

Implication of Roasting Goats with Tyre on Human Health and the Environment in Abakaliki, Ebonyi State, Nigeria

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Abstract

Implication of roasting goats with tyre on human health and the environment in Abakaliki metropolis, Ebonyi State was reviewed in this study. Tyre has 45.49, 40, 0.23 and 1.17% composition for carbon black, zinc oxide, wax and sulphur toxic materials which could pose health threats to human being and the environment. Most of the butchers in Abakaliki and its environs roast slaughtered goats with scrap car tyres. Scraped soot from the roasted goats have significant ($P < 0.05$) high levels of 5.40, 96.10, 38.03 and 61.00 mg kg⁻¹ heavy metal residues for pb, Zn, Cu, and Fe which are washed into the soil, water bodies and air that cause their contamination. These heavy metals concentrations are higher than maximum permissible limit (MPL). Appropriate laws should be made and enforced in Ebonyi State to stop local butchers from using tyres as roasting materials. Scraped soot should also be disposed off safely as is done elsewhere in order to reduce the risk of contamination of soils, water bodies and air with heavy metals in Abakaliki metropolis of Ebonyi State.

Keywords: Abakaliki metropolis; Environment; Goats; Human; Implication; Roasting; Tyre

Introduction

In Abakaliki, Ebonyi State of Nigeria and in several other African countries, roasting in an open fire is the major process by which hair on the skin of slaughtered goats is removed [1]. This is because roasting maintains the carcass hide for consumption and also evokes flavours in the meat which are acceptable to the consumer [2]. Roasting is done mainly by the use of firewood as fuel, but the relative scarcity of firewood in recent times has resulted in Abakaliki local butchers using scrap car tyre in place of firewood [1].

Tyres are believed to contain toxic materials which could contaminate the environment. US Agency for Toxic Substances and Disease Registry revealed that "tyre derived fuel" (TDF) contained several heavy metals such as lead (Pb), zinc (Zn), and Copper (Cu) that could be carcinogenic when exposed to consumers over a long period. Research by Obiri- Danso et al., [1] also revealed high levels of heavy metal residues in goat and cattle hides roasted with scrap tyres, which made them unsafe for consumption.

Furthermore, tyre being non-biodegradable combustible material, when burnt under open and uncontrolled fire conditions as low temperatures produces black plumes of smoke as well as toxic volatilization products such as soot, which become incorporated into the ambient environment cause air and water pollution [3] as well as result in human and environmental hazard. In addition, large amounts of greenhouse gases and becomes absorbed. Dioxin does not breakdown; it accumulates in the fatty tissues of animals and humans that consume the contaminated vegetation, meats, chickens and dairy products. In humans, these Dioxins can lead to productive impairments, development of injuries and an increase in the risk of diabetes. It is against this background of health implication and environmental concern as a result of contamination of soil, water bodies and air by deposits from roasting goats with tyre that this review becomes imperative. For instance, deterioration in water quality has adverse effect on human health as well as aquatic ecosystem either directly or indirectly [4-6]. The objective of this review was to highlight implication of roasting goats with on human health and the environment and therefore create awareness for people within the Abakaliki environment to be cautious.

Methodology

The review was carried out at Abakaliki metropolis, the capital of Ebonyi State, Nigeria using extrapolation of information from previous studies. Abakaliki metropolis is located by latitude 06°4'N and longitude 08°65'E in the derived savannah of the Southeast agro-ecological zone of Nigeria. Ebonyi State is one of the last six states created in 1996 by the then military regime in the country. It is characterized by bimodal pattern of rainfall which spreads from April – July and September – November with break in August. Minimum and maximum annual rainfall range from 1700mm to 2000mm, respectively. Temperatures are 27°C and 31°C for rainy and dry seasons [7]. Ebonyi State is an agrarian state which grows most common food crops such as yam, cassava, maize, rice and vegetables and rears native livestock for their livelihood. Nevertheless, part of the population engages in civil service work.

Results and Discussion

Composition of tyre

A review of tyre composition shows that styrene butadiene had highest percentage composition of 46.78% followed by carbon black with 45.49%. Others include Aromatic coil, Zinc oxide, stearic acid, Antioxidant 6C, wax, Sulphur, and accelerator Cz with 1.74%, 1.40%, 0.94%, 1.40%, 0.23%, 1.17% and 0.75% compositions of tyre, respectively.

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Tyre as a product is environmentally friendly. However, the additives, as well as their products of chemical reactions and degradation products incorporated into the polymeric material have the potential to be released into the environment where they cause significant health and environmental problems [8].

Statistics of disposal of scrap tyre

Nigeria does not have statistical data on scrap tyre generation and disposal. However, a number of organisations, most prominently the US Rubber Manufacturers' Association and the European Tyre Recycling Association (ETRA) have data on scrap tyres as given in Table 1.

The Table 2 illustrates the disposal methods of scrap tyre by EU and US as well as their diverse uses. It also indicates the percentages of their usage. For instance, energy recovery by EU is at 22.40% while US is 40.90%. The amount of scrap tyres that go to landfill by EU countries is estimated to be 30.8% while that of US is 22.40%. Rubber recycling of scrap tyre by EU and US is estimated to be between 15.70% and 14.60%, respectively. Scrap tyre export is seen to be higher in EU countries by 7.50% than US by 5.30%. United States (U.S.) uses scrap tyres for engineering purpose and this is 14.20% higher than EU countries which are 8.0%.

Nigeria does not have statistical data on scrap car tyres but it is believed that Nigeria which statistical data is not known has even more number of scrap tyres being disposed off without recycling. One of the disposal methods in Nigeria is by using tyre to roast goats or hides of animals. This is attributed to the influx of imported fairly used tyres from western countries into Nigeria. This situation has made Nigeria a "dumping ground" of fairly used tyres. As a result, the ubiquity of scrap tyres necessitates their use for roasting goats and other slaughtered animals due to scarcity of firewoods.

Material	Percentage
Styrene butadiene	46.78%
Carbon black	45.49%
Aromatic oil	1.74%
Zinc oxide	1.40%
Stearic acid	0.94%
Antioxidant 6C	1.40%
Wax	0.23%
Sulphur	1.17%
Accelerator CZ	0.75%

Source: Diane Kihara (2004); <http://www.calrecycle.ca.gov/Advisories/LEA/>

Table 1: Tyre composition.

Disposal method	EU		US	
	Tyres disposed (tonnes)	Percentage	Tyres disposed (tonnes)	Percentage
Energy recovery	563,69	22.40%	1,035,000	40.90%
Landfill/stockpiling	775,300	30.80%	567,000	22.40%
Rubber recycling	395,287	15.70%	369,000	14.60%
Used tyre export	189,509	7.50%	135,000	5.30%
Civil engineering	200,607	8.00%	360,000	14.20%
Miscellaneous	394,013	15.60%	63,000	2.50%
Total	2,518,406	-	2,529,000	-

Source: Kurt Reschner, (2003).

Table 2: Statistics of scrap tyre disposal for 2000-2001 in US and EU member states.

Emissions from open tyres fires

Emissions like sulphur (IV) Oxides (SO₂) and other Oxides of Nitrogen (NO_x) from open tyre fires are being suspected of having a serious impact on human health and the environment. Due to lack of data, it was uncertain to know exactly what was being emitted, how much was being emitted, and how dangerous these emissions are, especially to sensitive individuals such as the children and the elderly. These products can also contaminate soil, surface water and ground water.

When fire from tyre burns, it is believed that the smoke would contain hazardous substances. When the fire is cooling down it could release other poisonous substances, for example, the Benzene which is produced in this process once inhaled, ingested or touched will lead to symptoms such as dizziness, euphoria, giddiness, headache, nausea, weakness, drowsiness, respiratory irritation, pulmonary edema, pneumonia, skin and eyes irritation. The health conditions render the victim incapacitated and consequently reduces healthy work force.

Concentration of heavy metals in scrap soot from roasted slaughtered goats on soil, water bodies and air

Table 3 below shows concentrations of heavy metals in scrapped soot from roasted slaughtered goats. The scraped soot from the roasted animals has higher levels of heavy metal residues such as Pb, Zn, Cu and Fe with 5.40, 96.10, 38.03, 61.00 mg kg⁻¹ concentrations respectively and their corresponding individual maximum permissible limits (MPL) of 0.10, 50.00, 20.00 and 50.00MPL, which when above the recommended level pose threats to soil, water bodies air and even to human beings who depend on crops grown in the soil or water from the ground or inhale air for sustenance of life.

The soot from the burnt tyre is often washed into drains, and when there is rainfall, the soots are transported into various water bodies within and around. This could be one of the sources of heavy metals in soils, water air and even plants as reported by Qui et al. [9]. Heavy metals dissolve in water and are taken up by plants during photosynthesis [10]. When animals feed on these plants over a period of time, the heavy metals accumulate in their tissues and skin, hence the source of heavy metals detected in the hides of the un-roasted slaughtered animals. Furthermore, some butchers fetch water from nearby streams and other water bodies for washing the roasted slaughtered goat [11]. This therefore, may explain why washing roasted slaughtered goat with water could result in increased heavy metal risks of ecotoxicity as reported by Obiri- Danso et al., [1].

Heavy metals contamination of soil reduces crop yields and eventually destroys plots of agricultural land. The side effects of human exposure to these toxins in our food chain can lead to serious health conditions. Lead poisoning destroys human nervous systems,

Heavy metal	Concentration (mg/kg)	SEM(+/-)	MPL (mg/kg)
Pb	5.40**	0.01	0.1
Zn	96.10**	0.012	50
Cu	38.03**	0.015	20
Fe	61.00**	0.006	50
Mn	ND	-	-
Cd	ND	-	0.05

**= (p<0.01); MPL= European Commission's Maximum Permissible Level of Product Acceptability, SEM = standard error of means, ND= Not detected. Source: Adam et al., (2013).

Table 3: Concentration of heavy metals in scraped soot from roasted slaughtered goats.

causes retardation, learning difficulties, bone marrow deficiencies and stunted growth in children. Chromium and arsenic can also cause cancer [12].

In Abakaliki metropolis, Ebonyi state of Nigeria, some abattoir workers engage in combustion of old vehicle tyres as fuel to burn the fur on cattle and goats. This process releases dark sooty smoke into the atmosphere. Tyre is composed of natural and synthetic rubber, sulphur, filler, accelerators, antioxidants, fabrics and optionally steel wires. For the fact that majority of the components of tyre are of hydrocarbon origin; high temperatures are usually employed in the combustion processes. The emissions from such operations are most likely to contaminate the air [13]. Human beings are at health risks if they inhale such contaminated air.

According to Schwartz [14], air could also be polluted through emission of particulate matter (Black carbon) that occurs during the burning of fuels such as diesel or coal. The release of noxious gases such as SO₂, CO, NO_x and chemical vapours and particulate matter could lead to air pollution [15]. Hence, air pollutions are either particulates or gases. Gaseous and particulate pollutants may share some common sources however; they have different types of problems. Besides, some of these gases contribute immensely to climate change [16] which today has caused distortion in farming system, low crop and soil productivity with consequent famine in the country.

Health and environmental implication of roasting goats with tyres

Table 4 shows the permissible limits of CO, SO₂, NO₂, Pb, PM (2.5) as 9 ppm, 0.17 ppm, 10 ppm, 0.15 µg/m³, 150 µg/m³, and 15.0 µg/m³ respectively with their corresponding average time of 8hours, 24hours, 1hour, 24hours and 24hours above which could pose serious health hazards. For instance, carbon monoxide (CO) is a harmful pollutant and it's injurious to human health at a level greater than the safe concentration limit of 9ppm. Carbon monoxide (CO) reacts with oxygen carrying blood tissue to form carboxy-hermoglobin. When SO₂ concentration exceeds the permissible limit, it could cause respiratory difficulty especially with asthmatic patient, children and the elderly. Sulphur dioxide (SO₂) can also form acid deposition that has the ability of disrupting plant growth and damage to building roof.

The Table 4 above is also in accordance with WHO Allowable limits. Nitrogen dioxide (NO₂) formed during high combustion temperature, reacts with water vapour to give HNO₃, an irritant and highly corrosive substance [17]. Nitrogen dioxide (NO₂) contributes to the formation of ground level (tropospheric) ozone and fine particle pollution. It is linked with a number of adverse effects on the respiratory system. This includes airway increased respiratory symptoms in people with asthma among others. The emission of SO₂ from combustion of tyre can be traced to the presence of sulphur in tyre. To increase the tensile strength and durability of tyre, sulphur is usually incorporated as raw material during the vulcanization process.

Pollution	Safe concentration zone	Averaging time
Carbon monoxide	9ppm (10mg/m ³)	8hours
Sulphur dioxide	0.017ppm(ug/m ³)	24hours
Nitrogen dioxide	10ppm	1hour
Lead	0.15ug/m ³	-
Particulate matter PM(10)	150ug/m ³	24hours
Particulate PM (2.5)	15.0ug/m ³	24hours

Table 4: US- EPA standards for six principal pollutions.

Use of figures

The figures below show the processes used in abattoir by butchers in Abakaliki metropolis to roast goats in open fire from scrap tyres at different parts of the town.

As shown in Figure 1, roasting in an open fire is the major process by which hair on the skin of slaughtered goats is removed [1]. This is because roasting maintains the carcass hide for consumption and also adds some flavours in the meat which are acceptable to the consumer [2].

Roasting is done mainly by the use of firewood as fuel as indicated in Figure 2, due to relative scarcity or high cost of firewood in recent times resulting in local butchers using scrap car tyres in place of firewood [1]. The use of car tyres as fuel for roasting carcasses is reported to impart some toxic heavy metals to the roasted skin which could diffuse into the meat, thus rendering them unsafe for human consumption, as it poses several health threats to the consumer [18-21] in Adam et al., [22]. US-Agency for Toxic substances and Disease Registry carried out research revealing that "tyre derived fuel" (TDF) contains several heavy metals such as lead (pb), zinc (Zn), copper (Cu) that could be carcinogenic when exposed to consumers over a long period. Research by Obiri-Danso et al, [1] also revealed high levels of heavy metal resides in goat



Figure 1: Goat being roasted with Tyre at number 63 Gunning Road, Abakaliki.



Figure 2: Roasting done with Firewood at Garki off Ogoja road, Abakaliki.



Figure 3: one of the carcasses being washed Gunning Road, Abakaliki.

and cattle hides roasted with scrap tyres, which made them unsafe for human consumption.

According to Adam et al., [22], boiling and washing of the slaughtered goats as in Figure 3 slightly reduced the heavy metal concentrations, but the heavy metal residues after boiling were still higher than the maximum permissible level (MPL), indicating that boiling cannot render tyre-roasted carcasses wholesome for consumption.

Conclusion

Tyres are believed to contain toxic materials which could pose health threats to human beings, soil, water, and air. The scrapings or soot of roasted slaughtered animals (goats) have very high heavy metal concentrations above maximum permissible level (MPL) and incidentally are potential sources of heavy metals in soils, surface water and in plants. Roasting of slaughtered goats with tyres increases the heavy metal concentration in the hides or skin of the slaughtered animal which diffuse into the body beyond acceptable limits. Boiling of these carcasses slightly reduces the heavy metal concentration, but not below the safe or acceptable limits.

Consumption of slaughtered goats roasted with tyres could pose health threats to consumers. More importantly, human beings who eat the crops grown in soot contaminated soil, drink water or inhale air are at risk of ecotoxicity. Therefore, regulatory agencies should checkmate the activities of these local butchers in Abakaliki metropolis and beyond to ensure total compliance and henceforth slaughtered goats should be disposed of appropriately in order to minimize the contamination of soils, water bodies, air and the surrounding environment with heavy metals.

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