

## Drivers of bushmeat consumption and perception of zoonotic disease risks in a Nigerian wet market

Iwajomo, S. B.<sup>1\*</sup>  and Ogunsola, A. C.<sup>1</sup>

<sup>1</sup>Department of Zoology, Faculty of Science, University of Lagos, Akoka, Yaba, Lagos, Nigeria

\*Corresponding Author: Soladoye B. Iwajomo. [siwajomo@unilag.edu.ng](mailto:siwajomo@unilag.edu.ng).

Received: 26 March, 2022

Revised: 03 May, 2024

Accepted: 07 May, 2024

**Keywords:** Alternative protein, Bushmeat consumption, Divers, Zoonotic disease risk.



© 2024 Zoological Society of Nigeria



This is an Open Access article distributed under the terms of Creative Commons Attribution License 4.0 (CC BY-NC-SA)

### Abstract

Bushmeat trade has been documented as one of the causes of wildlife depletion and population decline and it is also implicated in the transmission of zoonotic diseases. This study investigated the factors influencing bushmeat trade and the perception of zoonotic disease transmission among vendors and buyers of the commodity at the Oluwo Market, Epe, Lagos, Nigeria. Data was collected using 150 structured interviewer-administered questionnaires through the KoboCollect survey tool between February and October 2022. Results revealed that the top three bushmeat sought after were Grasscutter (*Thryonomys swinderianus*), Pangolin (*Phataginus tricuspis*) and Antelopes. There was no significant association between household income and bushmeat consumption pattern ( $p > 0.05$ ), rather non-financial factors namely taste, aroma and cultural customs were the main drivers of bushmeat consumption. Most occasional consumers (67%) would choose cheaper alternative protein sources over bushmeat. However, price increase will not deter purchasing in both groups. The lack of knowledge regarding disease transmission through contact and consumption of bushmeat was high among sellers (79%) and buyers (47%). The use of hand protection like gloves was uncommon when handling animals. Establishing safety standards among buyers and sellers is urgently needed, along with public health education to address zoonotic diseases risks.

### Introduction

Wildlife extraction for food (bushmeat) has been identified as one of the factors responsible for the decline in population and defaunation in many tropical forests (Fa *et al* 2002). The combined effect of wildlife extraction and habitat loss have a significant impact on wildlife species and in some cases result in significant population declines (Lindsey *et al* 2013). Consuming bushmeat is customarily a behaviour associated with rural communities, where it is a common source of protein due in part to their proximity to forests and protected areas that act as havens for a variety of wildlife species, and where the custom of hunting wildlife has been perpetuated for centuries by cultural practices and traditional beliefs (Luiselli *et al* 2019). Yet in many urban communities, this habit continues to thrive as urban areas expand over time (van Vliet and Mbazza 2011; Luiselli *et al* 2020).

Several factors have been documented to contribute to bushmeat hunting, trade and consumption in Africa. These factors range from proximity of human settlement to protected areas, poverty, lack of incentive to discourage bushmeat hunting (van Viet *et al* 2011; Mgawe *et al* 2012; Chausson *et al* 2019; Luiselli *et al* 2019; Andong *et al* 2023). Zeigler *et al* (2016) reported that hunting pressure is significantly related to road density, proximity to protected areas and human population density. Economic factors such as changes in price of alternative protein sources can also affect bushmeat consumption (Wilkie *et al* 2005). The quantity and diversity of bushmeat consumed by households has been shown to be positively related to

household income (Wilkie *et al* 2005; Fa *et al* 2009; van Viet *et al* 2011). Yet in other studies, a negative relationship has been reported (Merson *et al* 2019). Brashares *et al* (2011) posited that in rural areas, the relationship between household income and bushmeat consumption could be dependent on the proximity to urban settlements.

As a result of the larger economic opportunities that urban settlements offer over rural areas, households residing in urban areas typically have greater access to alternate sources of protein. The price of these substitutes can moderate the demand for bushmeat through cost savings that encourage individuals to switch from bushmeat, particularly because the substitutes are cheaper (Rentsch and Damon 2013) but this will depend on whether households consider the alternative protein sources as complements or substitutes to bushmeat (Waleleign *et al* 2019). Rentsch and Damon (2013) in a policy analysis revealed that the effect of reducing the price of substitutes on demand for bushmeat varies depending on the type of alternative. Furthermore, a strong cultural attachment to bushmeat may influence continued demand for the commodity even when there are relatively cheaper alternatives.

Human contact with wildlife via wildlife trade increases the proximity between humans and many wildlife species that serve as host of zoonotic viruses (Shivaprakash *et al* 2021). These contacts can facilitate the emergence and re-emergence of zoonotic diseases among human populations (Muehlenbein 2013; Tazerji *et al* 2022). The COVID-19 pandemic further gives

credence to this argument, as it is believed to have originated from a “wet market” selling wild meat and live wildlife in China (Anderson *et al* 2020; Zhou *et al* 2020). Zoonotic disease outbreaks can however be followed by a temporary decline in wild meat trade. For example, Funk *et al* (2022) documented a decline in sales volume of several wildlife species in nine bushmeat markets in southern Nigeria within the period of the COVID-19 pandemic. The authors attributed this decline to fear of disease transmission from bushmeat and the imposed travel restrictions.

In Nigeria unregulated trading of bush meat occurs in many major cities and rural communities (Fa *et al* 2015; Alade and Onadeko 2017) and the risk of disease transmission from these animals is heightened by the constant handling of wildlife carcasses by both buyers and vendors within the markets. In spite of the Covid-19 pandemic, bushmeat trade and consumption has not abated. It is however expected that personal hygiene practices such as regular handwashing and wearing of gloves should be adhered to in high disease risk locations such as bushmeat markets. In this study we investigated the factors driving the continuing trade and consumption of bushmeat in a West African market two years after the Covid-19 pandemic. Firstly, we examined the association between frequency of bushmeat consumption and household economic factors. Secondly, we investigated whether the frequency of bushmeat consumption is associated with the market price of bushmeat relative to other sources of protein. Thirdly, we evaluated whether the perception of risks associated with bushmeat handling

and consumption has increased since the covid-19 pandemic and if this is evidenced by behaviours such as regular hand washing or use of hand gloves.

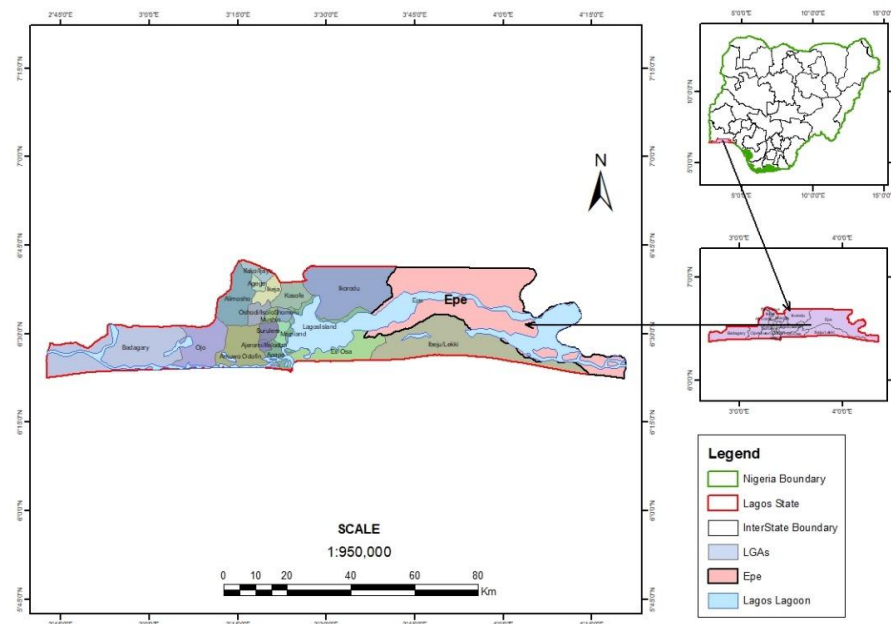
## Materials and methods

### Study area

This study was conducted at the Oluwo Market (6° 34' 56.9" N, 3° 59' 24" E), Epe, Lagos State, Nigeria (Figure 1), from February to October, 2022. This market was chosen because it is a major bush meat market in Lagos State where different types of bush meat are sold. Over the years Epe has transformed into a largely urban settlement although several rural communities still exist within the Local Government Area.

### Data collection

A preliminary survey was first carried out to understand the willingness of the respondents to answer the questions and to know the types of bush meat sold in the market. Thereafter data was collected through the administration of 150 structured interviewer-administered questionnaires. The questionnaire was uploaded on the KoboCollect survey tool within the KOBOToolbox App<sup>®</sup> and administered orally to willing respondents (buyers and vendors). Verbal consent was sought from all respondents. Questionnaire consisted of six sections which focused on the demography of respondents, household characteristics and economic standard, bushmeat consumption pattern, bushmeat preference, awareness and risk of exposure to zoonotic disease.



**Figure 1.** Map of Lagos State, Nigeria showing location of Oluwo Market, Epe with insert is map of Nigeria

## Results

A total of 150 respondents (122 buyers and 28 vendors) between the ages of 18-60 years and consisting of 91 females and 59 males were interviewed within the

period of this study (Table 1). Out of the total respondent, 56% were within the age range of 31–50 years while 12% were aged 51 years and above. In terms of educational qualification, 47% (n=71) of the

respondents had been educated up to tertiary level whereas 30% (n=45) and 19% (n=29) had only secondary and primary levels of education, respectively. Among the buyers 80% (n=98) were occasional consumers of bushmeat (i.e. consuming it only once in a while with no regular pattern), while 20% (n=24) were frequent consumers (i.e. they consume bushmeat either every day of the week or at least once a week).

#### Willingness to switch to cheaper alternative sources of protein

The willingness of buyers to switch to cheaper alternative sources of protein in the market was analysed between frequent and occasional consumers. The results revealed that whereas most occasional consumers (67%) of bushmeat would choose alternative protein sources if they are cheaper than bushmeat, most frequent consumers (54%) would not do so ( $p=0.02$ , Table 2). However, in both categories of buyers, the majority indicated their willingness to continue purchasing bushmeat even if the market price increases, although 12% of occasional consumers were undecided. Further, most frequent consumers believe that bushmeat is more nutritious than alternative protein sources whereas most occasional consumers are unsure (Table 2).

**Table 1:** Summary of demographic information of respondents

Category of respondent	Frequency	Percentage (%)
Buyers	122	81
Sellers/vendors	28	19
Gender		
Female	91	61
Male	59	39
Age range		
18 to 20years	1	1
21 to 30years	22	15
31 to 40years	56	37
41 to 50years	53	35
51years and above	18	12
Education		
Primary	29	19
Secondary	45	30
Tertiary	71	47
Not specified	5	3
Bushmeat consumption pattern		
Frequently	24	20
Occasionally	98	80

#### Bushmeat consumption

About 92% of those that are frequent consumers reported that they ate bushmeat a few days ago. Whereas, 49% of occasional consumers confirmed this. Most buyers in the two categories consume 1-2 pieces of bushmeat per food portion. A significant number of buyers who consumed bushmeat frequently and occasionally (63% and 98%, respectively, Fisher's test;  $p<0.001$ ) reported that they can cope without bushmeat.

Of the frequent consumers, 54% considered bushmeat as a significant part of their preferred diet. This was however not the case with occasional consumers where 95% did not consider bushmeat as a significant part of their preferred diet. When asked what their preferred bushmeat species was, both categories of buyers responded that they preferred grasscutter followed by antelope and pangolin (Figure 2). Both categories of buyers responded that apart from bushmeat, they preferred fish, red meat and goat meat as alternative sources of protein.

The top three bushmeat that individuals desired to buy at the market were the Grasscutter (*Thryonomys swinderianus*), Antelope species, white-bellied Pangolin (*Phataginus tricuspis*). Data from this study revealed that, monthly household income of the respondents was not significantly associated with the bushmeat consumption pattern among buyers ( $p<0.36$ ). Across all the income levels, most of the respondents consumed bushmeat occasionally. Most of the frequent consumers of bushmeat are relatively low-income individuals earning between ₦51,000-₦100,000 monthly while most occasional consumers earned between ₦101,000-₦200,000 monthly (Figure 3). The top three reasons given for bushmeat consumption by frequent and occasional consumers were taste followed by aroma and traditional/cultural beliefs (Figure 4).

#### Knowledge and risk of zoonotic disease transmission

The knowledge of zoonotic diseases was poor among buyers and vendors. Among buyers 33% of the respondents were aware of zoonotic diseases while 39% and 29% either had no knowledge of what zoonotic diseases are or were unsure, respectively. Among vendors, 21% were aware of the possibility of disease transmission to humans through handling and consumption of bushmeat while 79% had no such knowledge (Table 2). Similarly, 52% of buyers knew that diseases could be transmitted to humans through handling and consumption of bushmeat while 47% did not. Furthermore, most buyers (47%) and vendors (61%) were not aware that diseases like Ebola and Covid-19 can be contracted through contact with wild animals. Many of them were however unsure about the possibility of contracting these diseases (buyers: 33%, vendors: 25%). When asked if they would still buy bushmeat if it is linked to a disease transmissible to humans, the majority of them responded in the negative (buyer: 98%, vendors: 100%).

The result of this study revealed that risk associated with handling or consumption of bushmeat did not differ significantly between buyers and vendors ( $p>0.05$ ; Table 2). The analysis revealed that a higher percentage of buyers and vendors do not believe that the risks associated with handling or consuming bushmeat is higher than the benefits. Among buyers, this view did not differ significantly between frequent and occasional consumers ( $p=0.21$ ). In addition, among buyers 74% reported that the risks are not higher than the benefits while 16% reported that the risks were higher and 11% were unsure about the risks or benefits.

Among the vendors, 71% reported that the risks are not higher than the benefits while 14% reported that the risks were higher and 14% were unsure (Table 3).

Protective measures for reducing the risk of zoonotic disease transmission

This study reports that protective measures such as hand washing after touching wildlife or bush meat was a common practice among most buyers (92%) and

vendors (57%). However, for 7% of buyers and 43% of vendors, hand washing after handling bush meat is not a regular practice. Although, majority of buyers and all vendors agree that regular hand washing is an effective way of reducing the risk of zoonotic diseases (Table 3). Furthermore, majority of the buyers (98%) and vendors (96%) do not use personal protective materials like hand gloves when handling bushmeat in the market.

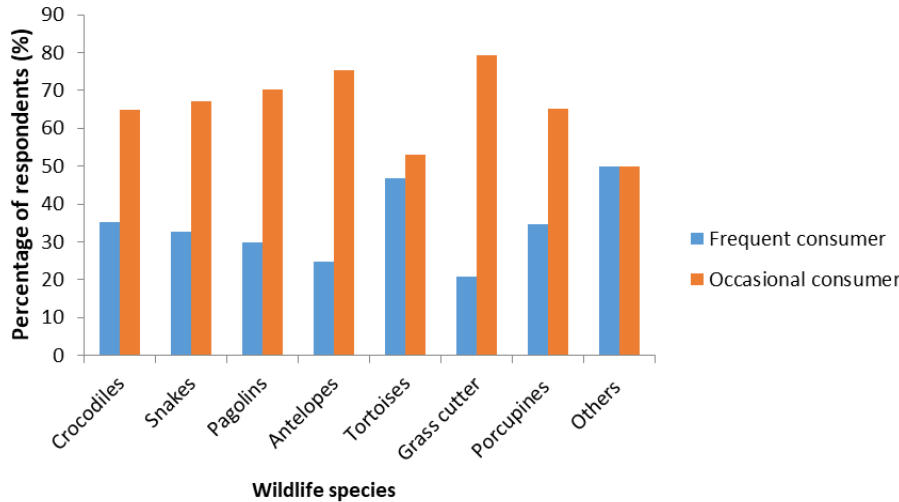


Figure 2. Bushmeat species preference among categories of buyers (frequent and occasional consumers)

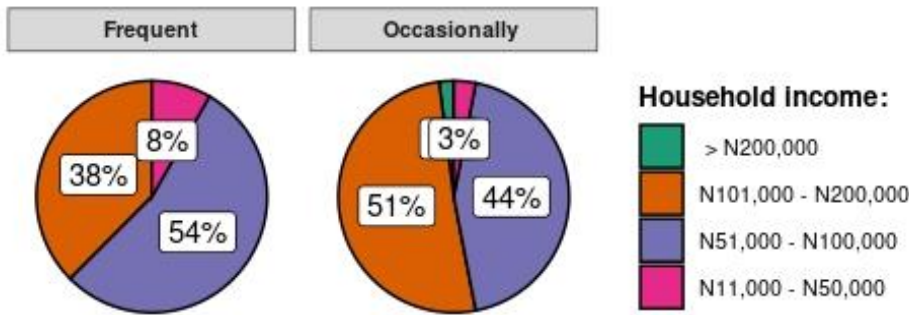


Figure 3. Frequency of bushmeat consumption among buyers based on household income

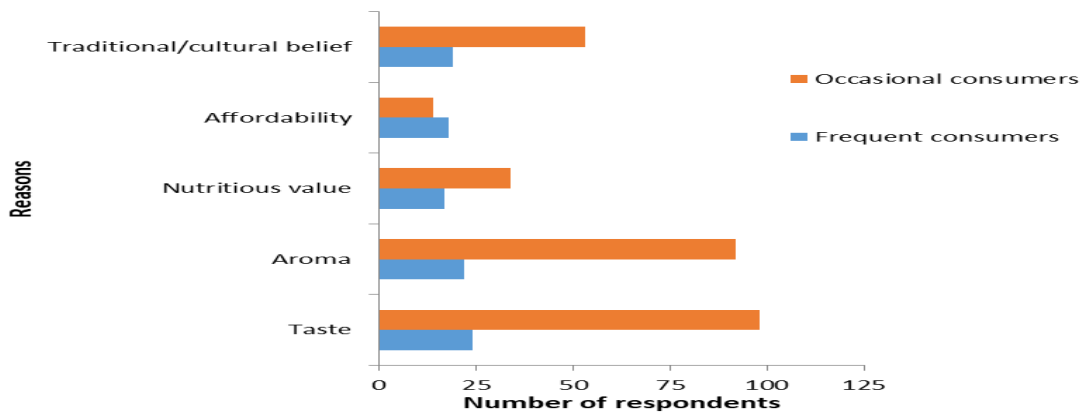


Figure 4. Reasons for consumption of bushmeat among buyers (occasional and frequent consumers)

**Table 2:** Percentage frequency of buyers' responses regarding questions relating to disposition to bushmeat and alternative sources of protein

Questions	Frequent consumers			Occasional consumers			p-value
	Responses						
	Yes	No	Maybe	Yes	No	Maybe	
Do you consider bushmeat a significant part of your preferred diet?	54	46	0	4	95	1	< 0.001
Can you cope without bushmeat?	63	29	8	98	2	0	< 0.001
Do you have a preference for bush meat over other sources of protein?	42	58	0	15	85	0	0.009
If other sources of proteins are cheaper in the market, will you prefer them to bush meat?	38	54	8	67	27	6	0.021
If the price of bush meat increases, will you continue to buy Bush meat?	96	0	4	55	33	12	0.0002
Do you believe bush meat is more nutritious than other sources of protein	75	0	25	40	13	47	0.004

**Table 3:** Percentage frequency of responses from buyers and vendors regarding questions relating to perception about zoonotic diseases and the risk associated with handling and consumption of bushmeat

Questions	Buyer			Seller			p-value
	Yes	No	Maybe/ Not sure	Yes	No	Maybe/ Not sure	
Are you aware of zoonotic diseases?	28	45	27	14	68	18	0.11
Do you agree that then risk associated with handling and consuming bush meat is higher than the benefits?	16	74	11	14	71	14	0.89
Are you aware that consuming bush meat exposes you to greater health risks than consumption of other sources of protein?	18	57	25	14	75	11	0.16
Do you wash hands after touching bushmeat?	92	01	07*	57	00	43*	< 0.01
Do you use any protective measures when handling the animals?	02	98		4	96	00	0.47
Do you know that regular handwashing is an effective way of reducing risk of zoonotic diseases?	99	01	00	100	00	00	1.00
Are you aware that diseases like Covid19, Ebola etc can be contracted through contact with wild animals?	20	47	33	14	61	25	0.47
If bush meats are associated with diseases that are transmissible to humans, will you continue to buy?	02	98	00	00	100	00	1.00

\*Response = sometimes

## Discussion

The study carried out in Nigeria's Epe wet market offers important insights into the consumption patterns of bushmeat and the main factors influencing consumption. The survey revealed that the majority of people who frequented the market preferred bushmeat species, particularly the grasscutter, antelope species and white-bellied pangolin. The high demand for grasscutter may be due to its comparatively larger meat yield as compared to small livestock species and its status as a wildlife that is acceptable among different cultures (Odebode *et al* 2011). Further, we found no significant association between bushmeat consumption pattern and economic means, despite differences in the buyers' reported household income levels. This suggests that decisions made by consumers about bushmeat may be more influenced by non-financial factors. Contrary to our findings, Brashares *et al* (2011) in a survey of 2000 households from four African countries, reported

that wealth had more influence on bushmeat consumption of families living near urban areas whereas in rural areas low-income was associated with higher bushmeat consumption. Similarly, Mbete *et al* (2011) also reported that household size and income of head of households positively influenced bushmeat consumption. In this study, the distribution of respondents based on household income revealed that most frequent consumers of bushmeat were relatively low-income earners. This pattern may have arisen because the majority of low-income people in the study area earned daily income and so can afford to spend a major part of it on bushmeat. This study also revealed that taste, aroma and cultural customs are the main driving forces behind the decisions made by regular and infrequent bushmeat consumers. Morsello *et al* (2015) highlighted the role of culture in driving bushmeat consumption among urban dwellers in Rio while Mbete (2011) reported a positive association between the ethnic group of heads of households and bushmeat



consumption. In a study conducted by East *et al* (2005) individuals purchasing bushmeat at market stalls indicated that their choice of bushmeat species was influenced by the flavour/taste. The findings of this study further emphasize the role of culturally driven preferences as a key driver of bushmeat consumption in African urban areas.

Furthermore, the readiness of buyers to move to less expensive alternative protein sources reveals different trends for regular and infrequent consumers. Although the majority of infrequent buyers expressed willingness to choose less expensive options if available, a sizable portion of regular buyers show a greater inclination to stick with bushmeat despite possible financial savings. This difference implies that for regular consumers, cultural preferences and established purchase patterns may take precedence over financial concerns. Wilkie *et al* (2005) reported a tendency for households in Gabon to substitute their protein diet with fish when the price of bushmeat increases. Similarly, Rentsch and Damon (2013) advocated for policy-driven price increase of bushmeat due to its potential for influencing reduction in bushmeat consumption. Foerster *et al* (2012) reported that a lack of alternative protein sources can motivate high-income rural households to continue to consume bushmeat. However, the study by Mgawe *et al* (2012) revealed that cultural background can moderate the decision of households. Specifically, the authors noted that compared to households that immigrate into the study area, wealthier indigenous homes consumed more bushmeat. The fact that in our study both frequent and occasional consumers of bushmeat are eager to buy the commodity even in the face of price increase, highlights the population's persistent need for bushmeat and presents difficulties for conservation initiatives meant to lower bushmeat consumption. The presence of undecided individuals among the occasional consumers however indicates opportunities for focused interventions and educational initiatives to support sustainable alternatives and change consumer behaviour toward more ecologically friendly protein sources.

In this study, we find a lack of knowledge among buyers and more notably vendors, about zoonotic illnesses connected to handling and consumption of bushmeat. This is surprising in view of the recent COVID-19 pandemic, which brought zoonoses to the fore. That only a minority of respondents possess knowledge of zoonotic diseases, suggests insufficient understanding of the potential health risks associated with consuming or handling bushmeat. Additionally, this study reveals a notable lack of awareness regarding the spread of specific diseases like Ebola and COVID-19 from wildlife, Alhaji *et al* (2022) revealed that most hunters, vendors and consumers of bushmeat in wildlife markets in Central Nigeria are not aware that zoonotic transmission of COVID-19 virus to humans is possible, underscoring the critical need for public health outreach and education programs in these communities. The majority of respondents, despite the general lack of knowledge, responded that they would be reluctant to

buy bushmeat if it is connected to diseases that can infect humans, suggesting that they might be inclined to change their ways if they became more aware of the risks. These findings emphasize the critical role that health education campaigns play in mitigating the risks of zoonotic diseases associated with bushmeat consumption and trade.

The results of this study also indicate that there is no discernible difference between buyers and vendors' perceptions of the risks involved in handling or consuming bushmeat. Furthermore, the majority of both groups do not agree that the risks exceed the benefits. These findings are similar to the report of Alhaji *et al* (2022), which noted that most hunters, vendors and consumers did not regard handling of wildlife as high zoonotic disease risk activity. Interestingly, in our study, a sizable portion of respondents expressed uncertainty about the risks relative to the benefits, suggesting that a knowledge gap exists, particularly among individuals who are unsure or perceive the risks to be lower than the benefits. Hence, addressing misconceptions and encouraging informed decisions about bushmeat consumption can help prevent the spread of zoonotic illnesses and safeguard the general public's health in the study areas.

We observed that the adoption of safety precautions by both buyers and vendors who handle bushmeat that are both positive and alarming. Notably, handwashing after contact with wildlife or bushmeat is a common practice among buyers and vendors suggesting that the personal hygiene knowledge and practices gained from the COVID-19 pandemic has been carried forward. Nonetheless, the fact that a sizeable proportion of buyers and vendors do not always adhere to this precautionary measure, increases the risk of disease transmission. Additionally, there is a general lack of use of personal protective equipment, such as hand gloves, by majority of buyers and vendors similar to the report of other studies (Alhaji *et al* 2022).

## Conclusion

This study revealed that the bushmeat preference among consumers at the Epe wet market is driven to a greater extent by non-financial factors namely taste, aroma and cultural customs rather than economic considerations. Given that the grasscutter accounted for the species most buyers purchased, we advocate for entrepreneurial training initiatives aimed at promoting sustainable alternatives to widely sought bushmeat. This can be combined with strict enforcement of laws on illegal wildlife trade to ensure that endangered species like Pangolins are not sold. Furthermore, the existence of a significant knowledge gap regarding zoonotic disease risks associated with bushmeat, calls for urgent public health education in the study area to mitigate health hazards and promote safer consumption practices. In addition, the inadequate adherence to safety precautions among buyers and vendors complicates ongoing risks of disease transmission.

### Acknowledgement

We thank all the bushmeat vendors at Oluwo Market, Epe, Lagos State for their support during the data collection.

### References

- Alade, I.A. and Onadeko, A.B. 2017. Analysis of bushmeat collection and trade in Epe, Ikorodu and Oyingbo (Lagos State). *J. Res. For. Wildl. Environ.* 9(1): 85-96.
- Alhaji, N.B., Odetokun, I.A., Lawan, M.K., Adeiza, A.M., Nafarnda, W.D., and Salihu, M.J. 2022. Risk assessment and preventive health behaviours toward COVID-19 amongst bushmeat handlers in Nigerian wildlife markets: Drivers and One Health challenge. *Acta Trop.* 235, <https://doi.org/10.1016/j.actatropica.2022.106621>.
- Andersen, K.G., Rambaut, A., Lipkin, W.I., Holmes, E.C. and Garry, R. F. 2020. The proximal origin of SARS-CoV-2. *Nat. Med.* 26(4): 450-452.
- Andong, F.A., Ossai, N.I., Echude, D., Okoye, C.O. and Igwe, E.E. 2023. Motives, other meat sources and socioeconomic status predict number of consumers with preference for two antelope species served in Enugu-Nigeria. *Glob. Ecol. Conserv.* 42, <https://doi.org/10.1016/j.gecco.2023.e02387>.
- Brashares, J.S., Golden, C.D., Weinbaum, K.Z., Barrett, C.B. and Okello, G.V. 2011. Economic and geographic drivers of wildlife consumption in rural Africa. *Proc. Natl. Acad. Sci.* 108(34):13931-6.
- Chausson, A.M., Rowcliffe, J.M., Escoufflaire, L., Wieland, M. and Wright, J.H. 2019. Understanding the sociocultural drivers of urban bushmeat consumption for behavior change interventions in Pointe Noire, Republic of Congo. *Hum. Ecol.* 47: 179-191.
- East, T., Kümpel, N.F., Milner-Gulland, E.J. and Rowcliffe, J.M. 2005. Determinants of urban bushmeat consumption in Rio muni, Equatorial Guinea. *Biol. Conserv.* 126(2): 206-215.
- Fa, J.E., Peres, C.A. and Meeuwig, J.A. 2002. Bushmeat exploitation in tropical forests: an intercontinental comparison. *Conserv. Biol.* 16: 232-237.
- Fa, J.E., Olivero, J., Farfán, M.Á., Márquez, A.L., Duarte, J., Nackoney, J., ... and Vargas, J.M. 2015. Correlates of bushmeat in markets and depletion of wildlife. *Conserv. Biol.* 29(3): 805-815.
- Fa, J.E., Nasi, R. and van Vliet, N. 2019. Bushmeat, anthropogenic change, and human health in tropical rainforests: The case of the Ebola virus. *Santé Publique.* 1: 107-114.
- Foerster, S., Wilkie, D. S., Morelli, G. A., Demmer, J., Starkey, M., Telfer, P. and Lewbel, A. 2012. Correlates of bushmeat hunting among remote rural households in Gabon, Central Africa. *Conserv. Biol.* 26(2): 335-344.
- Funk, S.M., Fa, J.E., Ajong, S.N., Eniang, E.A., Dendi, D., Nasi, R. and Luiselli, L. 2022. Impact of COVID-19 on wild meat trade in Nigerian markets. *Conserv. Sci. Pract.* 4(2), <https://doi.org/10.1111/csp2.599>.
- Lindsey, P. A., Balme, G., Becker, M., Begg, C., Bento, C., Bocchino, C. and Zisadza-Gandiwa, P. 2013. The bushmeat trade in African savannas: Impacts, drivers, and possible solutions. *Biol. Conserve.* 160: 80-96.
- Luiselli, L., Hema, E.M., Segniagbeto, G.H., Ouattara, V., Eniang, E.A., Di Vittorio, M., ... and Fa, J.E. 2019. Understanding the influence of non-wealth factors in determining bushmeat consumption: Results from four West African countries. *Acta Oecol.* 94: 47-56.
- Luiselli, L., Hema, E.M., Segniagbeto, G.H., Ouattara, V.A.L.Y., Eniang, E.A., Parfait, G., ... and Fa, J.E. 2020. Bushmeat consumption in large urban centres in West Africa. *Oryx* 54(5): 731-734.
- Mbete, R.A., Banga-Mboko, H., Racey, P., Mfoukou-Ntsakala, A., Nganga, I., Vermeulen, C., ... and Leroy, P. 2011. Household bushmeat consumption in Brazzaville, the Republic of the Congo. *Trop. Conserv. Sci.* 4(2): 187-202.
- Merson, S.D., Dollar, L.J., Johnson, P.J. and Macdonald, D.W. 2019. Poverty not taste drives the consumption of protected species in Madagascar. *Biodivers. Conserv.* 28(13): 3669-3689.
- Mgawe, P., Mulder, M.B., Caro, T., Martin, A. and Kiffner, C. 2012. Factors affecting bushmeat consumption in the Katavi-Rukwa ecosystem of Tanzania. *Trop. Conserv. Sci.* 5(4): 446-462.
- Morsello, C., Yagüe, B., Beltreschi, L., Van Vliet, N., Adams, C., Schor, T., Quiceno-Mesa, M.P. and Cruz D. 2015. Cultural attitudes are stronger predictors of bushmeat consumption and preference than economic factors among urban Amazonians from Brazil and Colombia. *Ecol. Soc.* 20(4): 21. <https://doi.org/10.5751/ES07771-200421>.
- Muehlenbein, M.P. 2013. Human-Wildlife Contact and Emerging Infectious Diseases. In: E. Brondizio and E. Moran (eds.), *Human-Environment Interactions.* vol 1., Springer, Dordrecht, 79-94. [https://doi.org/10.1007/978-94-007-4780-7\\_4](https://doi.org/10.1007/978-94-007-4780-7_4).
- Odebode, A.V., Awe, F., Famuyide, O.O., Adebayo, O., Ojo, O.B. and Daniel, G. 2011. Households' consumption patterns of grasscutter (*Thryonomys swinderianus*) meat within Ibadan Metropolis, Oyo State, Nigeria. *Cont. J. Food Sci. Tech.* 5:49-57
- Patil, I. 2021. Visualisation with statistical details: The 'ggstatsplot' approach. *J. Open Source Softw.* 6(61): <https://doi.org/10.21105/joss.03167>.
- Rentsch, D. and Damon, A. 2013. Prices, poaching, and protein alternatives: An analysis of bushmeat consumption around Serengeti National Park, Tanzania. *Ecol. Econ.* 91: 1-9.
- Shivaprakash, K.N., Sen, S., Paul, S., Kiesecker, J.M., and Bawa, K.S. 2021. Mammals, wildlife trade, and the next global pandemic. *Curr. Biol.* 31(16): 3671-3677.

- Tazerji, S.S., Nardini, R., Safdar, M., Shehata, A.A. and Duarte, P. M. 2022. An overview of anthropogenic actions as drivers for emerging and re-emerging zoonotic diseases. *Pathogens*. 11(11): <https://doi.org/10.3390/pathogens11111376>.
- van Vliet, N. and Mbazza, P. 2011. Recognizing the multiple reasons for bushmeat consumption in urban areas: a necessary step toward the sustainable use of wildlife for food in Central Africa. *Hum. Dimens. Wildl.* 16(1): 45-54.
- van Vliet, N., Nasi, R. and Taber, A. 2011. From the forest to the stomach: bushmeat consumption from rural to urban settings in Central Africa. In: S. Shackleton, C. Shackleton and P. Shanley (eds.). *Non-timber Forest Products in the Global Context*, Tropical Forest, Vol 7., Springer, Berlin. 129-145. [https://doi.org/10.1007/978-3-642-17983-9\\_6](https://doi.org/10.1007/978-3-642-17983-9_6).
- Walelign, S.Z., Nielsen, M.R., and Jakobsen, J.B. 2019. Price elasticity of bushmeat demand in the greater serengeti ecosystem: Insights for managing the bushmeat trade. *Front. Ecol. Evol.* <https://doi.org/10.3389/fevo.2019.00162>.
- Wilkie, D.S., Starkey, M., Abernethy, K., Effa, E.N., Telfer, P., and Godoy, R. 2005. Role of prices and wealth in consumer demand for bushmeat in Gabon, Central Africa. *Conserv. Biol.* 19(1): 268-274.
- Zhou, P., Yang, X.L., Wang, X.G., Hu, B., Zhang, L., Zhang, W., Si, H-R., Zhu, Y., Li, B. Huang, C-L., Chen, H-D., Chen, J., Luo, Y., Guo, H., Jiang, R-D., Liu, M-Q, Chen, Y., Shen, X-R., Wang, X., ... and Shi, Z.L. 2020. A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature* 579(7798): 270-273.
- Ziegler, S., Fa, J.E., Wohlfart, C., Streit, B., Jacob, S., and Wegmann, M. 2016. Mapping bushmeat hunting pressure in Central Africa. *Biotropica*, 48(3): 405-412.

#### ORCID

Soladoye B. Iwajomo: 0000-0003-2486-0622