Distribution of Heavy Metals in the Liver, Kidney, Heart, Pancreas and Meat of Cow, buffalo, Goat, Sheep and Chicken from Kohat market Pakistan.

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Abstract: This study was to determine the concentrations of heavy metals (Cu, Zn, Co, Fe, Cr, Cd, Ni and Pb) in liver, kidney, heart, pancreas and meat of Cow, Buffalo Sheep, Goat and Chicken, from Kohat Market Pakistan by using PerkinElmer PinAAcle™ 900T atomic absorption (AA) spectrophotometer. The levels of heavy metals in the liver, kidney, heart, pancreas and meat of cow, buffalo, goat, sheep and chicken ranged from 0.075±0.010 to 15.763±0.012 mg/kg Cr; 1.85±0.007 to 11.838±0.005 mg/kg Pb; 0.025±0.003 to 82.83±0.060 mg/kg Cu; 10.75±0.020 to 313.625±0.680 mg/kg Fe; 0.025±0.001 to 0.275±0.005Ni; 0.125±0.000 to 1.588±0.002 mg/kg Cd; 0.015±0.002 to 8.538±0.019 mg/kg Co; and 7.4±0.008 to 41.85±0.108 mg/kg Zn. Generally, livers and kidneys were found to have the highest significant levels of metals and meat the lowest levels. Also they showed significant differences when compared to one another (cow, buffalo, goat, sheep and chicken).

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Introduction

Meat and meat products are important for human diet because they provide a great part of nutrients, including the necessary trace elements. Heavy metals from man-made pollution sources are continuously released into aquatic and terrestrial ecosystems and therefore, the concern about the effect of anthropogenic pollution on the ecosystem is growing. Contamination with heavy metals is a serious threat because of there toxicity, bioaccumulation and biomagnifications in the food chain (Demirezen & Uruc, 2006). These pollutants often have direct physiological toxic effects because they are stored or incorporated in tissues, sometimes permanently (Bokori *et al*., 1996; Mariam *et al*., 2004). It is necessary to establish ongoing knowledge of various pollutants in meat. In Kohat, the shopkeepers sell most of the meat in open market and even on road side. The contaminated food and water are sources of illness in human body. Among various pollutants in the environment, heavy metals are directly related to health diseases in humans. Although it is difficult to classify trace metals into essential and toxic groups, yet it is well known fact that an essential metal becomes toxic at sufficiently high intakes (Khurshid and Qureshi, 1984)

Lead may enter the atmosphere during mining, smelting, refining, manufacturing processes and by the use of lead containing products. Lead intake occurs from the consumption of whisky fruit juices, food stored in lead lined containers, cosmetics, cigarettes and motor vehicle exhaust (Benneth, 1981). Excess lead can cause serious damage to the brain, kidneys, nervous system and red blood cells. Young children, infants and fetuses are particularly vulnerable to lead poisoning. US environment protection agency (EPA) says that lead may be implicated in causing Leukemia (Anonymous, 2002). High concentration of copper oxide may result from welding operation. The corrosion of copper containing alloys in pipe fittings may add measurable amount of copper into the water. Copper content of normal human adult is 50-120 mg, but above 15 mg causes nausea, vomiting, diarrhea intestinal pain (Greenwood and Earnshaw, 1986). Environmental concentration of nickel is increased by nickel producing and processing industries. Vehicles exhaust a large quantity of nickel which is obtained from the petroleum. Cigarette smoking can increase the inhaled nickel to as much as 4 micro gram per pack of cigarette. Most of the Mn in the air is due to the burning of fossil fuels. When one is exposed to higher level of Mn, it causes “manganese psychosis” a mental disease characterized by uncontrolled laughter,

euphoria, impulsiveness, sexual excitement followed by impotency. Zn is essential for normal functioning of cells including protein synthesis, carbohydrate metabolism cell growth and cell division (Saeed, 1998). However, if Zn concentration in air is over 15 mg per meter cube, "metal fume fever" may result; which causes fever, depression, malaise, cough, vomiting, salivation and headache. Cadmium replaces Zn in many enzymes. Therefore a higher amount of Zn is required to overcome the toxic effects of cadmium (Khan *et al.*, 1990). Iron deficiency is seen in the premenopausal women. In contrast to premenopausal women, adult men should not use iron supplements, because high tissue level of iron correlate with increased risk of myocardial infarction (Harvey and Champe, 1994). Food is one of the principle environmental sources of cadmium (Baykov *et al.*, 1996). As cadmium moves through food chain, it becomes more and more concentrated as it reaches the carnivores where it increases in concentration by a factor of approximately, 50-60 times (Daniel and Edward, 1995). Toxic effects of cadmium are kidney dysfunction, hypertension, hepatic injury, and lung damage (John and Jeanne, 1994). Cadmium chlorides at teratogenic dose induce significant alterations in the detoxification enzymes in liver and kidney (Reddy and Yellamma, 1996).

Material and Methods

Sample collection: Fresh samples of liver, Kidneys, meat, heart and pancreas of cow, sheep, goat and buffalo and meat, heart, pancreas and liver of chicken were collected from Kohat market PAKISTAN. The samples were collected in polyethylene bags and transported to the laboratory for analysis. The study was carried out between the periods of March, 2012 to June, 2012.

Sample Preparation: The Collected samples were decomposed by dry digestion method for the determination of various metals. First of all the crucibles and the glass wares used in the experiment were washed with distilled water and then dried in oven.Weight of each crucible was made constant by keeping it in electric furnace at 750 °c for one hour. Then transferred it to decicator and weighted it. The purpose was to remove all the moisture. This action was repeated till the weight became constant. A known quantity, 2g of each sample (liver, kidney, heart, pancreas and meat) was introduced into the crucible. The crucibles were then kept in electric furnace at 700 °C. The digestion of the samples completed in three to four days. Then added 2.5 mL of 6 molar HNO_3 to it to dissolve the contents. Filtered it and diluted the volume upto 25ml with distilled water.

Elemental analysis of samples: Determination of Cu, Zn, Cr, Fe, Cd, Ni, Co and Pb in all the samples were made directly on each of the final solutions using PerkinElmer PinAAcle™ 900T atomic absorption (AA) spectrophotometer (Shelton, CT, USA) equipped with the intuitive WinLab32™ for AA software running under Microsoft® Windows™ 7, which features all the tools to analyze samples, report and archive data and ensure regulatory compliance.

Results and Discussion

Chromium: The Cr concentration in the study of liver, kidney, heart, pancreas and meat of Cow, Buffalo, Sheep, Goat and Chicken has been summarized in Table 1, 2, 3, 4 and 5. The highest Cr concentration (15.763 mg/kg) was found in the liver of cow and the lowest (0.075 mg/kg) in the meat of chicken. All the remaining study samples showed minor variations amongst each other (0.3 to 2.063 mg/kg). The permissible for Cr in food is generally 0.5 ppm [1]. It was found that The concentration of Cr in the liver of cow was higher than the permissible limit. And also liver of chicken, heart of cow, heart of sheep, kidney of cow and pancreas of buffalo had higher concentration than the permissible limit (Tables 1, 2, 3 and 5), while the concentration of Cr in all the remaining study samples was lower than the permissible limit. Cr is an essential element helping the body to use sugar, protein and fat, at the same time it is carcinogenic for organisms (Institute of Medicine, 2002). Excessive amounts of Cr may cause adverse health effects (ATSDR, 2004).

Cadmium: The Cd concentration as observed in the liver, kidney, heart, pancreas and meat of Cow, Buffalo, Sheep, Goat and Chicken has been summarized in Table 1, 2, 3, 4 and 5. The highest Cd concentration was found in the liver of goat (1.588 mg/kg) and the lowest (0.125 mg/kg) was in liver of sheep. The remaining study samples showed minor variations amongst each other (0.138 to 1.513 mg/kg). The permissible limit for cadmium in liver has been reported as (0.5 ppm) set by (FAO/WHO, 2000). The highest value in liver of cow observed in the present study is slightly greater than the permissible limit. However, the concentration of cadmium in the sheep liver (0.125 mg/kg) was found to be slightly lower than the permissible limit. Aranha et al. (1994), and Roga et al. (1996), detected the cadmium levels in the livers and kidneys of cattle of Poland and found the cadmium concentration above the action level. Similarly, Doganoc (1996) found higher levels of cadmium and zinc in the livers and kidneys of the chickens, which exceeded the official tolerance levels.

Lead. The lead concentration was observed in all the samles of different animals (Cow, Buffalo, Sheep, Goat and Chicken) and it was found that the liver of cow showed the highest concentration of (11.838 mg/kg) and lowest concentration of (1.85 mg/kg) was found in the heart of goat (Table 1, 2, 3, 4, and 5). The results showed that the lead concentration

in all of all the species was higher than the permissible limit of, 1 ppm (ANZFA). Similar results obtained by Spierenburg et al. (1988) who determined lead concentrations in liver and kidney of cattle within a 20 Km radius of zinc refineries and compared these with cattle in unpolluted control areas. Significantly higher amounts of lead in liver and kidneys were found in cattle sampled around the refineries than those cattle reared in the mining area and also higher than those in cattle in the rural area. Aranha (1994) reported higher concentration of lead than the permissible limit in the liver and kidney of animals. Danev et al. (1996) showed that 86% samples of liver and 100% samples of kidney were contaminated above the limits set by the country's regulations. Similarly, Maldonado et al. (1996) studied lead with reference to its intestinal absorption, mobilization and redistribution during lactation in rats and showed significantly higher levels of lead in the livers and kidneys. The results revealed that the concentrations of lead in the liver, kidney and meat of beef, mutton and chicken were lower than the permissible limit, while the liver and kidney of caprine were higher than the permissible limit of 1 ppm (ANZFA, 2001) thus indicating contamination of the liver and kidney.

Table 1: Concentration of heavy metals in liver of Cow, Goat, Sheep, Buffalo and Chicken from Kohat Market Pakistan. Concentrations (mg/kg)

Samples	Cr	Pb	Cd	Co	Cu	Zn	Ni	Fe
Cow	15.763±0.012	11.838±0.005	0.825±0.000	0.163±0.001	5.9±0.043	23.075±0.023	0.213±0.004	31.075±0.011
Goat	0.45±0.002	2.7±0.005	1.588±0.002	8.538±0.019	82.83±0.060	34.538±2.208	0.188±0.001	15.863±0.028
Sheep	0.363±0.013	3.513±0.003	0.125±0.000	0.015±0.002	0.025±0.003	19.263±0.016	0.212±0.003	40.163±0.057
Buffalo	0.463±0.004	3.25±0.005	0.15±0.000	0.125±0.002	12.463±0.012	10.5±0.666	0.09±0.001	65.075±0.022
Chicken	0.538±0.008	2.9±0.008	1.213±0.000	0.2±0.003	20.863±0.038	19.95±0.013	0.25±0.002	75.363±0.110

Table 2: Concentration of heavy metals in heart of Cow, Goat, Sheep, Buffalo and Chicken from Kohat Market Pakistan. Concentrations (mg/kg)

Samples	Cr	Pb	Cd	Co	Cu	Zn	Ni	Fe
Cow	0.538±0.004	3.213±0.008	0.525±0.002	0.163±0.003	7.113±0.006	21.988±0.175	0.038±0.005	53±0.053
Goat	0.413±0.001	1.85±0.007	0.6±0.001	0.263±0.001	7.85±0.007	15.175±0.021	0.263±0.003	53.563±0.016
Sheep	0.538±0.007	3.85±0.004	0.138±0.001	0.063±0.000	4.138±0.005	14.788±0.038	0.175±0.003	38.488±0.035
Buffalo	0.325±0.009	3.075±0.011	0.613±0.000	0.138±0.002	8.163±0.010	27.525±0.045	0.238±0.006	42.825±0.035
Chicken	0.35±0.002	2.388±0.015	0.875±0.000	0.163±0.002	0.413±0.024	16.138±0.009	0.213±0.002	39.9±0.041

Table 3: Concentration of heavy metals in kidney of Cow, Goat, Sheep, Buffalo and Chicken from Kohat Market Pakistan. Concentrations (mg/kg)

Samples	Cr	Pb	Cd	Co	Cu	Zn	Ni	Fe
Cow	0.6±0.006	2.95±0.004	1.225±0.001	0.138±0.002	8.588±0.008	21.713±0.232	0.225±0.005	87.6±0.116
Goat	0.463±0.007	2.288±0.016	1.075±0.001	0.188±0.002	6.763±0.023	12.5±0.008	0.125±0.001	24.463±0.005
Sheep	0.488±0.009	3.663±0.016	0.488±0.000	0.038±0.003	10.375±0.006	15.05±0.005	0.275±0.005	51.65±0.016
Buffalo	0.438±0.006	3.25±0.024	0.863±0.001	0.138c0.001	6.738±0.004	17.85±0.002	0.025±0.006	83.125±0.105

Table 4: Concentration of heavy metals in meat of Cow, Goat, Sheep, Buffalo and Chicken from Kohat Market Pakistan. Concentrations (mg/kg)

Samples	Cr	Pb	Cd	Co	Cu	Zn	Ni	Fe
Cow	0.3±0.007	2.7±0.001	0.475±0.000	0.138±0.003	7.313±0.003	29.65±0.015	0.05±0.003	31.98±0.005
Goat	ND	2.15±0.016	0.375±0.000	0.188±0.001	4.088±0.008	26.413±0.110	0.063±0.003	10.75±0.020
Buffalo	0.488±0.005	3.25±0.011	0.35±0.001	0.05±0.002	3.013±0.004	41.85±0.108	0.225±0.004	18.9±0.014
Chicken	0.075±0.010	2.275±0.006	1.15±0.001	0.2±0.003	2.513±0.005	7.4±0.008	0.25±0.001	19.863±0.022

Table 5: Concentration of heavy metals in pancreas of Cow,Goat,Sheep,Buffalo and Chicken from Kohat Market Pakistan.Concentrations (mg/kg)

Samples	Cr	Pb	Cd	Co	Cu	Zn	Ni	Fe
Cow	0.475±0.002	2.5±0.021	0.3±0.000	0.15±0.000	4.6±0.006	38.15±0.388	0.213±0.003	313.625±0.680
Goat	ND	2.163±0.003	0.713±0.000	0.275±0.002	3.225±0.001	17.188±0.022	0.15±0.003	36.363±0.051
Sheep	0.4±0.008	3.85±0.008	0.313±0.000	0.088±0.001	2.488±0.003	24.5±0.038	0.2±0.003	142.75±0.359
Buffalo	2.063±0.008	3.138±0.007	0.225±0.001	0.088±0.001	0.063±0.004	13.763±0.019	0.15±0.002	221.125±0.307
Chicken	0.425±0.002	1.95±0.014	1.513±0.001	0.275±0.001	4.8±0.004	14.025±0.059	0.238±0.006	100.525±0.230

Copper. Copper concentration in all the samples of different animals has been shown in Tables 1, 2, 3, 4 and 5. Highest copper concentration was found in the liver of goat (82.83) and lowest (0.025 mg/kg) in the liver of sheep. When compared with the permissible limit of 200 ppm (ANZFA), the copper

concentration in the liver of goat was lower. And similarly in all the remaining study samples the concentration was below than the permissible limit. Mukhacheva and Bezel (1995) found higher levels of copper and zinc in the livers and kidneys of mutton and beef. Jozef *et al.* (1997) reported the accumulation and distribution of zinc, copper, arsenic, lead and cadmium in the livers, kidneys, spleen, musculature, uterus and in the ovaries of seven experimental and five control sheep. The results indicated that liver, kidney and uterus were the organs with the highest copper accumulation. Copper is essential component of various enzymes and it plays a key role in bone formation, skeletal mineralization and in maintaining the integrity of the connective tissues. It is essential element but its concentration in the livers of goat suggests that it may not be used frequently and gets accumulated in large concentrations.

Zinc. The zinc concentration in all the study samples has been summarized in Tables 1, 2, 3, 4 and 5.Highest zinc concentration (41.85 mg/kg) was found in the meat of buffalo and lowest concentration (7.4 mg/kg) in the meat of chicken. All the values in the study samples were below the permissible limit (150 ppm) set by (ANZFA). Jozef *et al.* (1997) reported the zinc and copper intoxication by industrial emission in the livers, kidneys, spleen, musculature and in the ovaries and uterus of some experimental sheeps. Results showed that the highest concentration of zinc in the experimental animals, died of zinc intoxication, was in the liver and kidneys. The low concentration of zinc may be attributed to zinc deficient soils, consequently the fodder/cereals available to buffalo and chicken are deficient of zinc. Perhaps, this is one of the reasons for low tissue content of zinc.

Nickel: The Ni concentration in the study samples of different animals (Cow, Buffalo, Sheep, Goat and Chicken) has been summarized in Tables 1, 2, 3, 4 and 5. The highest concentration (0.275) was found in sheep kidney while the lowest (0.025) was in buffalo kidney. Nickel has been proved to be essential for poultry, pig, and rat under experimental conditions. Ni is poorly absorbed from ordinary diets [7]. Absorbed Ni will be accumulated in liver, kidney and lung [1]. Data of Ni in foodstuffs are scarce.

Cobalt: The concentrations of Co in all the study samples are shown in Tables 1, 2, 3, 4 and 5. The highest concentration of Co (8.538) was found in liver of goat while the lowest (0.015) in the liver of sheep. Co is required in the form of cobalt-containing vitamin B 12. Co is widely distributed in the animal organ in relatively high concentration in liver, kidney, bone, spleen, and other glandular tissue.

[7]. The concentration of Co in the samples analyzed were still in the normal range except in the liver of goat.

Iron: The concentration Fe in all the samples under study of different animals (Cow, Buffalo, Sheep, Goat and Chicken) has been summarized in Tables 1, 2, 3, 4 and 5. The highest concentration (313.625) was found in pancreas of cow while the lowest (10.75) was shown by meat of goat. The permissible limit of iron in food is generally 30-150 mg/kg, [1].

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