International Journal of Microbiology and Applied Sciences
ISSN 1115-4004 Volume 4 issue 1 Jan, 2025 Research Article

Bacteriological Quality and Heavy Metal Residues in Cattle Hides (Kpomo) Singed With Scrap Automobile Tyres

Onwuchekwa, O.V[2]., Ekaiko, M.U[1*]., Kanu, M. I[2]., Onuoha-Elvis, C.N[2]., Oluoha, O.S[2]. and Ezenwa, A.M[2].
[1]Department of Science Laboratory Technology, Ihechukwu Madubuike Institute of Technology, Nkwoagu-Amuda Isuochi, Umunneochi L.G.A, Abia State, Nigeria. [2]Department of Science and Laboratory Technology, Abia State College of Health Sciences and Management Technology. Aba, Abia State, Nigeria. ***Corresponding Author:** *ekaikomarshall@gmail.com*

ABSTRACT

Due to some health related problems believed to be associated with the consumption of red meat, hides also known as kanda or kpomo in most part of Nigeria have become a substitute for red meat considering its availability and lower cost. Considering the importance and high demand for these products, abattoir workers have develop different methods and substance used as fuel in singeing the product to meet demand. The present study investigated the microbial quality and metal residues in hide singed with scrap automobile tyres. Standard pour plate method was used to for the bacteriological analysis and the AOAC methods using Atomic Absorption Spectrophotometry (AAS) was used to determine the heavy metal residues in the hide. The results of the study showed that the singed hides were contaminated at varying level with mean bacterial count ranging from $2.0x10^5$CFU/g to $3.5x10^5$CFU/g for the Total heterotrophic bacteria while the coliform count ranged from $1.0x10^5$CFU/g to $2.1x10^5$CFU/g. The study implicated the presence of seven bacteria species which included; *Bacillus*, *Staphylococcus*, *Micrococcus*, *Streptococcus*, *Pseudomonas*, *Enterobacter* and *Serratia* sp. The results also showed higher levels of Cupper (6.4mg/kg), Cadmium (1.7mg/kg), Magnesium (12.3mg/kg), Lead (2.4mg/kg), Zinc (43.2mg/kg), Nickel (1.8mg/kg) and Manganese, not detected compared to the un-singed hide with lower concentrations of heavy metals (Copper 2.3 mg/kg., Cadmium 0.2mg/kg., Magnesium 5.2mg/kg., Lead 0.4mg/kg., Zinc 15.02mg/kg., Nickel, 0.6mg/kg and Manganese, not detected). The presence of this bacteria species and heavy metals in the singed hide calls for urgent attention as their presence in the such food sample represent possible health hazard to consumers.

Keywords: Cattle Hides, Kpomo, Singeing, Automobile Tyres, Bacteriological, Heavy Metals.

Introduction

Although heavy metals are naturally occurring elements that are found throughout the earth's crust, most environmental contamination and human exposure result from anthropogenic activities (mining and smelting operations, industrial production and use, and domestic and agricultural use of metals) and metal-containing compounds (Shallari *et al*., 1998 and Goyer, 2008). Environmental contamination can also occur through metal corrosion, atmospheric deposition, soil erosion of metal ions and leaching of heavy metals, sediment re-suspension and metal evaporation from water resources to soil and ground water (Tchounwou *et al*., 2012). Metals and other elements can be naturally present in food or can enter food as a result of human activities such as industrial and agricultural processes.

The metals of particular concern in relation to harmful effects on health are mercury, lead, cadmium, tin, arsenic etc. The toxicity of these metals is in part due to the fact that they accumulate in biological tissues, a process known as bioaccumulation. This process of bioaccumulation of metals occurs in all living organisms as a result of exposure to metals in food and the environment, including food animals such as fish and cattle. However, these elements are essential in trace quantities for maintenance of cellular processes. Other metallic elements have no functional effects in the body and can be harmful to health if foodstuffs containing them are consumed regularly in the diet.

Due to some health related problems believed to be associated with the consumption of red meat, livestock (cattle, goats sheep and donkey) hides also known as kanda or kpomo in most part of Nigeria (Okiel, *et al*., 2009), have become a substitute for red meat in

Citation: Onwuchekwa *et al*. (2024). Bacteriological quality and heavy metal residues in cattle hides (kpomo) singed with scrap automobile tyres. *International Journal of Microbiology and Applied Sciences, 4(1)*: 1 – 6.

Nigeria considering it availability and lower cost. The product is also an essential part of diet in most tribes and cultures in Nigeria as it is used to prepare different delicacies which in turn have resulted in increased demand for the product. Considering the importance and high demand for these products, abattoir workers have develop different methods and substance used as fuel in singeing the product to meet demand. Singeing is a method largely favoured in most African and developing countries. It is believed to maintain the carcass hide for consumption while adding flavours in meat that are highly acceptable by the local populace (FAO, 1985). Traditionally, singeing is carried out in open fire using firewood as fuel. But the relative scarcity of firewood lately has resulted in local butchers using scrap tyres as alternative source of fuel to singe slaughtered livestock (Obiri-Danso *et al.*, 2008; Ariyo and Obire, 2023a). The practice, though unconventional and potentially dangerous, is increasingly favoured by local butchers.

Unfortunately, these tyres deposits some toxic metals into the hides , which is capable of causing harm to consumers (Ekenma, *et al*., 2015; Ariyo and Obire, 2023b). Automobile tyres are reported to contain toxic materials such as heavy metal which could pose health threats to humans (Ariyo and Obire, 2023a; Ariyo and Obire, 2023b). However, in Nigeria, most butchers singe livestock hides with scrap tyres. Heavy metals could build up in different body parts of humans, including blood, kidney, liver, heart, and spleen, where they cause disease conditions (Woyessa, *et al*., 2015) in addition to polycyclic aromatic hydrocarbons (PAHs) (Ariyo and Obire, 2023a). Due to the toxicity of heavy metals, their availability in food and drink is of immense concern to public health due to their biotoxic effects. The present study therefore seeks to investigate the microbiological quality and presence of heavy metals in cattle hides singe with scrap automobile tires in an abattoir.

Materials and Methods

Study Area

The study was conducted in Aba Metropolis of Abia state Nigeria. The singed hinds were obtained from the Ogbor Hill slaughter house, Aba and transported to the Department of Biochemistry Laboratory, Abia State Polytechnic Aba, Abia State where the chemical analyses of the samples was carried out.

Sample Collection

A total of five (5) freshly singed cattle hides were obtained from Ogbor Hill slaughter house, Aba. The singed hides were isolated from the muscles, and were packed in moisture proof polythene bags, placed in ice-packed container and immediately transported to the laboratory for chemical and microbiological analyses. Portions of the hides were boiled to an internal temperature of 70°C for 15 minutes before the analyses were conducted, while the other portions were analyzed in the uncooked form.

Laboratory Analyses of Meat Samples

The total Lead (Pb), Zinc (Zn), Iron (Fe), Copper (Cu), Manganese (Mn) and Cadmium (Cd) residues in the singed hides were determined according to the methods of the Association of Official Analytical Chemists (AOAC, 1990).

Blank solution consisted of the binary acid mixture (HNO_3:$HClO_4$), $H2SO_4$ and the distilled water used for the sample digestion. It was prepared similarly as the entire digestion process but without the meat sample. Standards for atomic absorption analysis were prepared from commercial stock metal standards of each metal.

Levels of Mg, Mn, Cu, Ni, Cd, Pb and Zn in each digest were determined in triplicates using Atomic Absorption Spectrophotometer, with the blank solution set as zero (0) and the standards used for calibration of the spectrophotometer.

Preparations of Ruminant hide and skin homogenate:

Twenty grams (20g) of Ruminant hide and skin sample were weighed and aseptically poured into sterile 80ml of buffered peptone water which were blended together to ensure thorough homogenized mixture (FAO/WHO, 1979).

Dilution and pour plating

The hides and skins homogenate was thoroughly shaking to mix, syringe was used to pipette 1.0ml of homogenate which was used to make serial dilution of 10 test tubes containing 9 ml of peptone water; 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6} to 10^{-10}.

Citation: Onwuchekwa *et al*. (2024). Bacteriological quality and heavy metal residues in cattle hides (kpomo) singed with scrap automobile tyres. *International Journal of Microbiology and Applied Sciences, 4(1)*: 1 – 6.

From the appropriate dilutions, 1.0ml of the dilution was inoculated into labeled sterilized Petri dishes containing nutrient agar and McConkey agar in duplicate plates. Thereafter, the plates were incubated at 37°C for 48 hours after the agar solidified (Bersisa *et al*., 2019). Following incubation, Petri dishes containing 30-300 colonies counts were recorded as results per dilution; the average count was taken from colonies in duplicate plates of a dilution and recorded in Colony Forming Unit per gram (CFU/g). Distinct colony that represented a different organism was picked up for characterization and identification.

Result

The result of the Mean Heavy Metal Concentration in Singed and Unsinged Cattle Hide is as shown in Table 1 while the Mean Bacterial Count (CFU/g) from Singed Cattle Hide is as shown in Table 2.

The result of the microscopic and biochemical profile of bacterial isolates from singed cattle hide is presented in Table 3 while the frequency of occurrence of each isolate from singed cattle hide is presented in Table 4.

Table 1: Mean Heavy Metal Concentration in Singed and Unsinged Cattle Hide

Heavy metal	Singed cattle hide (mg/kg)	Unsinged hide (mg/kg)	MPL (mg/kg)
Cupper (Cu)	6.4	2.3	20.0
Cadmium (Cd)	1.7	0.2	0.05
Magnesium (Mg)	12.3	5.2	-
Manganese (Mn)	ND	ND	-
Lead (Pb)	2.4	0.4	0.10
Zinc (Zn)	43.2	15.02	50.0
Nickel (Ni)	1.8	0.6	

MPL= Maximum permissible limit.

Table 2: Mean Bacterial Count (CFU/g) from Singed Cattle Hide

Hide Sample	Total Heterotrophic Bacteria Count (CFU/g)	Total Coliform Count (CFU/g)
1	2.6×10^5	2.1×10^5
2	2.0×10^5	1.1×10^5
3	3.5×10^5	2.0×10^5
4	2.4×10^5	-
5	2.1×10^5	1.0×10^5

Table 3: Microscopic and Biochemical Profile of Bacterial Isolates from Singed Cattle Hide

Isolate Code	Gram reaction	Catalase text	Coagulase	Methyl red	Vog-nrokaeur	Citrate utilization	Oxidase text	Indole	Urease text	Glucose	Lasctose	Sucrose	Most probable organism
A	+	+	-	+	+	+	+	+	+	A	A	A	*Bacillus* species
B	+	+	+	-	+	+	-	-	-	A/G	A	A	*Staphylococcus aureus*
C	+	-	-	-	+	+		-	-	A	-	A	*Micrococcus* species
D	+	-		+	+	-	-		+	A	-/-	-/-	*Streptococcus* species
E	-	-	-	-	+	-	-	+	+	A	-	-	*Pseudomonas* sp
F	-	+	-	-	-	-	+	-	-	AG	AG	A	*Enterobacter* sp
G	-	-	-	-	+	+	-	+	-	-/-	A/-	A/-	*Serratia* sp.

Note: + =Positive, - = Negative, A= Acid production, A/G= Acid and Gas production.

Citation: Onwuchekwa *et al*. (2024). Bacteriological quality and heavy metal residues in cattle hides (kpomo) singed with scrap automobile tyres. *International Journal of Microbiology and Applied Sciences*, *4(1)*: 1 – 6.

Table 4: Frequency of Occurrence of Each Isolate from Singed Cattle Hide

S/N	Isolates	Frequency of Occurrence (%)
1	*Bacillus* species	6 (85.7)
2	*Staphylococcus aureus*	7 (100)
3	*Micrococcus* species	5 (71.4)
4	*Streptococcus* species	3 (42.8)
5	*Pseudomonas* sp	5 (71.4)
6	*Enterobacter* sp	6 (85.7)
7	*Serratia* sp.	6 (85.7)

Discussion

Conditions of food safety include efforts to avoid contamination from biological, chemical, agents, and other substances that can endanger human health (Adolf and Azis, 2012). The safety of meat and meat products, which is delineated by a series of challenges associated with either microbial pathogens or other (biological or not) issues, has been one of the major societal concerns. Various events have been identified as potential explanations for the rising meat safety concerns of recent years including: changes in animal production, product processing, and distribution; increased international trade; increased worldwide meat consumption; changing consumer needs and consumption patterns (e.g., preference for minimally processed foods); higher numbers of consumers at risk for infection; and increased interest, awareness, and scrutiny by consumers (Sofos, 2008).

The present study investigates heavy metal contaminants and microbiological quality of singed cattle hide using condemn automobile tyres. The singed cattle hide samples were screened for seven (7) metals and the results of the study revealed that the cattle hide accumulate varying concentration of heavy metals in limit above the recommended or permissible limit for some of the metals. The results (Table 1) showed higher levels of Copper, 6.4mg/kg, Cadmium, 1.7mg/kg, Magnesium 12.3mg/kg, Lead, 2.4mg/kg, Zinc, 43.2mg/kg, Nickel, 1.8mg/kg and Manganese, not detected compared to the un-singed hide with lower concentrations of heavy metals (Copper, 2.3mg/kg, Cadmium, 0.2mg/kg, Magnesium 5.2mg/kg, Lead, 0.4mg/kg, Zinc, 15.02mg/kg, Nickel, 0.6mg/kg and Manganese, not detected). Thus, the results indicated that singeing of the carcasses with tyres increased their heavy metal contents. The presence of heavy metals in the un-singed hide could be attributed to residues in plants grazed by the cattle, contaminated water/soil and the environment. The results of the present study supports that reported by Obiri-Danso *et al.* (2008) and Ariyo and Obire (2023b) who reported increased levels of some heavy metals in goats and cattle hides singed with tyres. In addition, Adam *et al*., (2013) and Essumang *et al*. (2007) reported similar findings in their work and also stated a lower concentration of heavy metal in carcass singed with fire wood. These reports are indications that the mode of processing which involves the use of tyres increases the heavy metal concentration of singed carcasses. The results of the present study however contradicts the findings of Eremong *et al.* (2011) who reported decreasing levels of heavy metal residues in singed cattle hides. This observed differences can be attributed to differences in the methods used and environmental factors. The difference was also said to be due to losses through the scrapings of the hides after singeing (Okiel *et al*., 2009). All the values except for Manganese (Mn) which was not detected were above the maximum permissible level set by the European commission regulation (2006) for such food produce.

Heavy metals are naturally occurring elements that have a high atomic weight and a density at least 5 times greater than that of water. Their multiple industrial, domestic, agricultural, medical and technological applications have led to their wide distribution in the environment; raising concerns over their potential effects on human health and the environment. Their toxicity depends on several factors including the dose, route of exposure, and chemical species, as well as the age, gender, genetics, and nutritional status of exposed individuals. Because of their high degree of toxicity, some of them are rank among the priority metals that are of public health significance.

Citation: Onwuchekwa *et al*. (2024). Bacteriological quality and heavy metal residues in cattle hides (kpomo) singed with scrap automobile tyres. *International Journal of Microbiology and Applied Sciences, 4(1)*: 1 – 6.

The results for the bacteriological quality of the singe hide revealed that the hides were contaminated at varying level (Table 2) with the presence of some bacteria (*Bacillus, Staphylococcus, Micrococcus, Streptococcus, Pseudomonas, Enterobacter* and *serettia* sp.) contaminants in the food samples (Table 3). The results of the present study supports the finding reported by Zungum *et al*., (2020), Omorodion and Osita-Dinma, (2021) and Ariyo and Obire, (2002) who also stated the presence of similar bacterial isolates in their study including the presence of fungi contaminants. The presence of these organisms in the singed hide could be as a result of poor hygienic practice in the abattoir house, materials used, water and abattoir workers. According to Ariyo and Obire, (2002), the lack of proper quality control measures in handling dressing and processing of the cowhide in different abattoirs as well as the unhygienic practices of handlers such as talking, coughing and sneezing on the processed cow hide by the butchers, sellers and buyers could all be sources of contamination of the product. The presence of these bacteria species in the singed hide calls for urgent attention as their presence in such food sample represent possible health hazard to consumers. Hence, urgent action is needed in the abattoir to stop unsafe hide and skin consumption contaminated with such bacterial.

The report of the present study is a source of concern on the public implication of the long term consumption of such hides. Consumption of carcasses singed with automobile tyres could pose health threats to consumers and even abattoir workers who are involved in singeing of the hides. Regulatory agencies should therefore monitor the activities of local butchers, to stop the use of automobile tyres as singeing fuels and also enlighten the public on the health implications of such processed foods.

References

Adam, I., Okyere, D. & Teye, M. (2013). Assessment of Heavy Metal Residues in Hides of Goats Singed with Tyres, and the Effect of Boiling on the Heavy Metal Concentrations in the Hides. *Journal of Veterinary Advances. 3(5),* 165-169.

Adolf, J.N.P. & Azis, B.S. (2012). Microbiological status of various foods served in elementary school based on social economic status differences in Karawachi Region, Tangerang District-Indonesia. *Int. Food Res. J. 19(1),* 65-70.

AOAC, (1990). Association of Official Analytical Chemists, Official Methods of Analyses, 15th ed. AOAC, Arlington, Virginia, USA.

Ariyo, A. B. & Obire, O. (2022). Microbiological Quality of Roasted Cowhide Meat ('Ponmo') Processed and Sold in Some Abattoirs in Bayelsa and Rivers States. *Acta Scientific Microbiology*. *5(7),* 64-70.

Ariyo, A. B. & Obire, O. (2023a). Impact of roasting fuel on polycyclic aromatic hydrocarbons (PAHs) in roasted edible cowhide meat ("*Kpomo*"). *International Journal of Microbiology and Applied Sciences*. *1(1),* 16 – 22.

Ariyo, A. B. & Obire, O. (2023b). Minerals and heavy metal content of roasted cowhide meat ("*Kpomo*") sold in some abattoirs in Bayelsa and Rivers States. *International Journal of Microbiology and Applied Sciences. 2,* 29 – 36.

Association of Official Analytical Chemist (AOAC) (2000). Official Methods of Analysis of AOAC International. 17th edn. Maryland, USA: AOAC International.

Bersisa, A., Tulu, D. & Negera, C. (2019). Investigation of Bacteriological Quality of Meat from Abattoir and Butcher Shops in Bishoftu, Central Ethiopia. *Hindawi Inter. J. Micro,* 8,https://doi.org/10.1155/2019/6416803

Ekenma, K., Anelon, N. J. & Ottah, A. A. (2015). Determination of the presence and concentration of heavy metal in cattle hides singed in Nsukka abattoir. *Journal of Veterinary Medicine and Animal Health. 7(1),* 9-17.

Eremong, D.C., Akwetey, W.Y. & Donkoh, A. (2011). Chemical composition of cattle hide processed using four different procedures. *Proceedings of the Seventeenth Biennial Conference of the Ghana Society of Animal Production*, *Pp*. 69-73.

Essumang, D,K., Dodoo, D.K., Adokoh, K.C., Koka, V., Nkrumah, B.N. & Nuer, A.C.D. (2007). Heavy metal levels in singed cattle hide (*wele*) and its human health implications. Proceedings – *The First International Conference on Environmental Research, Technology and Policy*, ERTEP 2007, Accra, Ghana. Book of Abstracts, *p*.19.

Citation: Onwuchekwa *et al*. (2024). Bacteriological quality and heavy metal residues in cattle hides (kpomo) singed with scrap automobile tyres. *International Journal of Microbiology and Applied Sciences, 4(1)*: 1 – 6.

European Commission Regulation (ECR) (2006). No 1881/2006, Setting maximum levels for certain contaminants in foodstuff. *Official J. of the European Union*, L. *364*, 5-24.

European Food Safety Authority (EFSA) 2011. Scientific Opinion: Statement on tolerable weekly intake for cadmium, EFSA Panel on Contaminants in the Food Chain (CONTAM). *The EFSA Journal*. 9 (2), 1975.

FAO, (1985) Animal by-products: Processing and utilization. FAO Animal production and health series. No.9, FAO *Agricultural Development Paper* No.75, FAO, Rome.

FAO/WHO (1979). Manuals of food Quality control 4. Microbiological analysis: FAO EC/ microbiology/75/report 1/annex V. and bacteriological analytical manual for foods, 1976, 4 th Ed. Food and drug administration U.S.A

Gautam, P. & Irfan, A. (2011). Heavy metals contamination assesment of Kanhargaon Dam water near Chhindwara city. *Acta Chim. Pharm. Indica*. *1(1),* 7-9.

Goyer, R.A. (2001). *Toxic effects of metals*. In: Klaassen, CD., editor. Cassarett and Doull's Toxicology: The Basic Science of Poisons. New York: McGraw-Hill Publisher. *p*. 811-867.

Leita, L., Enne, G., De Nobili, M., Baldini, M. & Sequi, P. (1991). Heavy metal bioaccumulation in lamb and sheep bred in smelting and mining areas of S. W. Sardinia, Italy. *Food Sci. Technol*. *24*, 125-127.

Obiri-Danso, K., Hogarh, J.N. & Antwi-Agyei, P. (2008). Assessment of contamination of singed hides from cattle and goats by heavy metals in Ghana. *African Journal of Environmental Science and Technology*. *2(8),* 217-221

Okiel, W., Ogunlesi, M., Alabi, F., Osiughwu, B. & Sojinrin, A. (2009). Determination of toxic metal concentrations in flame treated meat products. *African Journal of Biochemistry Research*. *3(10),* 332-339.

Omorodion, N. J. & Osita-Dinma, F. (2021). Microbial and Heavy Metal Screening of Kpomo (Cow-Hide) Displayed for Sales in the Market. *Research Journal of Food Science and Quality Control*. *7(1),* 2695-2459.

Shallari, S., Schwartz, C., Hasko, A. & Morel, J.L. (1998) Heavy metals in soils and plants of serpentine and industrial sites of Albania. S*ci Total Environ. 19209,* 133–142.

Sofos, J.N. (2007). Challenges to meat safety in the 21st century. *Meat Science. 78*, 3–13.

Tchounwou, P., Newsome, C., Williams, J. & Glass, K. (2008). Copper-induced cytotoxicity and transcriptional activation of stress genes in human liver carcinoma cells. Metal Ions *Biol Med*. *10,* 285–290.

Tchounwou, P.B., Yedjou, C.G., Patlolla, A.K. & Sutton, D.J. (2012). Heavy Metals Toxicity and the Environment. *Natl. Inst. Health. 101*, 133–164.

World Health Organization (WHO) (1996). International Standards of Drinking Water, Geneva.

Woyessa, G.W., Kassa, S.B., Demissie, E.G. & Srivastava, B.B.L. (2015). Determination of the level of some trace and heavy metals in some soft drinks of Ethiopia. *Int. J. Curr. Res. Chem. Pharm. Sci. 2*, 84–88.

Zungum, I.U., Imam, T.S., Ahmad, A.G., Abubakar, T., Benjamin, B. & Daya, M.G. (2019). Impact of Typha Grass on Biodiversity Loss of Hadejia-Nguru Wetland Located between Jigawa and Yobe States of Nigeria: A review. *J. Appl. Sci. Environ. Manage*. *23(10),* 1847-1853.

Citation: Onwuchekwa *et al*. (2024). Bacteriological quality and heavy metal residues in cattle hides (kpomo) singed with scrap automobile tyres. *International Journal of Microbiology and Applied Sciences*, *4(1)*: 1 – 6.