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Potentially Toxic Substances in Singed and Unsinged Cow Skin from Selected Abattoirs Consumed in Port Harcourt Metropolis

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Abstract: Singed and unsinged cow skin (pelts), from four slaughter houses (Ishiodu, Eliozu, Rumuosi, and Rumuodumaya); sold and consumed in Portharcourt, Rivers State city - were evaluated for the concentration of PAHs, TPH and heavy-metals, using GC/FID and atomic absorption spectrophotometer respectively and the outcomes were then exposed to statistical examination (Spearman connection coefficient framework and One-Way ANOVA) to decide critical distinction between the singed and unsinged samples utilizing SPSS programming bundle (form 20.0). The total PAHs and TPH of singed cattle pelts were 0.023, 0.031, 0.035, and 0.035 mg/kg; 1.63, 2.16, 2.52, and 2.62 mg/kg for Ishiodu, Eliozu, Rumuosi, and Rumuodumaya slaughter houses respectively, of which the unsinged pelts and edible-flesh were pointedly ($p<0.05$) higher than the singed samples. The Fe, Cu, Cd, Zn, Cr, Pb contents were pointedly beyond the passable boundary while Aluminum, Arsenic, and BTEX were not detected. Mercury (Hg) was essentially not identified in singed samples purchased from the slaughter houses with the exclusion of Rumuodumaya (at 0.01mg/kg). The processing procedures aided with certain environmental activities impact negatively on the nutritional content of foods, thus placing consumers at potential wellbeing hazard.

Keywords: Processing Contaminants, Health Risk, Slaughter, Cow Meat

1. Introduction

Edible-tissue assumes a vital part in the dietary necessities of persons particularly in non-industrial nations where edible-tissue can possibly further develop nutrition which are frequently founded on a couple of food crops that give nutrients. Chemical contamination is a global food safety issue. There are many potentially toxic substances in the environment which contaminates foods consumed. They include inorganic and organic substances and which may originate from a wide range of sources.

Hides of cow meat popularly called '*ponmo*' in Nigeria are served as food delicacy in several parts of Africa. Ponmo, as other skins, contains a lot of Collagen, which is of extreme worth to the human tissue, particularly skin and joints. Different nutrients are on the low side as well". Besides, it is largely excellent dietary roughage that helps the course of assimilation quite well. Kanda or Ponmo in Nigeria is cow skin that has been handled for purchasers to cook and eat like edible-tissue. Ponmo has turned into a well-known nearby delicacy adored by all paying little mind to cultural class level. Its special taste and surface make it so famous.

Singeing off cow hair in flames fuelled by various substances such as wood mixed with spent engine oil, plastics mixed with refuse or tyres exposes the skin to some chemical contaminants. These materials contain toxic substances which can contaminate the hides and render them unfit for human consumption. The burnt hides are scraped to remove ash and thereafter boiled in water for about one hour to obtain the finished product, *ponmo.* Hides processed with flame fuelled by firewood and spent engine oil may contain toxic organic compounds such as polycyclic aromatic hydrocarbons (PAHs), dioxins, Furan, benzene and heavy metals. Lead, a highly toxic metal present in spent engine oil, can also contaminate the hides. Dioxin released during wood burning is a potential carcinogen implicated in extreme skin diseases [11, 25].

Wood smoke contains a wide range of chemicals such as phenols, aldehydes, acetic acid and a range of polycyclic hydrocarbons [13, 26]. PAH may be formed during processing and domestic food preparation, such as smoking, drying, roasting, baking, frying or grilling and barbecued due to incomplete combustion or thermal decomposition (Pyrolysis) of the organic material [4, 6, 13, 18]. Direct smoking involves intermediate products processed in the same chamber where smoke is formed. In traditional smoking methods, to form smoke, wood is thermally degraded. Due to the temperature of smoke, direct smoking techniques may be divided into cold smoking (smoke temperature 15–30°C) and hot smoking (smoke temperature to 80°C) [2].

It has been reported that the use of scrap tires for singeing meat pose a serious public health risk to people working in and living around slaughter houses in the study area because the open burning practices could release Volatile Organic Compound (VOCs), heavy metals, Polycyclic Aromatic Hydrocarbons (PAHs) into the environment [15]. Recent research work carried out on health risk assessment of polycyclic aromatic hydrocarbons (PAHs) in singed Capra aegagrus Hircus meat from Uyo Municipal [15]. Abattoir in Southern Nigeria. The presence and levels of contaminants in edible tissues prepared by smoking and flaming with tires and petrochemicals have been reviewed by many researchers [3, 8, 9, 16, 22].

This paper investigated the level of heavy metals and Polycyclic aromatic Hydrocarbons in Cow Edible-tissue (PONMO) samples.

2. Materials and Methods

2.1. Study Area

The survey region is situated in Port Harcourt Metropolis betwixt scope 4°53N - 4°54N and longitude 6°41E 6°4224E (Figure 1) in the South-South topographical zone of Nigeria. The geology is level landscape; normal stature of around 11m above ocean level. The level territory supports water stagnation after downpour episodes and no decent waste framework to channel overflow to the stream. The environment is moist tropical/central zone with a mean yearly temperature of around 28°c. The temperature goes from around 21°C - 36°C inside the blustery and dry seasons separately. The most noteworthy precipitation happens betwixt the long stretch of July and September and decline as dry season approaches among December and January with mean yearly precipitation of 2600mm.

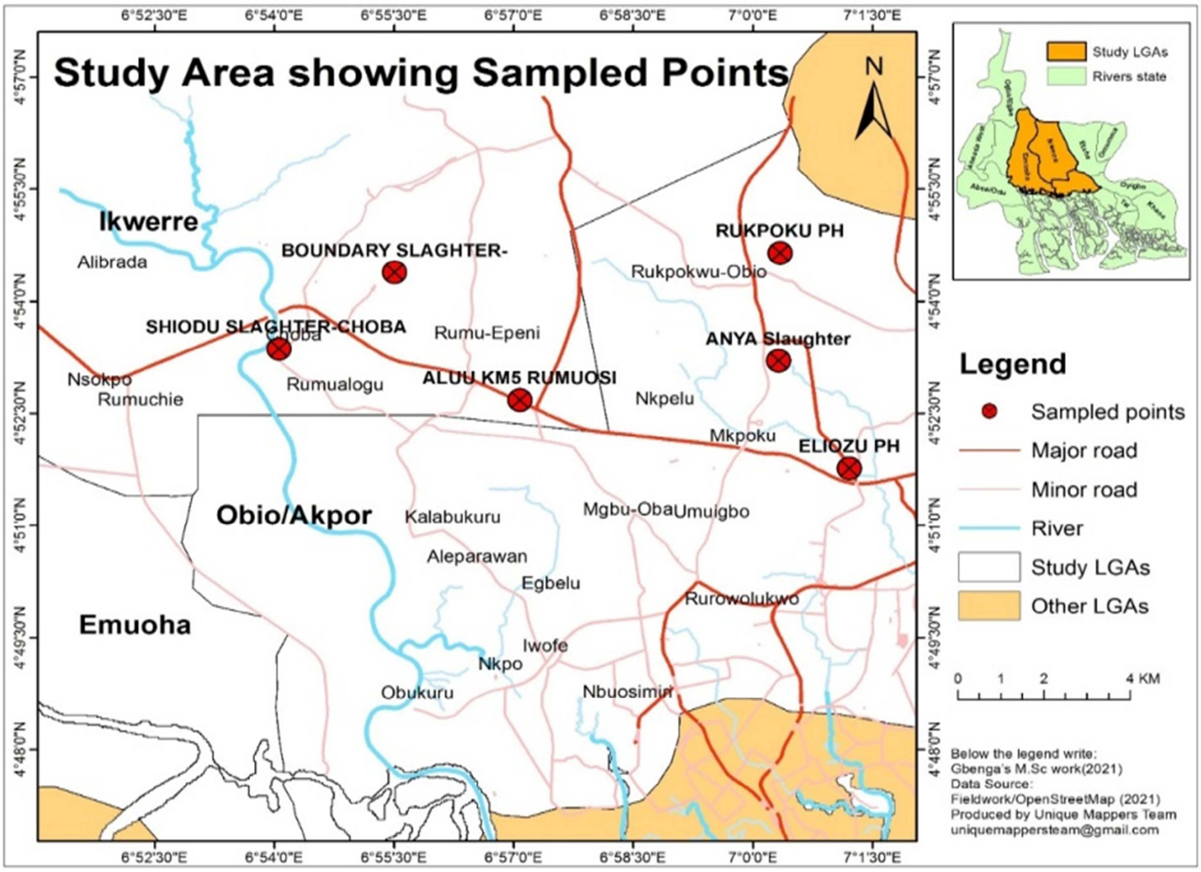

Figure 1. *Map of the Sampling Points.*

2.2. Sample and Sampling Techniques

Freshly slaughtered cattle meat was purchased from four different slaughter markets in Rivers State, Nigeria namely; Ishiodu-Choba, Eliozu, Rumuosi, and Rumuodumaya. The sampling technique employed was a quasi-sampling technique.

2.3. Samples Collection and Preparation

The survey configuration was a cross-sectional overview including heavy-metals and PAHs evaluation in seared and unseared cow edible-tissue. Newly butchered steers edible-tissue utilized for this study were bought from Ishiodu-Choba, Eliozu, Rumuosi, and Rumuodumaya butcher business sectors, Port Harcourt, Rivers State. The edible-tissue was then isolated into three gatherings; A, and B. Test A (control) was handled utilizing recently bought extremely sharp steels to scrap off the furs, and afterward washed with clean water. Test B was handled by burning with scrap tire, the subsequent soothe was washed off with clean water. Each of Samples A and B in the wake of handling were then additionally isolated into three (3) equivalent parts and shipped off the research center for determination of heavy-metal and PAHs (the samples isolated for PAHs examination were wrapped with aluminum foil to forestall acquaintance to light) prior to being transported to the laboratory for investigation.

2.4. Determination of Heavy Metal Content

The heavy metal contents of the samples were determined using the dry-ash method. Samples were weighed after washing with de-ionized water and blotting dry with tissue paper. The samples were then dried in an oven at 70°C for 72 hours, weighted and ground. A 0.5g sub-sample was digested in a ployunigl-floundie crucible with 4ml of concentrated nitric acid (HNO_3). The sample and solution [1, 14, 20] suspension was left at room temperature for two hours before the sealed vessel was fitted into a high-pressure metal cylinder. Metal cylinders were heated in an oven at 100°C for 1 hour followed by 170°C for 5 hours. After digestion, vessels (open at this stage) were put on a hot plate at 105°C to evaporate excessive acid until near dry. The residues were then diluted with de-ionized water to 50ml into volumetric flasks. Concentrations of the heavy metals in the samples were determined by atomic adsorption spectrophotometer (AAS)".

2.5. Determination of the Polyaromatic Hydrocarbon Content

The polyaromatic hydrocarbon contents of the samples were determined using gas chromatography (GC-MS Spectrometer model 6800) with target analytes being PAHs, TPH, and BTEX using the GC-FID. The prepared solution contained a concentration of 100µg/ml of all the compounds mixed in a solution of 90:10 methylene chlorides: acetone. Each standard (Surrogate, 8270 LCS mix) was analyzed using an Agilent 6890N Gas Chromatography coupled with Flame Ionization Detector (Hewlett Packard, HP, Wilmington, DE, USA). The elution times for all the non-alkylated target analytes and the surrogate compounds (2-fluorobiphenyl and 1-fluoronaphthalene) were confirmed through replicate analyses in which the elution time for each individual component remained consistent (± 0.1min). As soon as the elution times were confirmed, the PAH identification was carried out based on comparison of the retention times of the obtained analytes with those from standard mixture of PAHs (standard supplied by instrument manufacturer). Quantification of the compounds was based on external calibration curve prepared from the standard solution of each of the PAHs and all the samples were analyzed by GC-FID under the instrument parameters". [12, 23]

3. Results

Table 1. *Concentration of heavy metals, PAH, TPH and BTEX in sampled cow meat and control in the study.*

S/I.D.	Cr (mg/kg)	Cu (mg/kg)	Al (mg/kg)	Fe (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cd (mg/kg)	Hg (mg/kg)	As (mg/kg)	PAH (ppm)	TPH (ppm)	BTEX (ppm)
Control 1	ND	0.49	ND	93.42	ND	90.51	ND	ND	ND	0.01410305	1.21193	ND
Control 2	ND	0.51	ND	93.44	ND	90.54	ND	ND	ND	0.01420305	1.21195	ND
Ishiodu Choba	4.85	1.88	ND	211.39	10.91	52.08	0.23	ND	ND	0.0234215	1.6302	ND
Eliozu PH	4.44	6.08	ND	530.99	14.55	109.46	0.6	ND	ND	0.0309999	2.16924	ND
Rumuosi Slaughter	5.13	1.65	ND	123.7	15.25	79.26	0.41	ND	ND	0.0353354	2.52814	ND
Rumuodumaya Slaughter	1.2	1.04	ND	94.36	4.99	34.23	0.36	0.01	ND	0.03500091	2.62826	ND

*ND: NOT DETECTED

Table 2. *Test of difference between control cow meat samples.*

	Control	Samples	P-Value
	Mean ± SD	Mean ± SD	
Cr^{6+} mg/kg	0±0	3.91±1.83	*P<0.05
Cu^{2+} mg/kg	0.5±0.014	2.66±2.31	P>0.05
Fe^{2+} mg/kg	93.43±0.014	240.11±200.19	P>0.05
Pb^{2+} mg/kg	0±0	11.43±4.69	*P<0.05
Zn^{2+} mg/kg	90.53±0.021	68.76±32.85	P>0.05
Cd^{2+} mg/kg	0±0	0.4±0.15	*P<0.05
PAH	0.014±0	0.031±0.006	*P<0.05
TPH	1.21±0	2.24±0.45	*P<0.05

*bold values indicate significant difference

4. Discussion

Heavy metals concentration of singed cattle pelts ranged from 1.2 to 5.13 mg/Kg, Cr; 1.04 to 6.08 mg/Kg, Cu; 94.36 to 530.99 mg/kg, Fe; 4.99 to 15.25 mg/Kg, Pb; 34.23 to 109.46 mg/kg, zn; 0.23 to 0.60 mg/Kg, Cd and Al, As and Hg were not detected in all the samples. The total PAHs and TPH of singed cattle pelts were 0.023, 0.031, 0.035, and 0.035 mg/kg; 1.63, 2.16, 2.52, and 2.62 mg/kg for Ishiodu, Eliozu, Rumuosi, and Rumuodumaya slaughter houses respectively. There was significant difference between control mean and the mean of skin samples obtained in the abattoirs (Ishiodu Choba, Eliozu, Rumuosi, and Rumuodumaya) in chromium, cadmium, lead, PAH, and TPH at $P<0.05$ test of significance. This indicates that singeing with scrap tyre increases the chromium, cadmium, lead, PAH, and TPH concentration of hides and skin meat. The significant ($p<0.05$) difference between the samples and control sample could be attributed to the presence of Cd, Cr, Pb, PAH, and TPH in scrap tyres and other materials used. The results from this study showed that singed cattle hide and skin meat from the four abattoirs contained varying degrees of PAHs and heavy metals. The concentration of PAHs in the raw hides and skins in the present study may also be attributed to accidental or unintentional exposure to PAHs during grazing of the animals or industrial exposure due to air pollution in the state in which the animals are exposed to the contaminated air and grazing field. In addition, burning of bush and waste which are common practice in Nigeria, releases smoke into the atmosphere which precipitates as dew in the morning. Given that livestock are rarely housed but left over night in the open field in Nigeria, the dew fall on the body of the animals with the resultant penetration of PAHs and heavy metals into their skin. However, the result of Spearman's correlation coefficient matrix revealed that the heavy metals, PAH, and TPH came from a single source (Table 3), which could be attributed to the methods (wood and used tyres) used in singeing the cattles in the four abattoirs since the meat obtained from control was free of the elements and compounds. The sample size, sample source, as well as the level of environmental pollution may be responsible for the rates of PAHs components detection in the different studies. The significant increase in the level of PAHs after singeing in all the sampled hide and skin from the four studied abattoirs may be due to the use of different combustible materials for singeing in the study area. At Eliozu for instance, where the butchers' used scrap tyres fueled with kerosene to singe hides and skin, PAH and TPH concentration levels were extremely high.

Spearman's correlation coefficient matrix was performed on the data obtained to establish relationship between the two parameters (Heavy metals and PAHs). It helps to determine how one parameter predicts the other. Correlation matrix of the samples is presented in table 3. Iron and Copper correlates very positively (very strong) at $P<0.01$ two tailed with a correlation coefficient of $R^2 = 1$ indicating strong positive relationship or source.

Strong positive correlation at $P<0.05$ was observed between Lead and Chromium with a correlation coefficient of $R^2 = 0.878$, indicating a similar source/relationship.

Highly negative correlation was observed between Mercury and Chromium; Mercury and Lead at $P<0.01$ two-tailed with a correlation coefficient of $R^2 = 1$, indicating similar source/relationship. TPH and PAH correlated highly negatively strong at $P<0.01$ with a correlation coefficient of $R^2=1$. Which is an indication that the aromatic hydrocarbons found in the samples came from the same source. There was no correlation between the heavy metals with PAH and TPH.

Table 3. *Correlation coefficient matrix of heavy metals, PAH, TPH and BTEX.*

	Cr (mg/kg)	Cu (mg/kg)	Fe (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cd (mg/kg)	Hg (mg/kg)	PAH (ppm)	TPH (ppm)
Cr (mg/kg)	1								
Cu (mg/kg)	0.33558415	1							
Fe (mg/kg)	0.34673251	0.98998433	1						
Pb (mg/kg)	0.90573095	0.54373311	0.50255278	1					
Zn (mg/kg)	0.62412537	0.86934044	0.81750681	0.86087843	1				
Cd (mg/kg)	0.0795136	0.8210978	0.73508083	0.46680972	0.82430527	1			
Hg (mg/kg)	-0.9878795	-0.4691196	-0.4853677	-0.9141416	-0.7007194	-0.1738309	1		
PAH (ppm)	-0.4176809	-0.1291902	-0.2615134	-0.0674366	0.06186192	0.4594934	0.458617	1	
TPH (ppm)	-0.5307747	-0.2199301	-0.3439714	-0.2052027	-0.0694907	0.3702009	0.575261	0.990102	1

r (0.05)(∞2) df (3)=0.878

r (0.01)(∞2) df (3)=0.959

Bold values = Strong/Significant (P<0.05)

Bold values with underline= Very Strong/Highly Significant (P<0.01)

5. Conclusion

The PAHs and heavy-metals substance of cow skin samples processed with fire created by scrap vehicle tire in slaughter houses situated in Ishiodu Choba, Eliozu, Rumuosi, and Rumuodumaya, were assessed with Gas chromatography. The outcomes uncovered minor and trace measures of chromium, copper, iron, lead, cadmium, zinc, mercury, PAH, and TPH in the examined seared edible-flesh samples in every one of the four slaughter houses referenced previously. This demonstrates that ingesting cow pelt and edible-flesh seared with tire will put shoppers at the upshot of wellbeing risks from PAHs and heavy-metals tainting. The outcomes furthermore portrayed that the materials utilized in searing expands the levels of PAHs, TPH and heavy-metals (chromium, copper, iron, lead, cadmium, zinc, and mercury) in seared pelt and edible-flesh. Since the known cancer-causing PAHs and heavy-metals in the examples were over the greatest admissible level (control test), it is presumably of general wellbeing worry because of the related wellbeing hazard on total acquaintance through the dietary utilization of such defiled local delicacy.

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