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HUNTING PRACTICES AND HEAVY METALS CONCENTRATIONS IN FRESH AND SMOKED WILDMEATS IN KUMASI, GHANA

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ABSTRACT

The consumption of bush meat is currently a common practice in sub-urban and urban communities of Africa. The study investigates hunting practices and heavy metals (Cu, Zn, Fe, Pb, Cd and Mn) concentrations in fresh and smoked bush meats in Kumasi, Ghana. The animal samples were obtained from Sekyere Dumase, Atwemunom and Central Markets. A total of 32 samples from various game animals were used for the study. The samples were wet digested and analyzed using the Atomic Absorption Spectrometer. The use of guns (68%) was the most applied method of capture followed by cutlasses (10%), dogs (4%), traps (2%) and baits (2%). In the fresh meat, the concentration of Fe, Mn, Cu, Zn, Cd and Pb was 12.72±2.56mg ⁻¹kg 5.16±2.65mg ⁻¹kg, 0.96±0.29mg ⁻¹kg, 7.40±0.68 mg ⁻¹kg, 0.10±0.00 mg ⁻¹kg and 4.31±3.46 mg ⁻¹kg respectively while in smoked meats, Fe, Mn, Cu, Zn, Cd and Pb were 15.28±2.29 mg ⁻¹kg, 5.33±0.98 mg ⁻¹kg, 0.94±0.98 mg ⁻¹kg, 7.39±0.57 mg ⁻¹kg, 0.1±0.00 mg ⁻¹kg, 0.07±0.00 mg ⁻¹kg respectively. Higher amount of Lead (Pb) was found in the fresh wild meat than in the processed. The levels of Zinc in both the fresh and smoked bush meat were high while Mn, Cu, Fe and Cd in both fresh and smoked meats were in the acceptable range recommended for human consumption. However, there is need to monitor the levels of heavy metals in bush meat in relation to the hunting practices so as to avoid any possibility of poisoning to human health.

Keywords: Heavy metals, Bush meat, Hunting, Ghana, Health

INTRODUCTION

Globally, game animals also known as bush (wild) meat have a potential for meat production and serve as a good source of protein to rural poor in Africa (Fonweban and Njwe 1990). The commercial benefits and valuable nutritional source derived from bush meat consumption plays direct role in the livelihoods of nearly 150 million people in the world. In Central Africa, between one to two million tons of bush meat is harvested each year (Brown and Williams 2003) while aapproximately, 75% of the population of Ghana consumes bush meat (Asibey 1965).

The consumption of bush meat is currently a common practice in sub-urban and urban communities by virtually all classes of people (Matthew 2008, Soewu *et al*., 2012). The widespread acceptance of bush meat in Ghana has developed the trade network of bush meat which involves hunters, wholesalers, retail traders, butchers and chop bar owners as well as the general public (Falconer 1992). Bush meat provides food, security, job opportunities and income generation for both rural and urban poor. Earlier surveys by Asibey (1965) and Ntiamoa-Baidu (1998) have shown that most Ghanaians, irrespective of their educational, economic or social status, consume bush meat as and when it is available. The demand for bush meat has been met through hunting from the wild by the use of guns, cutlasses, chase dogs, baiting with chemicals, and bush burning (Oduro and Kankam 2002).

Hunting practices such as use of guns and baits used for killing wild animals could be a great threat to human life due to the presence of harmful chemicals or heavy metals such as Lead (Pb), Cadmium (Cd), Manganese (Mn), Iron (Fe), Zinc (Zn) and Copper (Cu) (Hunt *et al.*, 2009). The toxicity of heavy metals is one of the major environmental problems and its danger to animal and human health is as a result of bioaccumulation of these metals through food chain (Aschner 2002, Aycicek *et al*., 2008) and the resultant effect on brain cells calls for concern.

Wild animals are efficient users of native vegetation, according to Schleich *et al* (2010) many terrestrial ecosystems where game animals inhabit are usually contaminated with potentially toxic trace elements from the accumulation of agricultural pesticides, fertilizers, industrial effluents, waste disposal and mining (Schleich *et al* ., 2010). These wastes are usually high in heavy metals which can be absorbed by plants and later found in high concentrations in animal tissues and finally humans (Schleich *et al* ., 2010). Concentrations of these heavy metals in the bush meat are a critical issue that needs to be addressed in order to ensure consumer safety. More so, accumulation of heavy metals in bush meat could possibly be a matter of the methods employed in hunting and processing of these animals into edible meat. Adei and Forson-Adaboh (2008) investigated levels of toxic and essential metal content of liver tissue of some domestic and bush animals, while Nkansah and Ansah (2014) determined heavy metal levels in meat from the Kumasi Central Abattoir in Ghana.

However, information on the hunting practices and the ensuing heavy metals concentrations in consumed bush meat is quite important. This study seeks to evaluate the hunting practices and the relationship to heavy metals concentrations in fresh and smoked bush meat in Kumasi, Ghana.

MATERIALS AND METHODS

Study Area and Duration

The study was carried out in Atwemunom Market and Central Market in the Kumasi Metropolis of as well as parts of Sekyeredumase in the Ejura-Sekyedumase District within the Ashanti Region of Ghana. Sekyeredumase is located with latitude 6.747N and longitude -1.509W. The area is within the forest zone of Ghana characterized by high rainfall patterns. The presence of forests and grasses in the area favour game animals such as grasscutter, giant rat, squirrels, and antelopes among others. This study lasted for four (4) months from October 2015 to January 2016.

Study Design and Sampling

The study employed a cross sectional survey which sought to evaluate the type of hunting practices used and evidence of heavy metals in fresh and smoked bush meat. A random sampling technique of meat of fresh and processed bush meat was used. A total of 35 bush meat samples were obtained and used in this study.

Data collection

Data collection for this study involved two phases. This included the administration of structured questionnaires which entailed open and close ended questions and collection of bush meat samples of for heavy metals analysis.

Questionnaire administration

The questionnaires were administered to fifty (50) randomly selected respondents who are mainly hunters actively involved in the capturing of game animals from the wild. The questionnaire administered includes questions on demographic characteristics, general information on game animals, digesta preference, method of processing bush meat, hunting practices that are used in capturing game animals from the wild and the availability of the animals in different season.

Meat sample collection

Random meat samples of bush meat (both fresh and smoked) were collected from the study areas considered irrespective of the type of game animal and the part of the animal into sterile plastic bags and transported to the laboratory for analysis.

Sample preparation and Laboratory analysis

Samples collected were air-dried for 3-5 days and milled using a grinder which was washed thoroughly and cleaned in between milling of different meat samples. The laboratory analysis of the samples comprised protein digestion of the meat samples and heavy metal analysis. The protein digestion of the meat samples was carried out at the Chemistry Laboratory at the Faculty of Renewable and Natural Resources, KNUST, whilst the heavy metals analysis was done at the Ghana Atomic Energy Commission in Accra, Ghana.

Digestion of bush meat samples

1g of each sample was weighed into a glass beaker for the digestion process. 10mls of nitric acid was

added to it and minimum time frame of two to five minutes was used to boil the samples on the stove and allowed to cool down for five to ten minutes. Digested samples were filtered using 50 ml volumetric flasks, filter paper and a funnel. It was then topped up to 50 ml with distilled water.

Heavy metals analysis

The analyses of heavy metals were performed by adopting the AOAC (2000) methods of analysis of heavy metals. The digested meat samples were transferred to 100 ml volumetric flask and volume was made with distilled deionized water and then filtered and stored in air tight bottles for analysis of heavy metals using Atomic absorption spectrometer (model, Varian A.A.240)

Data analysis

Results obtained for the heavy metal analysis were subjected to one-way analysis of variance (ANOVA) to find out the significant differences in heavy metals concentration of both fresh and smoked bush meat. Their mean values were separated using Duncan Multiple Range Test. Questionnaires was analyzed using descriptive statistics by the help of Statistical Package for Social Sciences (SPSS) version 20.

RESULTS

Hunting practices used in the capture of bush meat animals

The hunting practices used in the capture of game animals by the hunters in the study area are represented in Fig.1 below. Results from respondents showed that, the use of guns (68%, Fig 2A, B) was the most applied method of capture followed by cutlasses (10%), dogs (4%), trap (2%) and bait (2%) respectively. This shows that gun was used often for the capture of game animals.

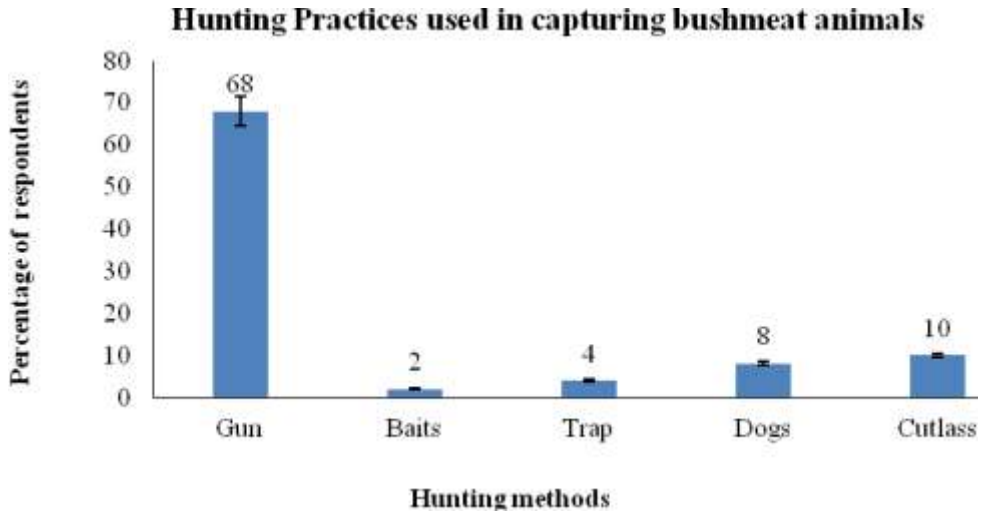

Fig 1: Hunting practices used by the hunters to capture the game animals.

Most preferred game animals and Seasonality of Supply

86% of the respondents showed strong preference for grasscutter (Fig 2C) followed by antelope (10%) and the least being giant rat (Fig 2D) and deer (2% each). Others include African Civet cat (Fig 2E), Crested Porcupine (Fig 2F), Duiker (Fig 2G), Palm civet (Fig H). From the survey, 68% of the respondents believed that rainy season has the highest supply of game meat while 28% of the respondents opted for the dry season.

Table 1. Response of respondents on most preferred bush meat

Variable	Categories	Frequency	Percentage (%)
Most preferred bush meat	Grasscutter	43	86.0
	Giant rat	1	2.0
	Deer	1	2.0
	Antelope	5	10.0
Season of availability of bush meat	Rainy season	34	68.0
	Dry season	16	32.0

Method of Processing bush meat

Results showed that majority (86%) of the respondents preferred smoking (Fig 2I) as a method of processing. 10% of the respondents preferred boiling while 4% of the respondents preferred drying (table 2). Results from table 3 showed that, the animal digesta which was preferred the most was the grasscutter represented by 82% of the respondents followed by that of Antelope (14%) and deer (2%).

Table 2: Response of respondents on method of processing bush meat

Variable	Categories	Frequency	Percentage (%)
Method of processing	Smoking	43	86.0
	Boiling	5	10.0
	Drying	2	4.0

Table 3: Response of respondents on most preferred bush meat digesta

Variable	Categories	Frequency	Percentage (%)
Most preferred bush meat digesta	Grasscutter	41	82.0
	Deer	1	2.0
	Antelope	7	14.0
	None	1	2.0

Heavy metal concentration in fresh and smoked bush meat

Recorded mean values of the different heavy metal concentrations in the fresh bush meat was is as follows; Fe (12.72±2.56), Cu (0.96±0.29), Zn (7.4±0.68), Cd (0.1±0.00), Pb, (4.31±3.46) Mn (5.16±2.65). Concentrations of the different heavy metals in the smoked bush meat also recorded are as follows; Fe (15.28±2.29), Cu (0.94±0.98), Zn (7.39±0.57), Mn (5.33±0.98), Pb (0.07±0.00), Cd (0.1±0.00) (Table 4).

The heavy metal concentrations for Cu, Pb and Zn in the fresh meat were relatively higher than those of the smoked meat. Also the concentrations of Mn and Fe were lower in the fresh meat when compared to the smoked meat however Cadmium concentration was similar in both the fresh and smoked bush meat as shown in Table 4.

Table 4: Heavy metals concentrations in fresh and processed bush meat

Heavy metals	Fresh Meat (mg/kg) Mean ± S. E	Smoked Meat (mg/kg) Mean ± S. E	Standard concentration (safe limit (ppm)
Fe	12.72±2.56	15.28±2.29	4.49 -15.0
Cu	0.96±0.29	0.94±0.98	0.87 -5.0
Zn	7.4±0.68	7.39±0.57	0.41 -5.0
Cd	0.1±0.00	0.1±0.00	0.33
Pb	4.31±3.46	0.07±0.00	0.01-0.38
Mn	5.16±2.65	5.33±0.98	Not Yet Confirmed

Figure 2: showing some of the game animals, some instrument used for hunting and cooking methods. A- African civet B- Crested Porcupine C- giant rats D- Maxwell Duiker E- Palm civet F- grasscutter G- Local gun H- local bullet I- Local processing of bushmeat (smoking).

DISCUSSION

The use of guns was the commonest method of capturing the animals from the wild, because it was easier to capture huge animals from far distances. The least hunting method used in capturing game animals was that of bait (1%). This may be connected with the fear of retention of the poison employed which may result in ill health or even death of those that consume such animals.

It was also found that availability of game animals is dependent on the seasonality. More game animals are captured in the wet season than dry season, this may be connected with availability of various vegetation and shrubs that serves as food for these bush meat animals as well as the increase in reproductive ability of bush meat animals during the wet season.

This study showed that the most preferred method of processing bush meat was by smoking which is one

of oldest methods of processing bush meat. This preference may be because smoking enhances meat preservation, improves flavor as well as taste of meat. In Ghana, most people prefer the use of the digesta in the preparation of soup with greater preference for ingesta of grasscutter possibly because it adds taste to soups and stews and that of giant rat is not consumed, because the people believed that these rats consume poisonous plants from the wild which could be detrimental to human health. However the implications of this habit to health have not been elucidated.

The results on the heavy metals concentration in this study showed that lead (Pb) was relatively high in the fresh bush meat as compared to the smoked which was within the recommended limits (0.07). The observed high level of lead concentration in the fresh bush meat could be connected to the use of gun by the hunters (Hunt *et al.*, 2009), however the low level lead concentration observed in smoked bush meat can be attributable to the reduction of water in the meat since lead is mostly found in the cytoplasm of the cell and a reduction in moisture may account for reduction in lead concentration (Eboh *et al.*, 2006, Okoro *et al.*, 2015). Despite the efficiency in the use of guns for hunting, hunters pay little or no attention to the accumulation of these heavy metals in bush meat and this neglect is of great concern to food safety and security (Doborowolska and Melosik 2008, Irschik *et al.*, 2012). Bullet shot animals often contain dispersion of heavy metals especially lead fragments in their bodies, hence a threat to human health if consumed since exposure of lead in humans can cause acute and chronic damage to the nervous system (Duiker and Miller 1999) especially in children where it is known to cause reduce intelligence, hyperactivity and antisocial behavior (Tuormaa 1995) and in adult humans, heart diseases, cancer and infertility. Our report of Pb (4.31 mg kg^{-1}) was similar to the levels of Pb (1.3-13.8 mg kg^{-1}) reported by Adei and Forson-Adaboh (2008) in tissue of some domestic and bush animals. The Pb level exceeds the proposed European Commission (EC) limit of 0.5 mg kg^{-1}. Nkansah and Ansah (2014) also reported concentration of lead above the tolerance level in all the meat samples examined with the highest concentration recorded in beef at 1.154 mg/kg and the lowest at 0.037 mg/kg in pork from municipal abattoir.

The Iron (Fe) concentration in the smoked meat was higher than that of the fresh meat possibly because of the use of the iron gauze used which may get deposited during processing (AESAN 2012). The mean concentrations of Mn, Cu, Fe and Cd in both the fresh and smoked bush meat were within the safe limits for human consumption as recommended by WHO (1984). The economic implication has also been reported by Wilkie and Godoy (2001).

In conclusion, of the various hunting practices identified, gun was the most preferred while the most preferred bush meat as well as bush meat digesta in the study was that of the grasscutter of which most of the supply was more in the rainy season. Higher amount of Lead (Pb) and Zinc (Zn) were detected in bush meat and this could be associated with the use of gun for hunting game animals. Concentrations of Mn, Cu, Fe and Cd in both the fresh and processed bush meat are low and within recommended safe limits for human consumption.

Smoking of meat was observed to be beneficial to consumers as it has tendency of reducing Pb levels in meats. However there is the need for further studies on heavy metals in bushmeat on a national scale. Continuous educations of the hunters on the detrimental effect of the use of guns for hunting should be encouraged.

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