

# Toxic Polycyclic Aromatic Hydrocarbons (PAHs) and Hazardous Air Pollutants (HAPs) Associated With The Use of Tyre-Derived Fuel (TDF) in the De-Furring of Small Ruminants at the Gwagwalada, Municipal Abattoir, Abuja, Nigeria

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**Abstract:** Synthetic rubber tyres contain significant concentration of toxic polycyclic Aromatic Hydrocarbons (PAHs) and Hazardous Air Pollutants (HAPs) which become air borne when tyres are burnt. Toxic emissions of numerous carcinogenic, mutagenic, and teratogenic chemicals are also released to the air. The use of tyre derived fuel (TDF) to de-fur small ruminants is a common practice in Gwagwalada Municipal abattoir, Abuja, Nigeria. The study was conducted to determine the impact of such practices on the human population. A self completed and well structured close ended questionnaire were administered to respondents randomly selected among abattoir workers and residence of the neighborhood. The questionnaire was pretested for validity and was of two sections namely, the demographic and the general sections. The data were presented in tables using frequencies and percentages. Fifty eight of the total 80 questionnaires distributed were returned as valid of which 44 (75.9%) were males and 14 (24.1%) females. According to age brackets, 15 (25.9%) of the respondents were between 18 – 25 years, 30 (51.7%) were between 26 – 40 years while 13 (22.4%) were between 41 and above. Fifty one of the respondents agreed to have fallen sick and that sickness may not be unconnected to the smoke and smell from the abattoir. Forty nine of the respondents regretted living very close to the abattoir. De-furring small ruminants with TDF is very hazardous with serious public health implications and should be stopped. Situating abattoirs close to residential areas should be discouraged as it poses health danger to residents.

**Keywords:** Polycyclic Aromatic Hydrocarbon, Hazardous Air Pollutants, Tyre Derived Fuel, De-furring, Abattoir

## 1. Introduction

The world is faced with the problem of adequate disposal of used tyres which (among other uses) have unfortunately been used in abattoirs in Nigeria to de – fur ‘kanda’ a popular cow skin delicacy, hence exposing the butchers to PAHs (Okonkwo *et al.*, 2014). Synthetic rubber tyres contain significant concentration of toxic and hazardous air pollutants and are manufactured from petrochemical feedstock such as styrene and butadiene which are both classified as human carcinogens (Carman, 1997). Styrene is a benzene derivative while butadiene is a highly carcinogenic four carbon compound that may be released from the styrene - butadiene polymer formed during combustion (Reisman and Lemeux, 1997). Chemical composition tests on waste rubber show that it contains numerous toxic and hazardous air pollutants and once burned these can become air borne (Carman, 1997).

The burning of tyres, say in ‘kanda’ processing releases several compounds and particles [such as carbon monoxide (co), sulphur oxide (so<sub>2</sub>), oxides of nitrogen (Nox), volatile organic compounds (vocs) and other hazardous air pollutants (HAPs) such as polychlorinated biphenyls (PCBs), dioxins, furans, hydrogen chloride, benzene and especially Polycyclic Aromatic Hydrocarbons (PAHs)] into the environment. Metals such as arsenic, cadmium, nickel, Zinc, Mercury, Chromium and Vanadium are released in the process (Carroscio *et al.*, 2002; Ferrao *et al.*, 2008). It is thought that the effects attributable to PAHs may in fact be accentuated by its co-contamination with other chemicals as

found in the cocktail of chemicals so released into the environment.

Polycyclic Aromatic Hydrocarbons (PAHs) also referred to as Polycyclic Organic Matter (POM) or Polynuclear Aromatics (PNAs) are a class of complex organic chemicals possessing a fused ring structure with at least 2 benzene rings (ATDSR, 1995). Typical examples of PAHs are fluoranthene, pyrene, benzo(a) anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3cd)pyrene, didenzo(a,h) anthracene and benzo(g,h,i)perylene (ATDSR, 1995). Most PAHs are likely to react with air and compounds borne in air (eg O<sub>3</sub>, Nox, So<sub>2</sub>) to form PAH derivatives such as nitro-PAHs and oxygenated derivatives (Walgraeve *et al.*, 2010; Shen *et al.*, 2011). The contamination of the ecosystem with PAHs could also result in the ground water pollution especially with the increase in the number of private shallow wells and boreholes in Nigeria (Okonkwo *et al.*, 2014).

Tyres through burning provide an inexpensive form of fuel that reduces energy cost. Incineration of tyres has the clear potential to produce toxic emissions of numerous carcinogenic, mutagenic and teratogenic chemicals (IARC, 2009). Tyre derived fuel (TDF) could amplify the negative impact on air quality by introducing new compounds into the incineration process and increasing the concentration of compounds already present. Compounds of interest include particulates, sulfur dioxide, nitrogen dioxide, carbon monoxide, benzene and heavy metals (Carman, 1997).

The use of tyres as fuel for meat processing in Nigeria is therefore worrisome especially as the prevalence of cancers in Nigeria is rising (Ifere *et.al.*, 2012). The thick black oil and black smoke that are seen outdoors when tyres are burning are due to the aromatic extender oils which require higher combustion temperature, residue times and oxygen to break down fully to carbon dioxide and water (Green peace, 2010). Aromatic extender oils - a toxic waste product of oil refining contains chlorine and comprise about 25% of most tyres today are known to cause cancer in laboratory animals as well as potential human carcinogens (Green peace, 2010). The inhalation of the choking smoke may lead to carboxyhaemoglobinaemia due to the Carbon monoxide content of the unburnt tyres. Carboxyhaemoglobin (CoHb) is a stable complex of carbon monoxide and haemoglobin that forms in red blood cells when Carbon is inhaled and hinders delivery of oxygen to the body. In large quantities, the effect of CoHb can result in death known medically as carboxyhaemoglobinaemia or carbon monoxide poisoning (Wikipedia, 2009).

The present study attempts to determine the impact of tyre derived fuel used in de-furring animals (small ruminants) on human population and environment.

## 2. Materials and Method

The study was carried out in Gwagwalada which is one of the 6 area councils in Abuja FCT. The abattoir is located in an area called Kutunku and is surrounded by a thick population of human habitation. Abuja lies between latitude 8° and 9° 25' N of the equator and longitude 6° 45' and 7° 45' E of Greenwich (Balogun, 2001).

Structured close ended questionnaire which was pre-tested for validity were distributed to abattoir workers and inhabitants of the neighbourhood to ascertain the impact of the use of tyre derived fuel (TDF) in the de-furring of small ruminants at the abattoir. Questions raised in the questionnaire were put in simple, concise and specific manner to prevent ambiguity (Katzenellonbogen *et al.*, 1997). The interviewer also assumed that the respondents understood the objectives and importance of the study.

The questionnaire contained inter-alia the following; how pleasant it was living near the abattoir, how they felt when tyres were burnt, how often they fell sick, whether they choked with tyre fumes etc. Of the 80 questionnaires distributed, 58 were returned as valid. The questionnaire was of 2 sections namely; demographic and general. Simple yes, no or indifferent were placed as response. The data were presented in tables using frequencies and percentages.

## 3. Results

Fifty eight questionnaires were returned as valid. The Demographic data showed that 44 (75.9%) were males and 14 (24.1%) females. According to age brackets, 15 (25.9%) of the respondents were between 18 – 25 years, 30 (51.7%) were between 26 – 40 years while 13 (22.4%) were between 41 and above. Butchers and other abattoir workers constituted 11 (19.0%) of the respondents, residents around

the abattoir were 28 (48.3%) while the general public were 19 (32.7%) of respondents as shown in Table 1.

Fifty one of the respondents agreed to have fallen sick and that sickness may not be unconnected to the smoke and smell from the abattoir. Forty nine of the respondents regretted living very close to the abattoir. Details of the questions raised and the response from the respondents are shown in table 2.

## 4. Discussion

The result of the study showed that 49 (84.4%) of the respondents regretted living very close to the abattoir while 6 (10%) were in different. Also, 51 (88%) of the respondents agreed that they often fell sick with 46 (79%) claiming that the sickness was due to the proximity of their homes to the abattoir.

Fumes coming out from the tyre derived fuel when de-furring small ruminants in the abattoir were thick, choking, uncomfortable and frightening and could expose the inhabitants to toxic air pollutants that may be of serious public health importance. It was postulated that the population is exposed to PAHs mixtures and two or more substances in the mixtures may compete with receptors or metabolizing enzymes and such action may result in carcinogenic or chemo-preventive effects (Zeiger, 2003; Baird *et.al.*, 2005). Some cancers attributable to PAH mixtures and indicative of route of exposure include lung and bladder cancer (Armstrong *et.al.*, 2004; Zhong *et.al.*, 2011), oesophageal cancer (Islami *et.al.*, 2012) and sinonasal cancer (Bruschweiler *et.al.*, 2012). According to Carman (1997), the fumes emitted during tyre incineration are packed with many toxic chemicals that tyre contain (including volatile organic compounds such as benzene, metals such as benzopyrene and synthetic rubber components such as butadiene and styrene).

Numerous health effects ranging from increased respiratory problems to increased incidences of cancer can result from additional emissions that may be released during incineration of tyre derived fuel (TDF). The entire population is at risk of PAHs exposure in varying degrees as they are ubiquitous (Okonkwo *et.al.*, 2014). An English surgeon Percival Pott noted an unusually high incidence of scrotal cancer among London chimney sweeps in 1775 and suggested that the observation was due to their constant exposure to soot and ash. Since then, PAH related cancers have been induced in laboratory animals and found in humans especially subjects in contact with coal tars, soot, coke and other PAHs containing substances (Kennaway, 1955; Kjaerheim, 1999).

The result showed that 40 (69%) of the respondents felt frightened due to the smoke from TDF which may contain toxic air pollutants that are injurious to health. Beetseh and Onum (2013) while working on emissions from combustion of scrap tyres used as fuel for meat dressing using hand held gas detector meter, detected sulphur dioxide, furans and butadiene at a relatively low level while carbon monoxide and styrene showed significant emission. Emissions from an open tyre fire can represent significant acute (short term)

and chronic (long term) health hazard to those living nearby depending on the length and degree of exposure (Beetseh and Onum, 2013). They further observed that depending on the length and degree of exposure, these health effects could include irritation of the skin, eyes, and mucous membranes, respiratory effects, central nervous system, depression and cancer.

## 5. Conclusion

The result from the questionnaire described the responses and views of respondents concerning the use of TDF in de-furring small ruminants in the abattoir. Despite the availability and cheapness of the used tyres, the public health consequences remain very high and unpalatable. Toxic and dangerous chemicals are released into the air on one hand and to the skin of the animals on the other hand. Over 70% of the respondents wanted the relocation of the abattoir due to the environmental hazards posed by the practice. Respondents advocated for the ban on the use of TDF in de-furring the small ruminants. Government should therefore advance policies and measures that will stop the use of TDF as cheap fuels in the abattoir. Efforts should also be made not to site abattoirs close to residential areas.

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**Table 1:** Demographic Data

Characteristics n=58	Frequency (n)	Percentage (%)
<b>Gender</b>		
Male	44	75.9
Female	14	24.1
<b>Age</b>		
18 – 25	15	25.9
26 – 40	30	51.7
41 & above	13	22.4
<b>Work designation</b>		
Butchers & workers	11	19.0
Residents near abattoir	28	48.3
General public	19	32.7

**Table 2:** General questions

Question	Yes	No	Indifferent
Do you often fell sick	51	6	1
Could your sickness be attributed to the abattoir environment	46	4	8
Do you feel unsafe with smoke from burnt tyres in the abattoir	36	13	9
Do you feel frightened with the smoke	40	18	-
Does the smoke choke or irritate you	58	-	-
Have you adapted to the smoke from the Abattoir	15	40	3
Is it pleasant living near the abattoir	-	56	2
Are you satisfied living near the abattoir	5	49	4
Do you regret living near the abattoir	49	3	6
Are you indifferent to the smoke from the Abattoir	6	47	5
Do you think meat from the abattoir is safe and edible	29	22	7
Do you eat meat from the abattoir	54	1	3
Do you want the government to ban the use of tyres in de-furring	57	-	1
Do you want the government to relocate the abattoir	52	-	6