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Cadmium Concentrations in Beef Consumable Tissues in Relation to Age of Animals and Area of Their Breeding

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Heavy metals are among the most dangerous forms of pollutants that have a tendency to accumulate in tissues and organs of animals, as well as in humans.

Cadmium (Cd) is one of the most toxic metal and every day new data on its toxicity are coming in. When a non smoker individual is not exposed to Cd at its occupational environment it is received only by means of air, water and food of plant or animal origin. Animals including cattles are polluted in the same manner.

Having all these in mind, we undertook a research programme on the measurement of Cd levels in beef muscle, liver and kidney from animals that grew up in rural and metalliferous areas of northern Greece. The results were correlated with the age of animals and the area of their breeding. The aim of this study was to protect public health from consuming polluted with Cd beef tissues.

MATERIALS AND METHODS

Biological samples analyzed were beef muscle, liver and kidney and the total number was 340. Specimens were grouped into three groups according to the age of animals : a. Between 10-18 months of age; b. Between 18 months-6 years; c. Between 6-13 years.

Sampling took place in two different areas of northern Greece : a rural free from industries and mines and a metalliferous with mines. The main ore of this area is

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sphalerite and Cd concentration in it ranges between 0.1-0.6 % w/w.

For the analysis, twenty grams of tissue were homogenized and wet digested with nitric and sulphuric acid. PH value was adjusted to 4 with ammonium hydroxide. Cd was extracted in APDC-MIBK and measured at 228.8 nm at a flame atomic absorption spectrometer (Friberg et al, 1974).

RESULTS AND DISCUSSION

Cadmium levels in samples are listed in tables 1-4.

Table 1. Mean Cd concentrations (mg/kg wet weight) in muscle, liver and kidney.

Tissue	N*	X**	Range	SD***
Muscle	118	0.07	0 - 0.49	0.08
Liver	129	0.17	0 - 0.63	0.16
Kidney	93	0.62	0.09 - 3.68	0.64

N* = Number of specimens
X** = Mean value of measurements
SD*** = Standard deviation

Table 2. Mean Cd concentrations (in mg/kg wet weight) in beef tissues from metalliferous and rural area.

Tissue	Area					
	Metalliferous			Rural		
	N	X	SD	N	X	SD
Muscle	56	0.10	0.10	62	0.05	0.04
Liver	67	0.21	0.17	62	0.13	0.13
Kidney	58	0.70	0.71	35	0.50	0.51

Cadmium mean concentrations in beef tissues from all animals of the two areas, varied between 0.07-0.62 mg/kg. The range of the muscle was 0-0.49, for the liver 0-0.63 and for the kidney 0.09-3.68 mg/kg (table 1). The highest mean concentration (0.62 mg/kg) was obtained in the renal tissue since kidney is the target organ that accumulates mainly toxic heavy metals in

Table 3. Mean Cd concentrations(mg/Kg wet weight) in beef tissues in relation with age of animals.

Tissue	Age								
	10 - 18 months			1.5 - 6 years			6 - 13 years		
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD
Muscle	51	0.05	0.04	46	0.07	0.05	21	0.13	0.15
Liver	60	0.13	0.12	47	0.18	0.16	22	0.25	0.21
Kidney	46	0.45	0.32	33	0.49	0.30	14	1.52	1.16

Table 4. Correlation of area and age to mean Cd concentrations (mg/Kg wet weight) in beef tissues.

Tissue	Metalliferous area						Rural area					
	10-18 months		1.5-6 years		6-13 years		10-18 months		1.5-6 years		6-13 years	
	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
Muscle	28	0.06	22	0.10	6	0.29	23	0.04	24	0.03	15	0.07
Liver	37	0.16	24	0.22	6	0.51	23	0.08	23	0.15	16	0.16
Kidney	31	0.51	22	0.55	5	2.53	15	0.34	11	0.36	9	0.96

mammalian organisms.

The area where beef grow up, plays a significant part in their contamination with Cd (Wixson and Gale, 1977; De Voogt, et al, 1980; Tsalev and Zaprianov, 1983; Van Bruwaene, et al, 1984). The levels of Cd in all tissues of animals growing in the metalliferous area were much higher than those of the rural ones. Particularly, beef muscle from the metalliferous area had a mean cocentration of 0.1 mg/kg while that of the rural 0.05 mg/kg. Mean liver and kidney concentrations from the metalliferous area were 0.21 and 0.70 mg/kg respectively, while that from the rural 0.13 and 0.50 mg/kg respectively (table 2).

Cd concentrations in beef tissues increase with the age of animals. This has been mentioned by other investigators (Underwood, 1977; Von Agthe and Dickel, 1980; Andersen and Hansen, 1982). Particularly, mean concentration in muscle of animals between 10-18 months of age, was 0.05 mg/kg, while at the age of 6-13 years, it was 0.13 mg/kg. In liver the concentration increased from 0.13 to 0.25 mg/kg and in kidney from 0.45 to 1.52 mg/kg (table 3).

Correlation between area and age showed higher Cd concentrations in tissues of animals from the metaliferous area and at the age of 6-13 years (table 4). These concentrations (0.29, 0.51 and 2.53 mg/kg for muscle, liver and kidney respectively) exceed limits proposed by Germany (Von Agthe and Dickel, 1980; Andersen and Hansen, 1982; Fytianos, 1983).

On the contrary, the corresponding concentrations from the rural area are much lower than those from the metalliferous and anyway, lower than the previously proposed ones.

Finally, it can be said that consumption of kidney from aged beef especially those growing in areas cotaminated with Cd should be avoided.

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