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METALLIC RESIDUES CONCENTRATION IN MUSCLE, LIVER AND KIDNEYS OF CATTLE SLAUGHTERED IN PUDUCHERRY REGION

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ABSTRACT

This study was planned to find out the concentration of chromium (Cr), copper (Cu), lead (Pb) and zinc (Zn) in muscle, liver and kidneys of cattle that are commercially sold at three places of Puducherry. A total of 108 samples collected to determine the metallic residues concentration by using Atomic Absorption Spectrometer (AAS). Results indicated that heavy metal concentration varied from tissue to tissue within the same species. Among the three tissues of cattle examined highest mean concentration of chromium was noticed in kidneys (1.77±0.17ppm), copper in liver (6.3±1.69ppm), lead in muscle (3.96±6.32ppm) and zinc also in liver (22.78ppm) respectively. Out of four metallic residue concentration analyzed, mean concentrations of three were well below the maximum permissible limit (MPL) prescribed by (FSSA, 2011) with the exception of lead which had relatively higher concentration in all three tissues of cattle.

KEYWORDS: Chromium, Copper, Lead, Zinc, Atomic Absorption Spectrophotometer

INTRODUCTION

Although heavy metals have industrial uses, their potential toxicity for people and animals is the object of several studies. But efforts have to be made to exercise control at all stages of meat production which helps to avoid or reasonably decrease contamination of meat with various pollutants (Sabir *et al.* 2003; Staniskiene and Garalevicience, 2004). As meat is one of the major route through which various chemical resides gain entry into the human system, it is essential to monitor the presence of these residues in meat at regular interval so as to ensure that the public health is not endangered (Noel *et al.* 2005). Keeping these points in view, the present study was designed to evaluate the concentration of heavy metal residues in cattle tissue samples sold as meat at three places of Puducherry.

MATERIALS AND METHODS

Fresh samples of cattle tissues, each weighing approximately 250 gram were collected randomly without contamination from three different places viz., Puducherry municipality slaughter house, Oulgarat slaughter house, and Sederapet (road side shop) (Details of sample collection is given in the Table 1). All the samples were conveyed to the laboratory for further processing. Upon reception, visible fat, excessive connective tissue and clotted blood were removed, stored at -20 °C in sealed plastic container until analysis.

Wet Ashing of Samples for Heavy Metal Analysis

A known quantity, approximately five gram of each sample was taken in the 100 ml conical flask along with glass beads and 25 ml of triple glass distilled water was added. About 10 ml each of concentrated nitric acid and 60% Perchloric acid was added to the contents of the conical flask. The conical flask was heated for about 30 minute a high temperature (135°C) and then temperature was reduced to 60°C and maintained, with intermittent shaking till the solution became clear. The solution was quantitatively transferred into a 50 ml volumetric flask and volume was made with triple glass distilled water.

Detection of Heavy Metals by Atomic Absorption Spectrometer

Atomic absorption spectrometer (AAS) (PERKINS ELMER 1003 MODEL) was used for estimating the metals. The sample was prepared in a solution form so that it could be easily aspirated through the nebulizer and the concentration of the metal to be determined was provided between 0.1 to 0.5 absorbance units, about 2ml of solution was utilized for each measurement. The working standards were analyzed at the beginning and end of a run and periodically during longer runs. According to the absorbance, the concentration was measured directly, when the sample is within the linear working rang. Presence of heavy metals was estimated using respective hollow cathode lamps to give lamp energy. The fuel oxidant was obtained by acetylene-air mixture, which provided the flame for determination of metals. For all elements, the fuel: oxidant ratio was used as prescribed in flame methods manual for atomic absorption. Detailed information about the elemental measurements is provided in table 2.

Statistical Analysis

Data obtained from the study were statically analyzed and interpreted (Snedecor and Coharan, 1989).

RESULTS AND DISCUSSIONS

The range of metallic residues in the cattle tissues are presented in table 3. The range of chromium in muscle, liver and kidneys of cattle were 0.6-3.1, 0.23-3.4, 0.9-3.5ppm respectively. Cattle tissues recorded copper concentration ranging from 0.29-1.90, 0.90-43.3 and 1.2-3.54ppm respectively in muscle, liver and kidneys samples. The concentration of lead recorded in the muscle, liver and kidneys of cattle were in the range of 2.0-5.42, 2.0-7.0 and 1.99-5.38ppm respectively. In muscle, liver and kidney the concentration of accumulated zinc ranged from 25.34-58.41, 32.31-59.71 and 16.56-29.11ppm respectively. Out of four heavy metals analyzed, few samples of liver had abnormally higher concentration of copper than the prescribed limit of 20ppm. However, good number samples of each tissue had higher, concentration of highly toxic metal lead than the prescribed limit of 2.5ppm in meat products. Table: 4 revealed that Mean ± S.E. of heavy metals viz., chromium, copper, lead and zinc content (ppm) in muscle, liver and kidneys of cattle. Among the three tissues of cattle analyzed, liver had the lowest chromium content of 1.34±0.18 ppm while the kidneys had the highest content of 1.77±0.17ppm. However, chromium concentrations did not differ significantly between muscle, liver and kidneys. No specific standards are available in India for chromium content in fresh meat. Similar results were reported by Jukna *et al.* (2006); Iwegbue (2008) in muscle, liver and kidney of beef. However, Abraham (1994) reported a relatively higher concentration of chromium (7.49±0.15ppm) in the muscle of cattle. Liver had significantly ($P<0.05$) higher mean copper concentration than the muscle and kidney of cattle. However, Zmudzki *et al.* (1991) reported a very high copper level, in the liver of Irish and Polish cattle as 56.7 and 22.1ppm respectively and Mariam *et al.* (2004) observed mean

concentration of copper value in liver and kidneys of cattle were 93.24±15.8ppm and 5.42±1.03ppm respectively. Among the three tissues of cattle the highest mean concentration of lead was noticed in the muscle (3.96±0.23ppm) and lowest mean concentration was observed in liver (3.47±0.26ppm) as these values did not differ significantly (P>0.05). Almost all the three tissues of cattle had recorded uniformly higher level of lead than the limit prescribed by FSSA (2011). This could be due to pre-exposure of live animal to contaminated air for a longer period, rearing animals nearer to the industrial areas such as smelters, batteries, crystal manufacturing and paint industries. Marian *et al.* (2004) reported the lead concentration of 2.81±0.38ppm and 2.02±0.44ppm in liver and kidneys respectively, whereas Abraham (1994) noticed much higher level of lead in the cattle liver (25ppm). In cattle, muscle, liver and kidney differed significantly ($p<0.05$) in the mean zinc concentration with liver recording highest accumulation with 42.41± 1.97 ppm as against muscle (34.80±2.38ppm) and kidney (22.78±0.76ppm). Mean zinc content present in the samples of cattle tissues was well below the permissible level of 50ppm prescribed by FSSA, (2011). Simakavo *et al.* (1993) reported much higher zinc level in beef up to 83.2 mg/kg.

CONCLUSIONS

Out of four heavy metals (chromium, copper, lead and zinc) studied, mean concentration of three heavy metals (chromium, copper and zinc) were below the Maximum permissible limit (MPL) prescribed by (FSSA, 2011) except lead which had relatively higher concentrations in all three tissues of cattle. Besides, a few individual samples of liver, muscle and kidney had higher concentration of copper and zinc indicating the needs for more care in animal husbandry to produce heavy metal residue free meat. This might be due to exposure of animals to air pollution for longer periods where they accumulated lead as automobile exhaust contains leaded gas and particulate lead, etc.

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APPENDICES

Table 1: Plan of Work for the Collection of Samples from Three Different Places in Puducherry

Sl. No.:	Name of Sample Collection Places	Name/Number of the Sample			Total
		Muscle	Liver	Kidneys	
1.	Puducherry municipality (Slaughter house)	4	4	4	12
2.	Oulgarat (Slaughter house)	4	4	4	12
3.	Sederapet (road side shop)	4	4	4	12
Grand Total =					**36**

36x 3 phases = 108 samples

Table 2: Parameters for Elemental Measurements by Atomic Absorption Spectrophotometer (AAS)

Element (S)	Wavelength (Nm)	Slit Width (Nm)	Flame	Concentration On Check	Sensitivity
Chromium	357.9	0.7	Air-acetylene	4.0	200µl/50ml
Copper	324.8	0.7	Air-acetylene	4.0	200µl/50ml
Lead	283.3	0.7	Air-acetylene	20	200µl/50ml
Zinc	213.9	0.7	Air-acetylene	1.0	200µl/50ml

Table 3: The Range of Heavy Metals Viz., Chromium, Copper, Lead and Zinc in Muscle, Liver and Kidney Samples of Cattle

Element (s)	Organs		
	Muscle	Liver	Kidneys
Chromium	0.60-3.10	0.23-3.40	0.90-3.50
Copper	0.29-1.90	0.90-43.30	1.20-3.54
Lead	2.00-5.42	2.00-7.00	1.99-5.38
Zinc	25.32-58.41	32.31-59.71	16.56-29.11

Table 4: Mean ± S.E of Heavy Metals Viz., Chromium, Copper, Lead and Zinc Content (Ppm) in Muscle, Liver and Kidneys of Cattle

Element (S)	Organs		
	Muscle	Liver	Kidneys
Chromium	1.55±0.15	1. 34±0.18	1.77±0.17
Copper	0.74±0.08[b]	6.3±1.69[a]	2.51±0.17[b]
Lead	3.96±0.23	3.47±0.26	3.52±0.26
Zinc	34.80±2.38[b]	42.41±1.98[a]	22.78±0.76[c]

[abc] Means with different superscripts in a row differ significantly ($p<0.05$)