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Some Heavy Metals Accumulate More in the Flesh of *Thryonomis swinderianus* (Lem), Grasscutter, than in Beef of *Bos* Species, Cow

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Some heavy metals are essential for the growth and development of plants and animals (Cralley 1972; Bowen 1966). Others are detrimental to them (Davidson et al and Lloyd et al 1959) even in trace amounts. A source of heavy metals for humans is food. An important food item is meat. Meat is a very essential source of proteins for the healthy growth of people. In developing countries like Ghana, meat is not abundant. The quantity of meat is supplemented with bush meat. Bush meat is a general term applied to meat obtained from wild animals. Thryonomis swinderianus (Lem), grasscutter, is a source of bush meat. The grasscutter resembles the rabbit but it may be longer and bigger, depending on its age, than the rabbit. Grasscutters have dark greyish colour with fur which is bristly, have shorter snouts and are less agile than the rabbit. Its meat is regarded as a delicacy in a number of West African countries. For this reason grasscutter meat is more expensive than mutton, chicken, fish and beef of Bos species, cow. Meat certainly contributes to metal content of the human body.

The investigation reported here is part of the studies into the heavy metal contents of various food crops, meat and fish in the Ashanti Region of Ghana.

MATERIALS AND METHODS

Beef and grasscutter meat were purchased from markets in Kumasi city, Konongo and Obuasi. In each market on each sampling day beef and grasscutter meat were purchased from not less than ten meat sellers in various parts of the markets. Each market was sampled once a month for ten months in 1990. These were put in separate poly ethylene bags and transported to the laboratory. In the laboratory, the flesh were put in separate petri dishes and dried in an oven at 100 - 110°C to constant weight.

Weighed amounts of the dried samples in triplicate were put in boiling tubes. To each portion of samples in the tubes, depending on the weight taken, was added 5 - 25ml of concentrated AnalaR HNO_3 in a fume cupboard and then heated in a

sand bath until complete dissolution. The cooled digest was made up to 100ml in a graduated flask with several rinses of double distilled water. This was poured into a plastic sample bottle and analysed in AAS3 Atomic Absorption Spectrophotometer, East German make.Standard solutions of the various metals were used in preparing the calibration curves and the blanks were made up of the concentrated AnalaR HNO_3 diluted to 100ml with the double distilled water used in preparing the solutions of the samples. The means were calculated for each sample. The means for all the samples from the various markets were computed. Thus the recorded means were from beef and grasscutter meat of hundred individual animals sold in different months in the year. The AAS was operated only in the linear region of the calibration curve. The detection limits varied with the metals. Those for silver, zinc, and cobalt were 0.003, 0.0026, 0.005 ppm respectively.

RESULTS AND DISCUSSION

From the five markets sampled the mean levels of the metals in beef were as follows: Mn 4.06, Cu 11.30, Fe 34.69, Zn 104.47, Co 0.00, Cr 4.82, Ni 20.05, Pb 1.35, Au 1.64 and Ag 1.09 ppm. The mean levels in grasscutter meat were: Mn 6.88, Cu 14.09, Fe 51.87 Zn 64.45, Co 0.97, Cr 9.62, Ni 19.83, Pb 2.59, Au 10.21 and Ag 3.23 ppm. Though there were variations from one market to another in the three towns, with the exception of Kononго Table 3, on the average grasscutter meat contained higher levels of the metals, (see also Tables 1 - 5) than beef. The highest level of zinc 212. 31 ppm was measured in beef samples from Central market in Obuasi. The next highest was in Kumasi Central market with a value of 113. 09 ppm. One would have expected that all the beef from Obuasi would have high levels of zinc but this was not observed. Grasscutter meat in Konongo market did not contain higher levels of Mn, Cu, Fe, Cr and Ni than beef. Cattle are usually obtained from varied sources. Some might have come from the Northern and Upper Regions of the country but others are bred locally and hence their metal contents are bound to vary. When the samples were collected it was not possible to find out where the cows were purchased from.

Cattle normally feed on grasses and as such the metal contents of beef will be dependent on what were present in the pasture. These in turn will be dependent on the chemistry and the geochemistry of the soils. In addition, grains such as maize, millet and rice bran are usually fed to cattle in the dry seasons. Thus the metals present in beef will be dependent on the amounts in the pastures and cereals. The grasscutters on the other hand are not domesticated and usually obtained from the wild by hunting and trapping. Their sources of food are not known with certainty. They feed on grasses, roots, tubers, grains of cereals, the wood of all sorts of palm trees, and cassava sticks. During digging for tubers and roots they might have consumed bits of soil on the roots and tubers and hence have higher metal content in their meat.

Table 1. Mean levels in ppm of metals in beef and grasscutter meat purchased from Asafo Market in Kumasi city in 1990.

Metal	Mn	Cu	Fe	Zn	Co	Cr	Ni	Pb	Au	Ag
Beef	0.0	11.24	45.30	65.91	0.0	18.07	64.45	0.04	0.50	0.0
Grasscutter meat	2.26	10.73	41.78	40.28	0.0	8.55	30.33	1.29	0.26	2.51

Table 2. Mean levels in ppm of metals in beef and grasscutter meat purchased from central in 1990.

Metal	Mn	Cu	Fe	Zn	Co	Cr	Ni	Pb	Au	Ag
Beef	0.92	3.45	38.47	113.09	0.0	0.0	6.83	0.59	2.51	2.92
Grasscutter meat	14.35	4.58	109.41	44.65	4.84	23.49	34.74	4.13	7.74	0.11

Table 3. Mean levels in ppm of metals in beef and grasscutter meat purchased from Konongo market in 1990.

Metal	Mn	Cu	Fe	Zn	Co	Cr	Ni	Pb	Au	Ag
Beef	7.05	29.43	44.62	70.01	0.00	2.97	3.64	0.70	0.01	0.02
Grasscutter meat	6.72	19.19	29.40	85.9	0.00	1.01	1.54	1.82	7.12	0.19

Table 4. Mean levels in ppm of metals in beef and grasscutter meat purchased from Tutuka market at Obuasi in 1990.

Metal	Mn	Cu	Fe	Zn	Co	Cr	Ni	Pb	Au	Ag
Beef	0.0	2.22	21.53	61.03	0.00	0.97	17.24	3.80	1.09	2.50
Grasscutter meat	7.72	33.75	40.30	84.04	0.00	13.04	14.62	4.46	17.98	10.32

Table 5. Mean levels in ppm of metals in beef and grasscutter meat purchased from Central Market at Obuasi in 1990.

Metal	Mn	Cu	Fe	Zn	Co	Cr	Ni	Pb	Au	Ag
Beef	12.34	10.16	23.55	212.31	0.00	2.08	8.10	1.26	0.00	0.00
Grasscutter meat	3.33	2.21	38.48	67.38	0.00	1.99	17.92	1.20	20.54	3.01

The feeding habits of the grasscutter could account for the higher levels of gold in its flesh especially at Obuasi and Konongo, Tables 3 to 5, which are gold mining towns. The same reason may explain the higher levels of silver in the grasscutter flesh than in beef, though silver is not mined in Ghana the soils may contain traces of it.

The higher levels of lead in the meat of grasscutter can also be attributed to the fact that the grasscutter in addition to feeding on grasses also feeds on roots and tubers it digs up with its teeth and claws from the soil and therefore might have swallowed bits of soil which contained traces of the metal. Often when one journeys at night, hunters are seen hunting for grasscutters in the vegetation alongside the roads. As such the majority of the grasscutters easily killed and trapped are those which feed in grasses on the roadsides. Such easy preys certainly constitute larger portion of grasscutter meat in many markets. Vegetation and soils on roadsides contain higher levels of lead aerosols from the combustion of leaded gasoline in petrol engines (Lagerwerff et al 1970) than those far removed from roads. The surface soil near roads contain more lead than the deeper soil layers (Chow 1970). Hence the grasscutters which feed on grasses and roots in the surface soil near roadside harbour more lead in their flesh than others which feed in places remote from roads. Cattle feed less on grass alongside main roads but feed mainly in pastures which are usually far removed from roads. The pastures are less contaminated with lead aerosols. This certainly explains the lower lead levels in beef. Also other metals like zinc and nickel which contaminate roadside soils and vegetation as a result of vehicular movement (Gish et al 1973) may also be higher in grasscutter meat than in beef. This was not distinctly displayed in this investigation. This may be due to the fact that they were not carried in exhaust fumes and did not settle where lead aerosols did.

Occasionally cattle are seen feeding on grasses on roadsides. This explains some of high levels of metals in some beef, Tables 4 and 5. It is not unlikely that livestock keepers in Obuasi have been feeding their herds of cattle on roadside vegetation. This goes to emphasize that the levels of the metals in grasscutter is due more to amounts present in its food and not any special biocumulative ability of its flesh.

Since at times levels of lead are close to 5 ppm which is supposed to cause acute lead toxicity (Patterson 1965) a people constantly feeding on grasscutter meat are at greater risk of lead poisoning than those who feed on beef.

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