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Prevalence of lead (pb) residues in kidney and liver of slaughtered pigs at Sabo-Wakama market of Akun development area of Nasarawa state, Nigeria

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ABSTRACT

The prevalence of Lead (Pb) in liver and kidney samples of slaughtered pigs at Sabo Wakama Market of Akun-Development Area of Nasarawa State was determined using Atomic Absorption Spectrophotometer. A total of thirty number of samples were collected for analyses and all the samples were positive for Lead residues. The highest and lowest concentration of Lead (Pb) residue in liver and kidney were found to be among the age groups of 0-2 years and those at 3-5 years respectively. There was a significant difference ($P < 0.05$) in the concentration of Lead in liver and kidney samples of the different age groups of the slaughtered pigs. The mean Lead concentration in liver and kidney of all the age ranges is higher than the maximum permissible level of Lead (0.5 mg/kg) in edible offal of pig recommended by Food and Agricultural Organisation (FAO, 2002). It is therefore obvious that the liver and kidney of the slaughtered pigs at Sabo Wakama Market of Akun-Development Area contain Lead residues. This finding needs an immediate attention of health regulatory authorities and the researchers as well. There is an urgent need of local database or risk assessment studies in local food animals to assess the potential risk to animals and humans from heavy metals residue.

1. Introduction

Heavy metals are those elements which have density more than 5,000 kg/m^3 (Passow *et al.,* 1961*;* Hawkes *et al.,* 1997), atomic weight of 63.546 to 200.590 (Kennish, 1992) and a specific gravity greater than 4.0 (Connell and Miller, 1984). Although heavy metals contaminate ground water, soil, pasture (vegetation) and air, these metals when consumed by animals and human they tend to bio-accumulate in their tissues and organs and excess accumulation will lead to severe health hazard (Kennish, 1992).

Historically, the fall of Roman Empire was believed to be as a result of utensils coated with Lead, which lead to Lead poisoning in the Empire (Andrada *et al.*, 2006). Once the environment is contaminated with heavy metals, they remain for years to increase the chances of becoming toxic to humans and animals. Recent studies have shown that the modern products like paints, petrol, battery, engine oil (Bastarche, 2003), mercury amalgam dental filling (Ellender *et al.*, 1978; Chin *et al.*, 2008), cosmetics (Hardy *et al.*, 1998), and ground water residues (Ghosh *et al.*, 2004) of certain chemicals lead to chronic exposure to heavy metals.

Food crops and pasture grown on contaminated soil or irrigated with contaminated water accumulate heavy metals and serves as a source of heavy metals exposure to the animals and humans (Ward and Savage, 1994). Some occupations that involve direct contact with heavy metals like, painters, dental surgeons, welders, plumbers, mechanics (Olah and Tolgyessy, 1985; Mohammad *et al.*, 2008) are at greater risk of exposure to heavy metal poisoning. Indiscriminate dumping of waste materials and sewage water on land gradually increase the concentration of heavy metals in the soil and these are increasingly up taken by the plants and vegetables and finally find its way into the food chain causing severe health hazard to both animals and human (Haiyan and Stuanes, 2003).

Animals reared on contaminated pasture or fed with contaminated feed become a good source of heavy metal residues in edible animal products such as meat, fish, eggs, milk. Animal products that are contaminated with heavy metal have been reported in different part of the world by researchers (Maggi *et al.*, 1975; Imparato *et al.,* 1999).

Heavy metal contamination in meat and other edible tissues is a matter of great concern for food safety. These metals are toxic in nature and even at relatively low concentrations can cause public health hazard (Mahaffey, 1977; Santhi *et al.*, 2008). Different researchers have reported the instances of contamination of heavy metals in meat products during processing (Brito *et al.*, 2005; Santhi *et al.*, 2008). Heavy metals residues were found in meat and meat product of food animals fed with contaminated feed and reared in proximity to polluted environments (Korenekova *et al.*, 2002; Sabir *et al.*, 2003; Miranda *et al.*, 2005).

The above statements show how heavy metals posed serious health hazard to general public. The main objective of this study was to determine the level of Lead residue in liver and kidneys of slaughtered pigs consumed at Sabo Wakama Market of Akun Development Area of Nasarawa State Nigeria.

2. Materials and methods

2.1. Study area

Nasarawa State falls within the guinea savannah agro-ecological zone and is found between latitudes 7^{0}52'N and 8^{0}56'N and longitudes 7^{0}25'E and 9^{0}37'E respectively. Annual rainfall figures range from 1100 to 2000 mm. The mean monthly temperatures in the State ranges between 20^0 C and 34^{0}C (Lyam, 2000).The State is bounded on the north by Kaduna State, on the east by Plateau State, on the south by Benue State and on the west by Kogi State and the Abuja, FCT. The state has a total human population of about 1,207, 876 (NPC 2006) and the vegetation is Guinea Savannah which is conducive for farming and rearing of livestock. The state consists of 13 local government areas within three senatorial districts. One of the Development Areas of the State was selected randomly. This Development Area is among those where livestock are raised in high population especially pigs.

2.2. Source of samples

The samples consist of two different parts of pigs (liver, and kidney) which were sampled at Sabo-Wakama Market of Akun Development Area where pigs are slaughtered.

2.3. Sample collection and preservation

A total of 30 fresh samples of liver and kidney of slaughtered pigs at Sabo-Wakama Market of Akun Development Area of Nasarawa State were sampled and collected between the month of November 2011 and January 2012, the animals were selected randomly, the age of the slaughtered pigs were determined using teeth eruption and wearing. About 100g of liver and a whole kidney of each selected animal were packed in a sterile polythene bags, properly labelled with permanent marker, frozen and stored in a freezer. The frozen samples were then transported in a cold chain to Chemical Research Institute Zaria, Kaduna State, Nigeria for further processing and analysis.

2.4. Processing of sample

2.4.1. Digestion of sample (dry digestion)

Liver and kidney samples were dried at 45^o C using oven, after drying, individual sample was crushed into fine powder using mortar and pestle, and 1.0g of the fine powdered sample was weigh into porcelain crucible. The crucible and the fine powdered samples were ignited in a muffle furnace at 500^oC for six to eight hours. The Samples were then removed from the furnace and allowed to cool in desiccators, and weighed again. The difference between the weight of the crucible and ash and the weight of the crucible alone was used to calculate the percentage ash content of the sample. 5cm3 of 1M Trioxonitrate (v) acid (HNO_3) solution was added to the left-over ash and evaporated to dryness on a hot plate and returned to the furnace for heating again at 400^oC for 15-20 minutes until perfect grayish-white ash was obtained. The samples were then allowed to cool in desiccators. 15ml (cm^3) hydrochloric acid (Hcl) was then added to the ash to dissolve it and the solution was filtered into 100 cm3 volumetric flask. The volume was made to $100cm^3$ with distilled water.

2.4.2. Spectrophotometry techniques for lead (pb) detection

In the prepared liver and kidney samples, Lead (Pb) residue was determined under specified condition according to the manufacturer (AA-6800, Shimadzu Atomic Absorption Spectrophotometer) (Szkoda and Żmudzki, 2005).

2.5. Statistical analysis

Data from the study were presented in tables and percentages**;** ANOVA (Analysis of Variance) was used to compare the mean concentration of lead in liver, and kidney in different age groups. The results were analysed using Graphpad Instat **3.10**, 32 bit for window.

3. Results and discussion

The mean Lead concentration in the kidney was higher among the age group of 0-2 year with the mean Lead concentration of 2.279 mg/kg and mean Lead concentration was lower in the age range of 3-5 years with the concentration of 0.8023 mg/kg. While in the liver, the mean Lead concentration was also higher among the age group of 0-2 year with the mean Lead concentration of 2.275 mg/kg and the lower concentration was found among the age group of 3-5 years with mean concentration of 1.131 mg/kg.

The mean Lead concentration in liver and kidney samples of different age groups ranged from 0.8023 to 2.279 mg/kg. From this result, the concentration of Lead in both tissue sample are low compare to that of Santhi *et al.*, (2008) who reported mean Lead concentration in pork products range from 1.352 to 3.250 mg/kg in Chennai (India).

Generally the mean Lead concentration in liver was slightly higher than the mean Lead concentration in the kidney of all age range except that of age range of 0-2 years, this is similar to that of Bala *et al*., (2012), who worked on Lead residue in kidney and liver of slaughtered cattle at Sokoto State of Nigeria. Liver because of its good iron content, the consumption of animal liver by human has increased over the years in many parts of the world (Siddiqui *et al*., 2006), consequently may results to indirect ingestion of Lead from the liver, kidney and other tissues of these slaughtered pigs, and may pose a serious threat to public health.

Table 1
Mean and Standard Deviation (Mean ± SD) of Lead (Pb) concentration (mg/kg) in liver and kidney samples in different age groups of Slaughtered Pigs

Age range (years)	Mean and SD of Pb conc. In kidney (mg/kg)	Mean and SD of Pb conc. in liver (mg/kg)
0-2	2.279±0.9129	2.275±0.7462
3-5	0.8023±0.4099	1.131±0.7091
6-8	1.060±0.5660	1.790±1.2430
≥9	1.140±1.0310	1.944±1.5180

P= 0.0280: P < 0.05
There was a significant variation in lead accumulation among different age groups of pig (P < 0.05).

The mean Lead concentration in liver and kidney of all the age ranges is higher than the maximum permissible level of Lead (0.5 mg/kg) in edible offal of pig recommended by Food and Agricultural Organisation (FAO, 2002), this result shows that both the kidney and liver of the slaughtered pigs in the study area is not safe for human and animals consumption, because it may in turn bio-accumulate in their tissues if they consume it and this may lead to a serious health hazard.

The bone is considered to be a sink for Lead and it may contain 90-98% of the total body burden of Lead. When bones and blood from the affected animals are used as bone and blood meal in animal feed, the Lead content may bio-accumulate in tissue of the animals fed with such feeds and may cause lead poisoning (Kosnett, 2005; Kosnett *et al*., 2007).

4. Conclusion

Lead residue was detected in all the liver and kidney samples collected from the slaughtered pigs at Sabo-Wakama Market of Akun Development Area of Nasarawa State. It shows that these animals were exposed to Lead either in their feed, water, or inhalation of exhaust fume from automobile, as they scavenge for food. It is an indication that the environment where these animals are reared for human consumption is highly contaminated with Lead related substances. The liver and kidney of slaughtered pigs at Sabo-Wakama Market of Akun Development Area of Nasarawa State, Nigeria, are not safe for consumption by both human and animals considering the concentrations of Lead present in them.

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