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Detection of Heavy Metal Contents in Meat and Milk of Buffaloes from Area of Ring Road and Kasur Lahore

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ABSTRACT

The purpose of this study was to detect the concentrations of various heavy metals in meat, liver, milk and fodder of buffaloes by using atomic absorption spectroscopy. For this purpose samples were collected from areas of Kasur and Ring road each having three different sites where fields are irrigated with the industrial effluents. During present investigations the level of most heavy metals in meat of buffaloes ranges from Zn 13.9 to 22.5, Co 0.625 to 33.125, Cu 0.15 to 12.8, Cd 0.14 to 20.4, Ni 2.45 to 27.54, Cr 0.242 to 0.406.However the concentration of these metals in liver of buffaloes ranges from Zn 10.81 to 77.43, Co 3.958 to 20.625, Cu 1.52 to 12.88, Cd 11.85 to 26.1, and Ni 1.29 to 23.38, Cr 0.3122 to 0.4061. In milk of buffaloes it ranges from Zn 3.197 to 18.15, Co 3.958 to 166.458, Cu 0.22 to 6.06, Cd 20.4 to 209, Ni 2.54 to 65.04, Cr 0.2653 to 3.844. Similar levels were seen in fodder of buffaloes Zn 13.15 to 25.05, Co 0.208 to 53.125, Cu 0.38 to 10.61, Cd 0.05 to 9, Ni 0.45 to 47.54, and Cr 0.383 to 0.4765. Generally most values of heavy metals have been found higher in milk of buffaloes from areas of Kasur. Detoxication of industrial effluents being used for irrigation purpose is highly recommended.

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Introduction

Heavy metals are elements having a density of more than **5 g/cm3**, atomic weight ranges from 63.546 to 200.590 and a specific gravity of greater than 4.00. Heavy metals remain in ground water and soil for a large time until they tend to accumulate and become very toxic at certain levels. The metals classified as heavy metals include Zn, Cu, Mn, Cr, Ni, Li, Cd, Ar, and I. Within the groups of heavy metals some elements (Na, K, Ca, Fe) are essential for living organisms required by their bodies in certain amounts and excess of which leads to various harmful effects [1].

Environment is defined as the entirety of circumstances surrounding an organism or group of organisms especially, the combination of external physical conditions that affect and impact the growth, development and survival of organisms [2].

Heavy metals enter the environment through air source from coal burning plants, smelters and other industrial processes [3]. Decaying of heavy metals in ground water also results from natural processes e.g naturally occurring deposits of Arsenic in ground water (4).

Once heavy metals are present in excess in environment, they remain there for years to increase the chances of effects to humans and livestock. Recent studies have shown that ground water residues [4] of certain chemicals lead to chronic exposure to these heavy metals.

Accumulation of heavy metals in soil is of great concern due to its adversely effects on food quality and crop growth. Irrigation of land containing food crops with industrial wastewater gradually increases the concentrations of heavy metals in soils, which are taken up by plants and then animals, which graze on these plants. In this way these metals are circulate in the food chain causing severe damage to human health [5].

Humans get exposed to heavy metal through inhalation of dust, direct ingestion of soil, and consumption of food plants grown in metal contaminated soil. The contaminated food and water causes illness in human body. To classify trace metals into essentials and toxic group is difficult, but it is a known fact that at sufficiently high level of even essential group becomes toxic to human health.

Grazing of animals on contaminated soil results in deposition of these metals in their meat due to which higher level of these toxic metals have been found in beef and mutton[6].Providing animals with toxic metal contaminated feed results in the prevalence of these metals in the environment [7].

Consumption of heavy metals above the bio-recommended levels results in the bio toxic effects. It is essential to keep the level of some metals such as (Na, K,I, Ca,) in their specific range for continuing proper metabolic functions in human body, which can be done by taking selected foods in daily diets [8].

Presence of non-essential elements such as Cd, Cr, Ni in the body can cause profound biochemical and neurological changes.

Heavy metal contamination is a serious threat because of their toxicity, bioaccumulation and biomagnification in food chain [9].

Methodology

3.1 Sample collection

Meat, liver and fodder of cows were collected from two different sites of Lahore city i.e Kasur and Ring road. Three areas from each site were selected for sample collection .6 cows were randomly selected for collection of their meat,

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liver, milk and food for analysis. These samples were collected in a polythene bags and were frozen at -4C.

The following points should be kept in mind while collecting samples.

- Samples were collected from areas, which had more factories.
- Animals, which were receiving fodder grown in areas, irrigated with industrial effluents.
- No alternate source of water for irrigation and use by animals of that area.

3.2 Chemicals

- Nitric acid
- HCl
- Hydrogen peroxide
- Distilled water
- Deionized water

Salts used for standards preparation

- Nickel sulphate
- Zinc sulphate
- Copper sulphate
- Cadmium sulphate
- Cobalt sulphate

3.3 Method for standard preparation

Calculated amount of the salt was taken in a 1000ml conical flask and distilled water was added upto the mark to make 1000ppm solution. $C_1V_1 = C_2V_2$ formula was used to calculate different concentrations of the same salt to make different standards. Calculated amount of the solution was taken from 1000ppm solution in 100ml conical flask and then fill the flask upto the marked level with distilled water. Same procedure was used for all salts.

3.4 Microwave digestion for Sample preparation

5g of meat was homogenized with a homogenizer. 2ml of distilled water, 2 ml of nitric acid, 4ml of Hydrogen peroxide was added to 5ml of meat solution. The glass vile containing a mixture was covered with a cap and heated in a microwave oven for 2 minutes. After 2 minutes of cooling at room temperature sample was heated again for short intervals till a clear solution was obtained.

Homogenizer

Equipment used for homogenization of various types of materials such as tissues, plants and food. It is used to make a mixture of two mutually non-soluble liquids.

3.5 Technique Used

Atomic Absorption spectroscopy

Now this prepared sample is subjected to atomic absorption spectroscopy for detecting concentration of various metals within the subjected samples.

Atomic spectroscopy is the determination of elemental composition by its electromagnetic or mass spectrum. Atomic spectroscopy is closely related to other forms of spectroscopy. It can be divided by atomization source or by the type of spectroscopy used. The basic principle is that light is passed through a collection of atoms. If the wavelength of the light has energy corresponding to the energy difference between two energy levels in the atoms, a portion of the light will be absorbed. The relationship between the concentrations of atoms, the distance the light travels through the collection of atoms, and the Beer-Lambert law gives the portion of the light absorbed [10].

Results and Discussion

Results

The present study was conducted to detect the concentration of heavy metals in meat of Cow by using Atomic absorption spectroscopy. Data was divided into two groups for comparative analysis that which area has higher concentration of metals in meat, liver, milk and food of cow.

Table 1a. Standards for Cobalt.

Concentration (ppm)	Absorbance
1	0.001
2	0.004
3	0.009
4	0.013
5	0.013
6	0.014
7	0.017
8	0.019
9	0.021
10	0.024

Table 1b. Concentration of Co in samples of meat, liver, milk and fodder (mg/Kg).

	MEAT	LIVER	MILK	FOOD
BHAMA (RING ROAD)	16.458	3.958	3.958	3.958
BHAINI ROAD	12.292	16.458	1.875	53.125
KAROL GHATTI	1.458	8.125	28.958	6.875
KASUR RAIWIND ROAD	0.625	0	166.458	0.208
RAJA JANG (KASUR)	12.29	3.958	1.458	2.2917
RAO WALA KHAN (KASUR)	33.125	20.625	37.291	6.042

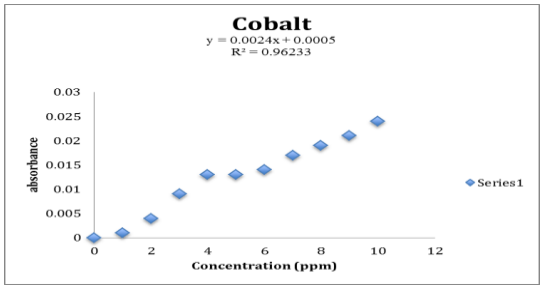


Fig 1a. Standards for Cobalt

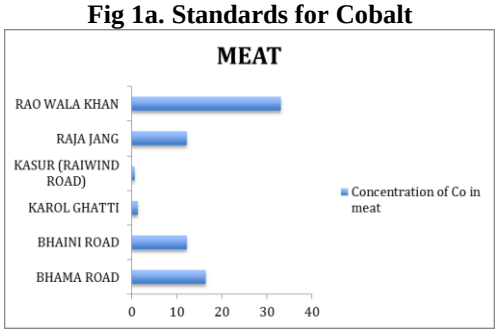


Fig 1b. Overall meat samples taken from Kasur area have the highest concentration of Cobalt.

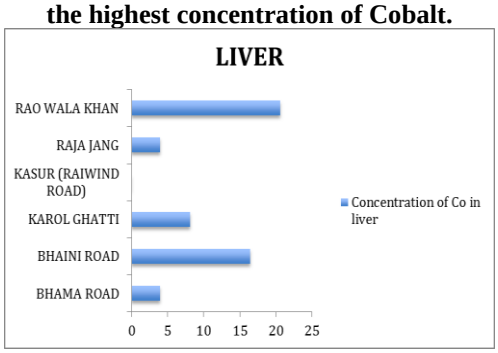


Fig 1c. Overall liver samples taken from Kasur area have the highest concentration of Cobalt.

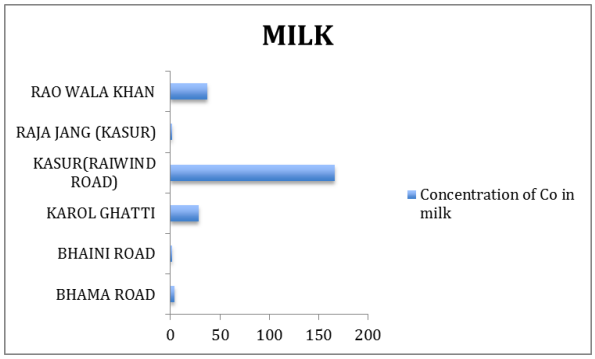


Fig 1d. Overall milk samples taken from Kasur area have the highest concentration of Cobalt.

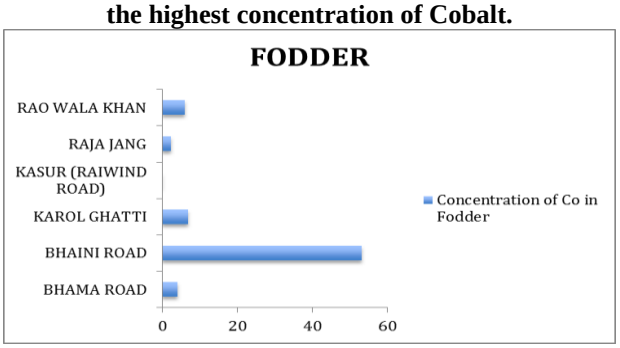


Fig 1e. Overall fodder samples taken from Kasur area have the highest concentration of Cobalt.

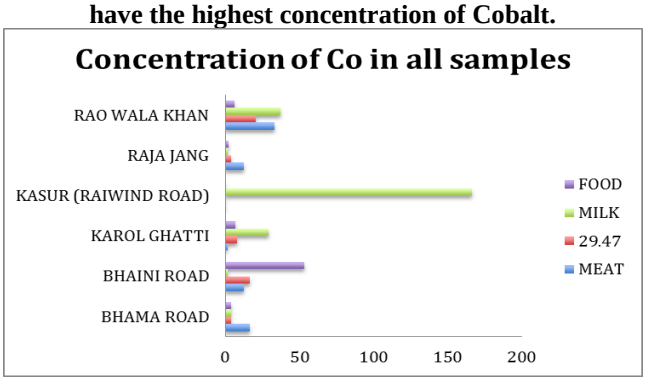


Fig 1f. All 24 12 samples taken from Kasur has the highest concentration of Cobalt as compared to ring road.

Table 2a. Standards for Chromium.

Concentration(ppm)	Absorbance
1	0.054
2	0.114
3	0.165
4	0.202
5	0.252
6	0.296
7	0.323
8	0.355
9	0.412
10	0.452

Table 2b. Concentration of Cr in meat, liver, milk and fodder.

	MEAT	LIVER	MILK	FOOD
BHAMA (RING ROAD)	0.242	0.4061	3.844	0.4765
BHAINI ROAD	0.2887	0.382	1.63	0.3357
KAROL GHATTI	0.32	0.3592	0.25	0.2
KASUR RAIWIND ROAD	0.29	1.09	0.11	0.3122
RAJA JANG (KASUR)	0.4061	0.3357	0.2653	0.383
RAO WALA KHAN (KASUR)	0.3357	0.3122	0.2653	0.383

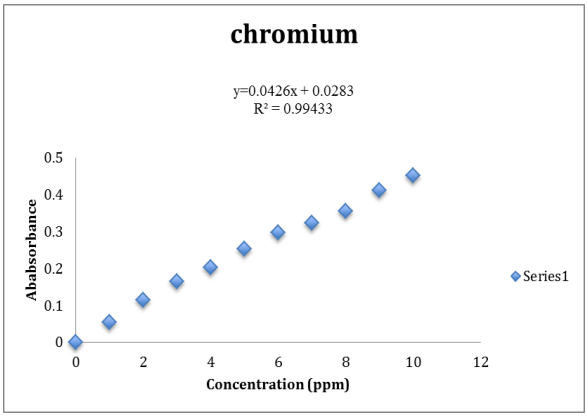


Fig 2a. Standards for chromium

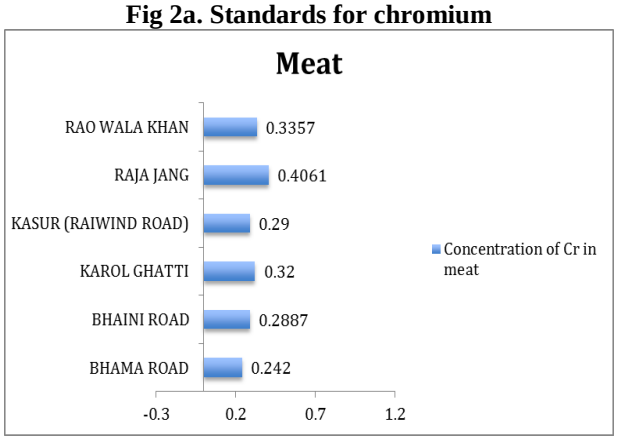


Fig 2b. Overall meat samples taken from Kasur area has the highest concentration of Chromium.

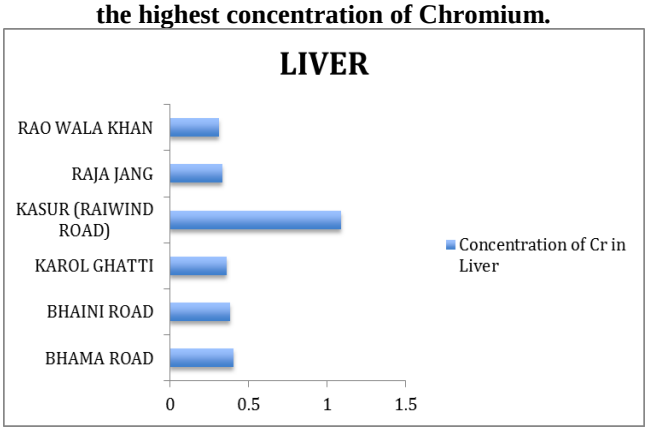


Fig 2c. Overall liver samples taken from Kasur area has the highest concentration of Chromium.

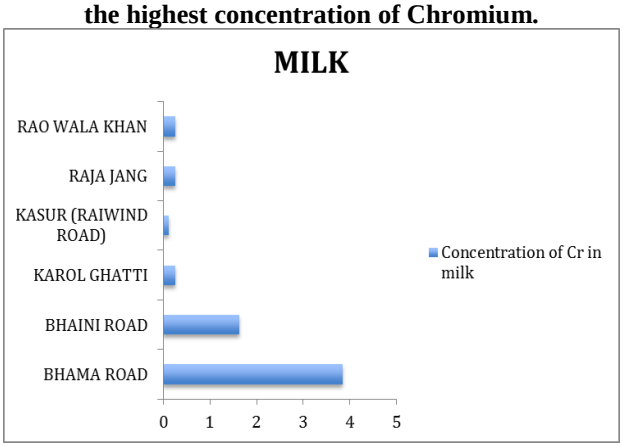


Fig 2d. Overall milk samples taken from Bhama and Bhaini (ring road) area have the highest concentration of Chromium.

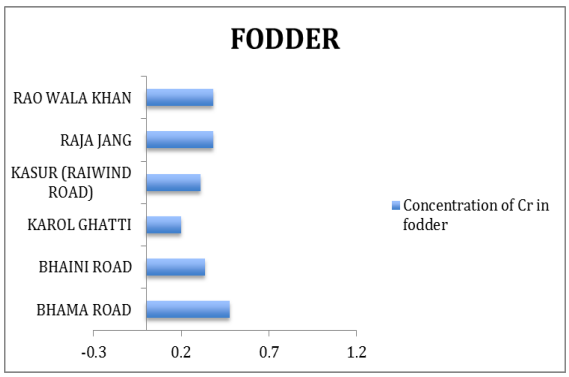
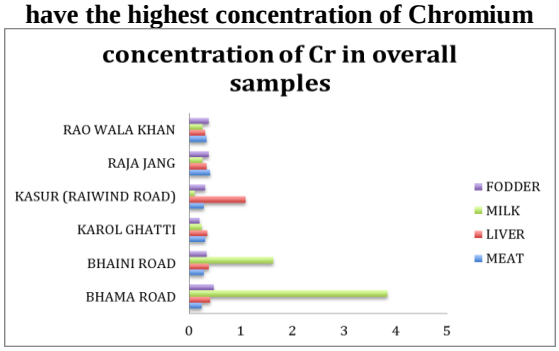


Fig 2e. Overall fodder samples taken from Kasur area have the highest concentration of Chromium



2f. overall ring road areas have the highest concentration of Chromium due to the higher levels of chromium in the milk samples of Bhama and Bhaini(ring road) area.

Table 3a. Standards for ZINC.

Concentration (ppm)	Absorbance
1	0.11
2	0.13
3	0.15
4	0.18
5	0.204
6	0.28
7	0.37
8	0.45
9	0.52
10	0.58

Table 3b. Concentration of Zinc in meat, liver, milk and fodder.

	MEAT	LIVER	MILK	FOOD
BHAMA (RING ROAD)	19.6	25.7	9.608	28.19
BHAINI ROAD	22.5	14.4	5.375	20.09
KAROL GHATTI	19.4	21.5	3.88	24.24
KASUR RAIWIND ROAD	20	77.43	18.15	13.15
RAJA JANG (KASUR)	13.9	10.81	6.625	25.05
RAO WALA KHAN (KASUR)	17.6	14.16	3.197	13.68

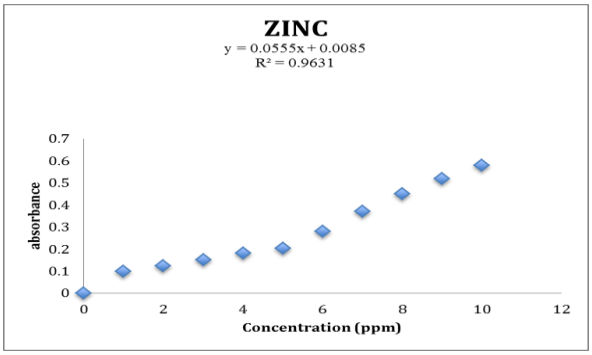


Fig 3a. Standards for Zinc

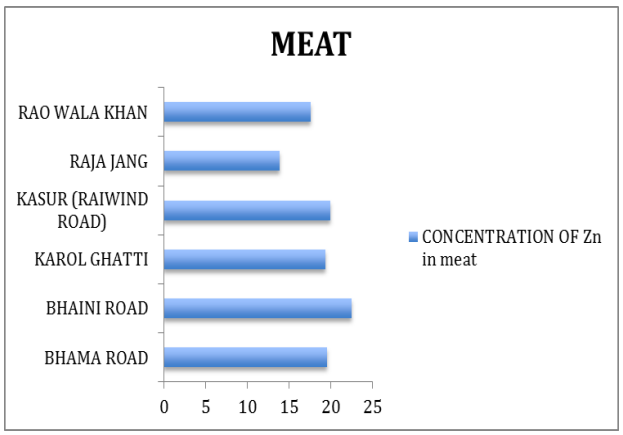


Fig 3b. Overall meat samples taken from ring road areas have the highest concentration of Zinc.

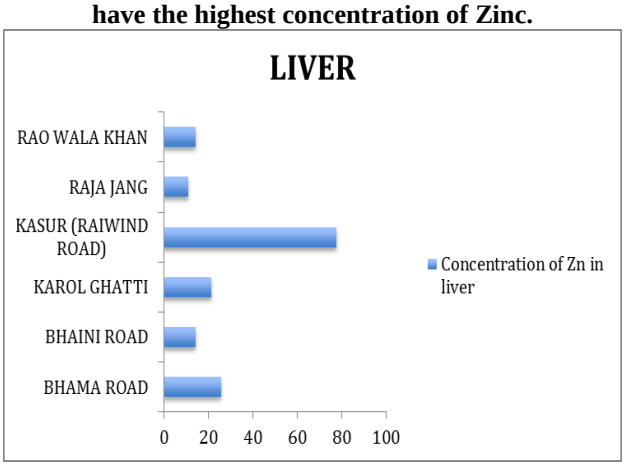


Fig 3c. Overall liver samples taken from Kasur area has the highest concentration of Zinc.

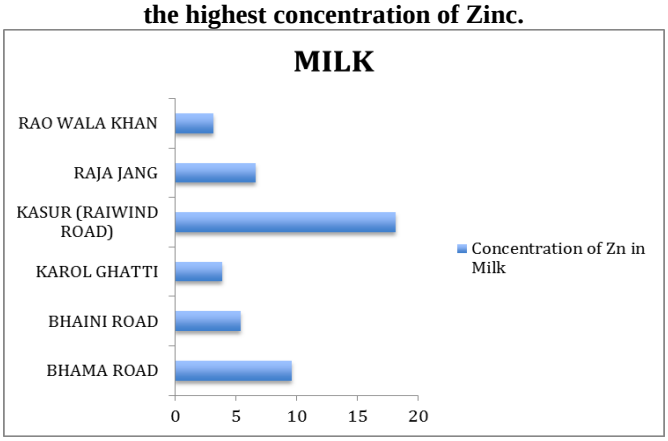


Fig 3d. Overall liver samples taken from Kasur area have the highest concentration of Chromium.

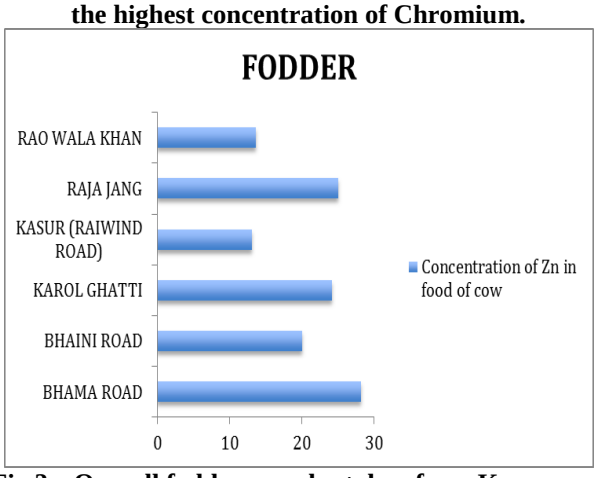


Fig 3e. Overall fodder samples taken from Kasur area have the highest concentration of Zinc.

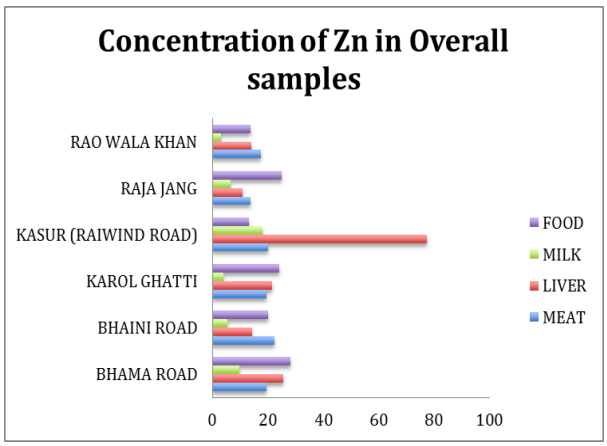


Fig 3f. In all 24 samples Kasur has the highest concentration of Zn due to high level of Zn in Liver samples of Raiwind road Kasur.

Table 4a. Standard for Cadmium.

Concentration (ppm)	Absorbance
1	0.008
2	0.0134
3	0.0169
4	0.0192
5	0.0224
6	0.0265
7	0.03
8	0.0321
9	0.0371
10	0.0385

Table 4b. Concentration of Cd in meat, liver, milk and fodder (mg/Kg).

	MEAT	LIVER	MILK	FOOD
BHAMA (RING ROAD)	0.14	23.2	26.1	0.05
BHAINI ROAD	4.14	14.71	209	3.571
KAROL GHATTI	14.71	11.85	29	9
KASUR RAIWIND ROAD	11.85	0	0	11.85
RAJA JANG (KASUR)	20.4	26.1	49.04	0,42
RAO WALA KHAN (KASUR)	14.71	17.57	20.4	9

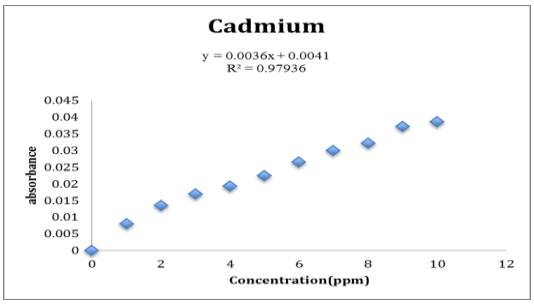


Fig 4a Standards for Cadmium.

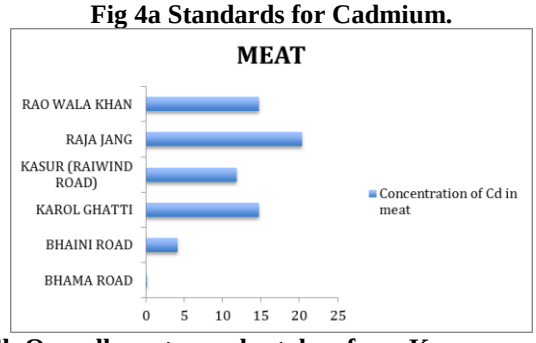


Fig 4b Overall meat samples taken from Kasur area have the highest concentration of Cadmium.

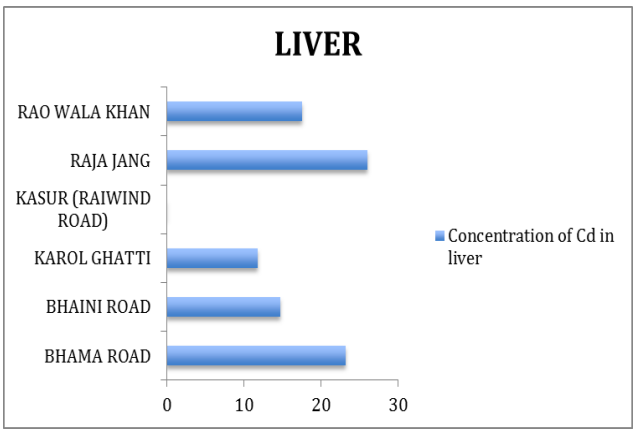


Fig 4c. Overall liver samples taken from ring road areas have the highest concentration of Cadmium.

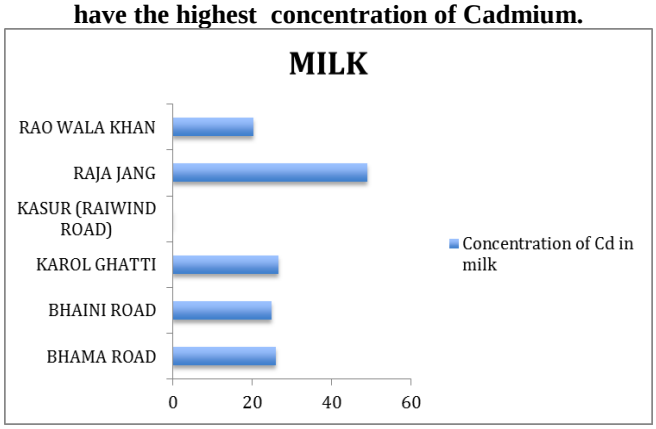


Fig 4d. Overall milk samples taken from Ring road areas have the highest concentration of Cadmium.

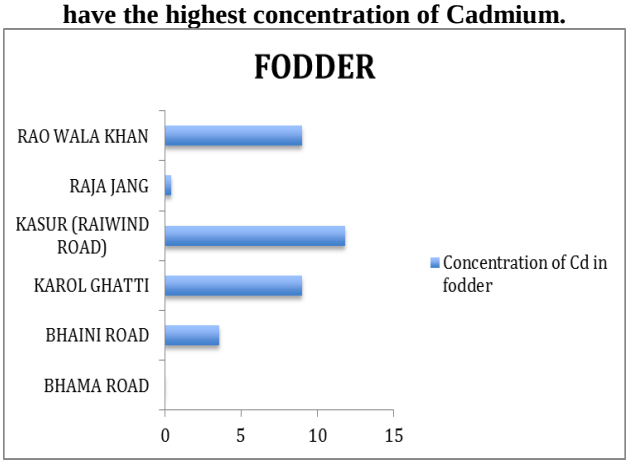


Fig 4e. Overall fodder samples taken from Ring road area have the highest concentration of Cadmium.

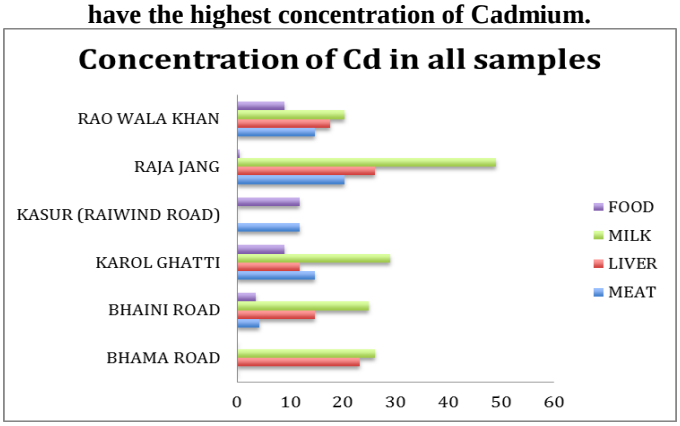


Fig 4f .In all 24 samples higher concentration of Cadmium was found in samples of Kasur due to high level of Cd in milk samples of Kasur area.

Table 5a. Standards for Nickel.

Concentration	Absorbance
1	0.011
2	0.015
3	0.019
4	0.023
5	0.026
6	0.028
7	0.03
8	0.033
9	0.033
10	0.037

Table 5b. Concentration of Ni in meat, liver, milk and fodder (mg/Kg).

	MEAT	LIVER	MILK	FODDER
BHAMA (RING ROAD)	2.45	1.29	2.54	1.70
BHAINI ROAD	19.20	31.7	65.04	0.45
KAROL GHATTI	4.20	23.3	2.125	47.54
KASUR RAIWIND ROAD	10.875	23.38	10.87	19.20
RAJA JANG (KASUR)	27.54	2.54	19.20	23.38
RAO WALA KHAN (KASUR)	15.45	23.37	48.37	10.88

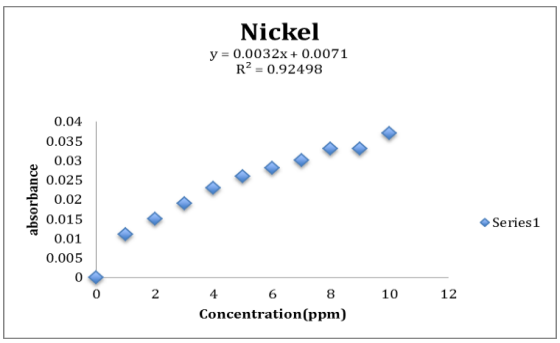


Fig 5a Standards for Nickel.

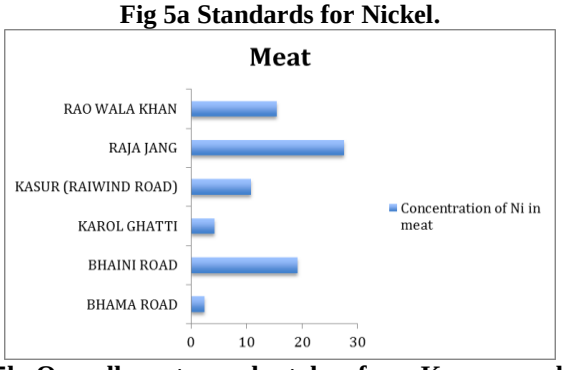


Fig 5b. Overall meat samples taken from Kasur area have the highest concentration of Nickel.

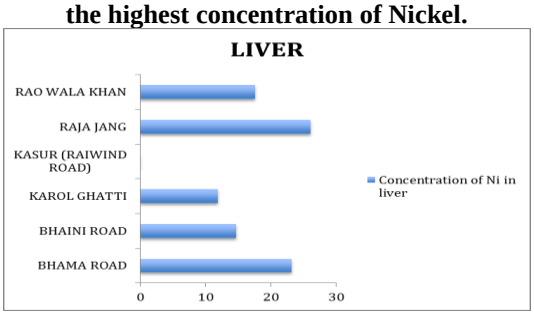


Fig 5c Overall liver samples taken from Kasur area have the highest concentration of Nickel.

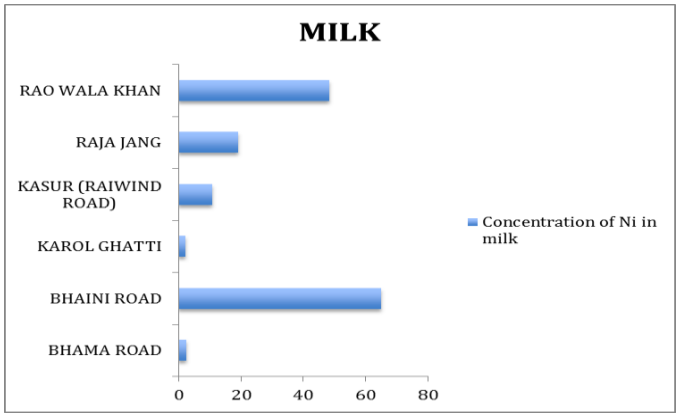


Fig 5d. Overall mik samples taken from Kasur area have the highest concentration of Nickel.

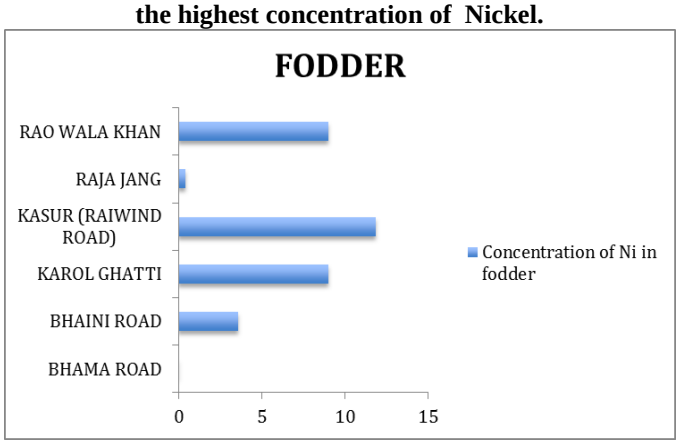


Fig 5e. Overall fodder samples taken from Kasur area have the highest concentration of Nickel.

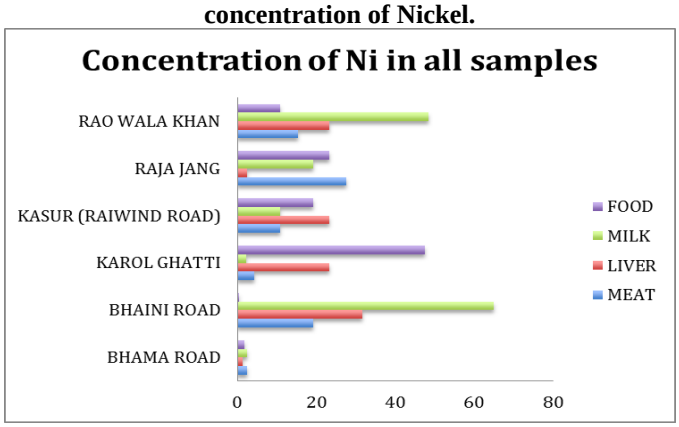


Fig 5f. All samples taken from areas of Kasur have the higher concentration of Nickel.

Table 6a. Standards for Copper.

Concentration	Absorbance
1	0.011
2	0.015
3	0.019
4	0.023
5	0.026
6	0.028
7	0.03
8	0.033
9	0.033
10	0.037

Table 6b. Concentration of Copper in meat, liver, milk and fodder.

	MEAT	LIVER	MILK	FODDER
BHAMA (RING ROAD)	12.8	10.61	6.06	10.61
BHAINI ROAD	8.34	15.15	0	1.06
KAROL GHATTI	0.15	12.88	5.15	3.79
KASUR RAIWIND ROAD	1.52	1.52	0	0.38
RAJA JANG (KASUR)	0.9	10.61	0.22	2.20
RAO WALA KHAN (KASUR)	1.75	8.34	0.61	0.84

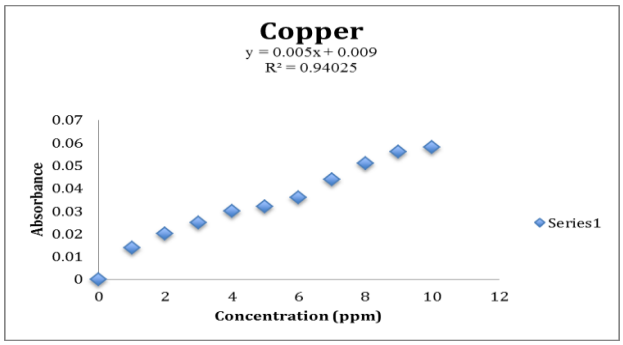


Fig 6a. Standards for Copper.

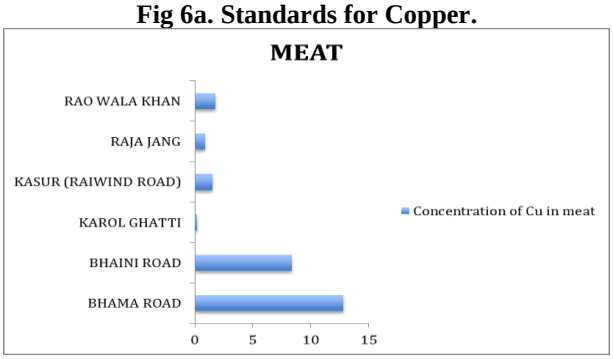


Fig 6b. Overall meat samples taken from Ring road area have the highest concentration of Copper.

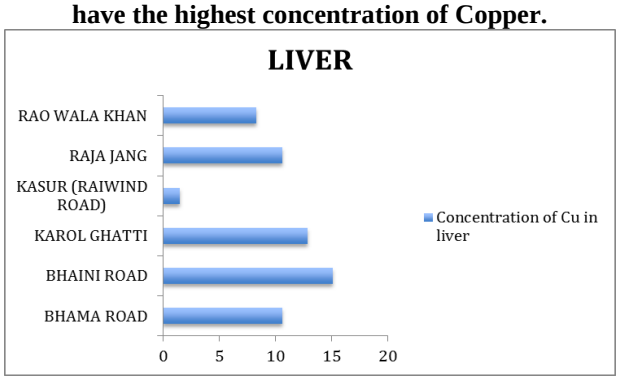


Fig 6c .Overall liver samples taken from Ring road area have the highest concentration of Copper.

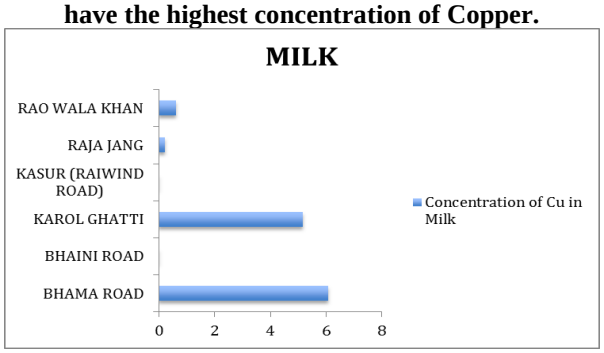


Fig 6d. Overall milk samples taken from Ring road area have the highest concentration of Copper.

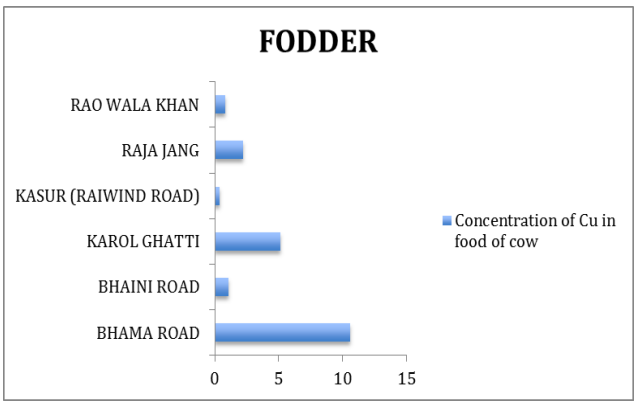


Fig 6e. Overall fodder samples taken from Ring road area have the highest concentration of Copper,

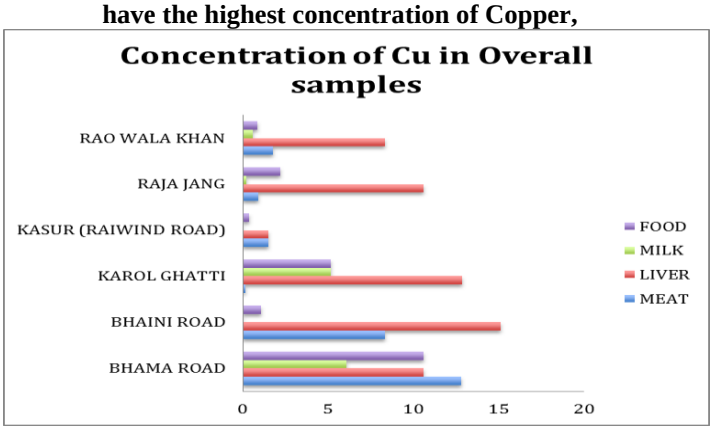


Fig 6f. All samples of Ring road area have the highest concentration of Copper.

Discussion

The low concentration of chromium even in Kasur which is otherwise notorious for high concentration of Chromium was possibly because the vegetation was actually irrigated by the effluents from the vegetation was usually irrigated by the effluents from the nearby factories which include textile paper and paint industry. All three of these factory types and the soap and steel industry of the Ring road area donot usually use chromium in the manufacturing process.

Although well below the cut off value for chromium research suggests that chromium is secreted in milk and is a much more threat to a society if buffaloes are reared in areas of high chromium contamination. This observation was supported by [11] who suggest that most of the metals are given out in body secretions such as milk. This may be a defense mechanism of a body to protect itself from excess amount of metals. The problem however arises because the milk is consumed by the calves for very short period hardly they feed on milk for 2-3 months. On the other hand human consumed milk for a long time usually buys milk from the same milkman.

The results of the present study indicate that the concentration of heavy metals such as Zn, Cd, Co and Ni in samples collected from Kasur is higher as compared to the area of ring road. This is due to the fact that area of Kasur has more factories than the area of ring road, which releases large amount of industrial effluents in the nearby lands. Moreover in Kasur animals are used to graze more on open fields as compared to animals of ring road where animals are not reared on contaminated lands. Animals reared on contaminated lands have higher concentration of these residues in their organs.

Results also indicate that milk has higher concentration of these residues.

This is due to the fact that lactating animals accumulate higher concentration in their secretions such as milk. [12]

The results of the present study indicate that the concentration of heavy metals such as Cr and Cu in samples collected from ring road is higher as compared to the area of Kasur.This is due to the fact that area of ring road has more factories of steel, which use these metals for electroplating process releases large amount of industrial effluents in the nearby streams or drains. As animals drink that contaminated water they accumulate these toxic metals in their bodies. Moreover that area is most of the times flooded by water of river Ravi, which contain toxic chemicals of different areas.

The concentration of metals in fodder show that these animals graze on contaminated fields, which are irrigated with industrial effluents. Consumption of contaminated fodder result in the accumulation of these toxins in different organs of animals.

Conclusion

- Level of heavy metal residue(Co and Cd) is higher in samples as compared to values reported in the literature.
- Industrial effluent result in the transfer of metals in the food chain.
- Intake of these heavy metals upto the dietary limits proves carcinogenic for human health.
- Secretion of buffalo such as milk has the highest concentration of metal residues as compared to all other samples.

Limitations

- It was difficult to collect the samples.
- It was hard to convince factory owners to get information about their factories.
- Communicating with people of rural areas was difficult because they cannot understand you properly.

Recommendations

- The water use for agriculture and domestic purpose should be treated properly before use especially in industrial areas.
- All edible samples that pass the permissible limit of toxic metals should declared unsafe for human health.
- Both public and government sectors must cooperate to find the solution of this increasing problem.

References

1). Szyczewski P, Siepak J, Niedzielski P, *et al.* Research on heavy metals in Poland. Polish J.of Environ.Stud.(2009);18(5):755-768.

2). Duruibe JO, Ogwuegbu MOC, Egwurugwu JN. Heavy metal pollution and human biotoxic effects. International Journal of physical Sciences. (2007); 2(5): 112-118.

3).Fernandes AG, Ternero M, Barragan GF. (2000); 2(2) :123-136.

4).Sanyal SK, Nasar SKT. Arsenic Contamination of ground water in West Bengal. Build up in soil crop system. (2002); 2:123-136.

5). Haiyan W, Stuanes AO. Heavy metal pollution in Air-Water-Soil-Plant system of Zhuzhou City, Hunan Province, China .Water, Air and soil pollution. (2003); 147 (1-4):79-107.

6). Hamasalim HJ, Mohammed HN. Determination of heavy metals in exposed corned beef and chicken luncheon that sold in sulaymaniah markets. African Journal of food science. (2013) ; 7(7):178-182.

7). Hussain RT, Ebraheem MK, Moker HM, Assesment of heavy metal (Cd, Pb, Zn) contents in liver of chicken available in local markets of Basrah City, Iraq. (2012); 11(1):43-48

8). Chowdhury ZA, Siddique ZA, Hossain SMA, *et al.*Determination of essential and toxic metals in meats meat products and eggs by Spectrophotometric method. Journal of Bangladesh chemical society. (2011); 24(2):165-172.

9). Okiei W, Ogunlesi M, Alabi F, *et al.* Determination of toxic metal concentrations in flame treated meat products, ponmo. African Journal of Biochemistry research.3(10):332-339.

10). Richard LA . Diagnosis and improvement of saline and alkaline soils. (1968); Handbook No.60.

11). Radwan A.m, Salama A.k. Market basket survey for some heavy metals in Egyptian fruits and vegetables. Food and Chemical Toxicology.(2006); 44:1273–1278.

12). 27). Uluozlua O.D, Tuzen M, Mendil D *et al.* Assessment of trace element contents of chicken products from turkey. Journal of Hazardous Materials.(2009); 163: 982-987.