectious diseases (Buisson et al., 2008b; Thakali & MacRae, 2021). These substances can unintentionally enter food during production, processing, or preparation, and microorganisms can be introduced from sick animals, processors, other foods, or the environment (Osbjer et al., 2015; Thakali & MacRae, 2021).

Bushmeat carries a risk of harmful substances, as animals are often hunted directly from the wild with unknown health status and preparation methods that may not adhere to proper slaughter measures (Benítez-López et al., 2017). In Africa, the consumption and handling of bushmeat have contributed to the emergence and spread of viral diseases, including Lassa virus hemorrhagic fever and Ebola viral disease (Akani et al., 2015; Mufunda et al., 2016; P. Degla et al., 2017; Kenmoe et al., 2020; Lecompte et al., 2006; N'koué Sambiéni et al., 2015b; Yessinou et al., 2020; Cénat et al., 2021; Malvy et al., 2019; Rugarabamu et al., 2022; Semper et al., 2016).Thus the consumption and the various manipulations of the carcasses of wild animals expose the population to many health risks including infectious diseases, zoonoses that are very dangerous and difficult to control such as the Corona virus disease Covid 19 (Mafunda et al., 2016; WHO,2020).

Apart from pathogenic microbes, meat preservation methods like smoking can also pose risks, such as the presence of Polycyclic Aromatic Hydrocarbons (PAHs) (Abdul, 2014a). Foodborne illnesses remain a public health concern in Sub-Saharan Africa, but the incidence is often underestimated, and the origins are rarely identified due to limited diagnostic capabilities and weak health management systems.

Food-borne illnesses remain a public health problem in Sub-Saharan Africa, but health authorities underestimated the incidence, and their origins are rarely elucidated due to the weakness of diagnostic means, particularly bacteriological and the health management system.

MICROBIOLOGICAL QUALITY OF BUSHMEAT CONSUMED IN AFRICA

MICRO-ORGAMISM FOUND IN BUSHMEAT IN AFRICA

In Africa, recent health crises prompted studies on the microbiological status of bushmeat to assess risks to human health. Cooked bushmeat in Kisangani, Congo, showed a high prevalence of Salmonella spp (56.25%) (Makelele et al., 2015). This exceeds rates in fresh bushmeat muscle (0.8%) in Gabon (Bachand et al., 2012) but is lower than smoked bushmeat in Lumbubashi, DRC (3.8%) (Mpalang et al., 2013a). High prevalence in Kisangani might not be solely from bushmeat, as unsanitary cooking and serving conditions could contribute to contamination. In Nigeria, a study found Salmonella contamination (5.7%) in smoked meat samples of large cane rats or grasscutters (Thryonomys swinderianus), wild rabbits (Oryctolagus cuniculus), monitor lizards (Varanidae), and antelope species sold in urban markets (Kayode & Kolawole, 2010a). Cross-contamination is considered a likely cause. Salmonella spp is a pathogen found in warm-blooded animals, with S. Typhi, Paratyphi, and Sendai as the most pathogenic serotypes for humans (Korsak Koulagenko et al., 2004). Serotypes were not identified in these studies, although Salmonella is a zoonotic pathogen.

E.coli has been found in smoked bushmeat in Nigeria (prevalence: 18.6%) (Kayode & Kolawole, 2010b). This prevalence is lower than that of antelope (19.2%) and cane rat (25%) in ready-to-eat dried meats in Rivers State, Nigeria (Ikeh et al., 2021). In Lumbashi, Congo, bushmeat showed a 100% prevalence of E.coli with an average of 4.87 ± 0.6 log10 CFU·g-1, indicating significant fecal contamination (Mpalang et al., 2013b). The presence of E.coli in bushmeat can be attributed to poor evisceration practices and inadequate washing (Salifou et al., 2013). Some E.coli strains, including Shiga toxin-producing E.coli (STEC), pose substantial risks to human health (Zarei et al., 2021). Smoked bushmeat in Lumbashi, Congo, had a 2.2% prevalence of STEC based on PCR results (Mpalang et al., 2013b).

The incidence of E.coli O157:H7 and non-O157:H7 Shiga toxin-producing E.coli (STEC) was assessed in fresh big game meat in Namibia, with 74.6% of samples (94 out of 126) testing positive for Shiga toxin virulence genes (stx) and intimin (eae) using real-time PCR (Haindongo et al., 2019). STEC strains are significant foodborne pathogens and can cause severe illnesses such as diarrhea, hemorrhagic colitis, hemolytic uremic syndrome, thrombocytopenic purpura, and even death. The serotype E.coli O157:H7 is particularly associated with hemorrhagic colitis and hemolytic uremic syndrome (Bouzari et al., 2018; Zarei et al., 2021). The presence of E.coli in bushmeat highlights the need for enhanced hygiene measures, and further studies should explore this detection in greater detail, as only one study has examined it. Given that the bushmeat analyzed in this study was smoked, poor handling and cross-contamination are also plausible factors to consider.

Staphylococcus spp. were detected in ready-to-eat bushmeat, with an overall prevalence of 28.9%, including antelope (26.9%) and aulacode (25%) (Ikeh et al., 2021). Studies in Nigeria have identified Staphylococcus aureus and Staphylococcus epidermidis in smoked bushmeat, with S. aureus being more commonly found (Emelue & Idaewor, 2018; Kayode & Kolawole, 2010b; Oghenekome & Rose, 2020). In cooked bushmeat from Kisangani, Congo, S. aureus was found with a prevalence of 93.75% (Makelele et al., 2015). The presence of Staphylococcus aureus in bushmeat is likely attributed to inadequate hygiene measures, as these bacteria are commensal in animals and humans (Parlet et al., 2019). Staphylococcus aureus is a significant pathogen responsible for severe nosocomial and community infections, including emerging zoonotic cases (Fitzgerald, 2012).

Campylobacter, a zoonotic pathogen, was found in Central Africa with a prevalence of 6% (Bachand et al., 2012). The most common Campylobacter species associated with diarrhea are Campylobacter jejuni and Campylobacter coli, with C. coli being more prevalent in slaughterhouses (Rossler et al., 2020). In Lubumbashi, PCR detected Campylobacter jejuni (3.8%) and Campylobacter coli (15.9%) in bushmeat (Mpalang et al., 2013c). Shigella (1%) was also found in Central African bushmeat (Bachand et al., 2012), but further studies on these microbes are lacking.

Zoonotic pathogens including Bacillus, Brucella, and Coxiella have been detected in bushmeat in Tanzania, with DNA traces found (Katani et al., 2021). B. anthracis (0.48%), Brucella (0.9%), and Coxiella (0.66%) DNA signatures were identified in 77 samples, with wildebeest (56%), dik-dik (50%), and impala (24%) showing the highest prevalence rates.

Other microorganisms such as Klebsiella pneumoniae (6.8%), Proteus spp. (8.5%), Streptococcus faecalis (13.5%), and Lactobacillus casei (9%) have been found in bushmeat (Kayode & Kolawole, 2010b). Pseudomonas spp. showed a prevalence of 21.1% (antelope 23.1% and aulacode 12.5%) in Nigeria, with Pseudomonas aeruginosa identified (Ikeh et al., 2021). Total aerobic and fungal flora were determined in ready-to-eat bushmeat in Nigeria, with antelope (8.09 ± 0.15 log10 CFU/g) and grasscutter (7.62 ± 0.9 log10 CFU/g) showing aerobic flora levels, and antelope (4.03 ± 0.54 log10 CFU/g) and grasscutter (3.85 ± 0.47 log10 CFU/g) exhibiting fungal flora (Ikeh et al., 2021). These findings indicate hygiene issues and poor handling of the meats.

SPECIES ANALYZED

Microbiological analyses of bushmeat mainly focused on ruminants like bovids, suids, and some small animals. Reptiles, birds, and other small animals received less attention, despite their consumption in Africa (Chabi-Boni et al., 2019; Gluszek et al., 2021). Limited studies identified higher prevalence rates of certain microorganisms in specific species. For instance, in Tanzania, among 32 meat species analyzed (3784 samples), wildebeest (56%), dik-dik (50%), and impala (24%) exhibited higher prevalence rates (Katani et al., 2021). Ruminants, known for a higher incidence of E. coli, also showed a significant presence of Shiga toxin-producing E. coli (STEC) in large bush ruminants in Namibia. The presence of microbes varied across species, emphasizing the need for future studies to consider species-specific pathogens. However, the scarcity of microbiological studies on bushmeat limits our understanding of prevalent microorganisms in different species. Future research should prioritize common pathogens for humans and domestic animals while accounting for species difference

Species	Salmonella	Campilobacter	E.coli (STEC/CC)	Staphilococcus	ACC/CF	Shiguella	Pseudomonas	Klebsiella	Streptococci	Proteus	Lactobacillus	Provenda	Bacillus	Brucella	Coxiella
Cane rat	35	35	35; 37	35; 37; 43	35; 37		35; 37	35	35; 43	35; 43	35	38	37;43		
Hare (hare)	35	35	35	35	35		35	35	35	35	35		12	12	12
Antelope (Impala, Gazelle, Dik-Dik, Springbok, Greater Kudu, Duiker)	35; 34	35; 34	35; 37; 34; 40	35; 37; 42; 43	35; 37; 42		35; 37	35	35; 42	35	35		37; 12	12	12
Monitor lizard	35	35	35	35	35		35	35	35	35	35				
Cane rat			42	42	42					42					
Bush Pig	34	34			42							42			
Buffalo	34	34	34												
Wild Rabbit	35		35	35	35		35	35	35	35	35				
Monkey	33			43		33				33					
Zebra													12		12
Wildebaest			40										12	12	12
Cattle															
Hippo													12		12

Table1: The various microbes found in the specifies analyzed

Legend: N° = Source

BUSHMEAT HYGIENE IN AFRICA

Microbiological loads were reported in 5 of the journals studied and these results were often presented according to European regulations (EC, 2005). The bushmeat samples analyzed were in fresh form (Bachand et al., 2012; Katani et al., 2019, 2021) and processed (Emelue & Idaewor, 2018; Ikeh et al., 2021; Katani et al., 2021; Makelele et al., 2015). Samples of bushmeat in processed form were the most dominant, and the type of processing noted was smoking, however some were in cooked forms in sauce, others dried and ready to eat. The vast majority of the carcasses analyzed were not classified for compliance with food standards, only one study among those analyzed was subject to classification and the bushmeat samples in this case were classified as unsatisfactory on the based on AFNOR standards (Makelele et al., 2015). This remark would surely be linked to the virtual non-existence of African standards with regard to the hygiene of bushmeat production as well as microbiological criteria. Future studies should take account. The average bacterial count on the samples varied from one study to another. The diversity of results reflects the parameters of bushmeat production: Methods of capturing and killing animals; weight and age of animals; weight and age of animals, species, evisceration and washing procedures; time or place of sampling, handling during and after processing; the state of carcass exposure, temperature, conservation, etc. (Lucas et al., 2022).

All these elements underline the need to improve the hygiene of primary and secondary production of bushmeat and to respect the requirements and constraints relating to the treatment of the meat after evisceration, as with domestic meats. Good hygiene practices must also be adopted and adapted to the wild game meat production chain. It would also be relevant to set process hygiene criteria for bushmeat carcasses so that food sector actors can respect them. Small bush animals such as lagomorphs, birds and reptiles were poorly represented in the various studies analyzed. Also include them in the post-mortem check because they are often more easily found and consumed (Chabi-boni, 2019, Djagoun, 2016). This would also limit the risks associated with their consumption. Similarly, other studies should also focus on these small game animals to understand the importance and relevance of hunting and production hygiene at their level.

CONCLUSION

A review of research on the microbiological safety of bushmeat in Africa over the past decade revealed that most studies focused on large animals like Antelope and other bovids, with limited research on small game except for grasscutter. The role of bushmeat in transmitting STEC and Antimicrobial Resistance in the food chain requires further investigation. The pathogens found in wild bushmeat were similar to those relevant to livestock and humans, including Salmonella spp, Staphilococcus spp, and E.coli. However, there were relatively few studies on Shigella spp, despite its significance as a foodborne pathogen. It is crucial to implement monitoring and control measures for foodborne zoonotic agents in bushmeat, similar to those for domestic animals. Meat hygiene measures need to be implemented, and specific microbiological criteria for bushmeat should be established to enhance safety during official inspections in game handling establishments. Given the unique aspects of the game food chain, such as hunting and field gutting, it is important to prioritize training for hunters.

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