

Lead and Cadmium Concentrations in Livestock Bred in Campania, Italy

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In recent years the industrial, agricultural and zootechnic development has been responsible for the diffusion of many chemical substances in the environment causing the pollution of rivers, lakes, seas, and coasts, soil and atmosphere. Among the various aspects of the environmental pollution special attention must be directed to heavy metals, which show a remarkable tendency to accumulate in tissues and organs of animals and humans. Particularly, lead and cadmium are of great concern when one considers that the variety of their uses have increased their level in the environment and that they have been identified as the causes of several clinical problems. Since heavy metals may be used as indicators of industrial contamination, the Italian Ministry of Health started a research program concerning the lead and cadmium levels in meat, cow's milk and eggs produced by Italian livestock and in wellwater, local and industrial feedstuffs employed in their breeding. This is the object of the present study carried out in the Campania province.

MATERIALS AND METHODS

Meat sampling was carried out in 15 farms representing 5 Campania districts, selecting 30 beef, 30 pork and 30 lamb specimen for slaughter. Muscle, liver and kidney samples were obtained from each animal immediately after slaughtering.

20 cow's milk samples were collected in dairy farms, and 20 egg samples in poultry farms.

The industrial and local feedstuffs (hay, lucern, maize, bran, bean leaves, etc.) and wellwater samples employed in animals breeding were collected in all the considered farms.

Homogenized tissues (10 g), cow's milk (100 g) and whole edible egg contents were previously lyophilized, while 10-20 g of suitably triturated animal feedstuffs were dried in an air-forced ventilation oven at 105°C overnight. Dry samples were gradually ashed by increasing temperature from 200°C to

450°C at 50°C/hour. Ashes were dissolved in about 2 ml of hot 10% HNO₃, making, after cooling, the volume to 10 ml with deionized water. The acid solutions were filtered and analysed for Pb and Cd contents by atomic absorption spectroscopy.

Water samples were analysed according to the Standard Methods for lead and cadmium determination in natural waters (APHA, 1985).

Data are presented as mean (\bar{x}); standard deviation (S.D.) and range in brackets.

RESULTS AND DISCUSSION

Lead and cadmium contents in analysed samples are listed in Tables 1-3. Lead mean concentrations in beef tissues varied between 0.147 and 0.573 mg/Kg; in pork tissues between 0.190 and 0.511 mg/Kg and in lamb between 0.226 and 0.696 mg/Kg. Cadmium mean levels in beef were from 0.038 to 0.342 mg/Kg, in pork from 0.048 to 0.666 mg/Kg and in lamb tissues from 0.178 to 1.035 mg/Kg (Table 1). The highest concentrations of metals were obtained in renal tissue, since the kidney is the organ that mainly accumulates toxic heavy metals in mammalian organisms. Pb and Cd levels in liver were also higher than in muscle tissues . In lambs we obtained the highest absolute levels of lead and cadmium.

Lead and Cadmium mean amounts were 0.210 and 0.023 mg/Kg in the eggs; 0.241 and 0.021 in cow's milk.

Considering lead and cadmium contents in feedstuffs (Table 3) it is possible to remark that in the local agricultural feeds the Pb mean level was 2.167 mg/Kg and the range 0.050-10.000 mg/Kg, the Cd mean value amounted to 0.498 mg/Kg in a range between 0.060 and 17.857 mg/Kg , while the industrial products showed lower contents of contaminants .

In the wellwater samples (Table 3) Pb and Cd levels were constantly lower than the established European limits for drinking water (Pb 0.05 mg/l ; Cd 0.005 mg/l) .

As a comment on these results we observe that the lead contents in beef and lamb were lower than those found in other Italian provinces , while concentrations in pork tissues, in cow's milk, in eggs and in the local forage were similar (Renon & Cantoni, 1977; Baldini et al., 1984; Cattaneo & Balzaretto, 1984). Pb levels in meats are moreover lower than those found by Belgian researchers in animals from the Liegi district (Noirfalise & Fouassin, 1980) . On the contrary , in the U.S.A., Pb levels found in beef, cow's milk and eggs are very lower than ours, while those in pork meat are similar (Jelinek, 1982) .

These differences could be explained considering that in many Italian provinces , including Campania, there are a lot of small

Table 1 . Pb and Cd levels in beef,pork and lamb tissues from Campania farms (ng/Kg wet weight)

SPECIES SPECIMEN		Pb				Cd							
N.		Muscle		Liver		Kidney		Muscle		Liver		Kidney	
		\bar{x}	S.D.	\bar{x}	S.D.	\bar{x}	S.D.	\bar{x}	S.D.	\bar{x}	S.D.	\bar{x}	S.D.
30	BEEF	0.147 (0.030-0.400)	0.116 (0.100-1.600)	0.405 (0.100-1.600)	0.365 (0.200-2.600)	0.573 (0.200-2.600)	0.491 (0.020-0.120)	0.038 (0.020-0.120)	0.020 (0.038-0.320)	0.119 (0.038-0.320)	0.081 (0.060-0.900)	0.342 (0.060-0.900)	0.253 (0.060-0.900)
30	PORK	0.190 (0.040-0.500)	0.133 (0.200-0.600)	0.357 (0.200-0.600)	0.131 (0.200-1.200)	0.511 (0.200-1.200)	0.258 (0.010-0.095)	0.048 (0.010-0.095)	0.025 (0.066-0.500)	0.199 (0.066-0.500)	0.122 (0.056-1.600)	0.666 (0.056-1.600)	0.536 (0.056-1.600)
30	LAMB	0.226 (0.050-0.400)	0.132 (0.300-0.880)	0.537 (0.300-0.880)	0.219 (0.300-1.430)	0.696 (0.300-1.430)	0.361 (0.035-0.690)	0.178 (0.035-0.690)	0.215 (0.058-0.390)	0.219 (0.058-0.390)	0.109 (0.080-3.000)	1.035 (0.080-3.000)	1.005 (0.080-3.000)

Table 2 . Pb and Cd levels in cow's milk and in eggs from Campania farms (mg/Kg)

SAMPLES		Pb		Cd	
	N.	\bar{x}	S.D.	\bar{x}	S.D.
MILK	20	0.241 (0.200-0.300)	0.049	0.021 (0.020-0.025)	0.002
EGG	20	0.209 (0-0.400)	0.134	0.024 (0-0.036)	0.013

Table 3 . Pb and Cd levels in local and industrial feedstuffs (mg/Kg wet weight) and in wellwater (mg/l) employed in Campania livestock breeding

SAMPLES		Pb		Cd	
	N.	\bar{x}	S.D.	\bar{x}	S.D.
LOCAL FEEDSTUFFS	15	2.167 (0.050-10.000)	2.410	0.498 (0.060-17.857)	0.544
INDUSTRIAL FEEDSTUFFS	20	0.889 (0-6.000)	0.699	0.180 (0.025- 1.260)	0.113
WELL WATER	10	0.017 (0-0.044)	0.021	0.002 (0-0.005)	0.002

farms where the use of local forage is prevalent, so the livestock lead ingestion may be uncontrolled and is closely related to the intensity of local road traffic and industrialization (Toscano, 1985).

Also Cd levels found in beef samples are lower than those from other Italian provinces ,particularly from Emilia-Romagna, one of the most industrialized Italian provinces (Dazzi et al.,1982). Moreover , as observed about the Pb feedstuffs contamination , the Cd concentrations of local forage are quite high and , consequently , the highest levels of Cd and Pb have been shown by lambs , that are fed mainly by free pasture.

For recent European and U.S. publications about Cd levels in livestock and feedstuffs are not available or refer rather old data (Drury & Hammons , 1979 ; Travis & Etnier , 1982 ; Laugel & Gretz , 1984) , it is not possible to do any significant comparison .

The above mentioned results show that in Campania the grade of Pb and Cd environmental pollution is quite lower than in other Italian provinces , nevertheless the magnitude of contamination of some local forage appears to justify a watchful eye being kept particularly in reducing the employment of uncontrolled feedstuffs in livestock breeding .

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REFERENCES

- APHA (1985) Standard methods for the examination of water and wastewater, 15th Edition. Washington. D.C.
- Baldini M, Coni E, Guidotti M, Stacchini P (1984) Contaminazione da Pb negli alimenti nella provincia di Roma. Riv Soc Ita Sci Alim 13:145-150.
- Cattaneo P, Balzaretti C (1984) Livelli attuali di Piombo e Cadmio negli alimenti. Ind Alim 23:771-780.
- Dazzi G, Madarena G, Campanini G, Maggi E (1982) Contaminazione da Cadmio nelle carni. Ig Mod 78:285-300.
- Drury JS, Hammons AS (1979) Cadmium in Foods . A Review of the World's Literature . Office of Toxic Substances , U.S. Environmental Protection Agency , Washington. D.C.
- Jelinek CF (1982) Levels of lead in the United States food supply. J Assoc Off Anal Chem 65:942-946.
- Laugel P, Gretz HM (1984) Situation actuelle du cadmium comme contaminant alimentaire. Ann Fals Exp Chim 77:343-355.
- Noirfalise A, Fouassin A (1980) Contribution à l'étude de la contamination de la chaîne alimentaire par le cadmium et par le plomb. Arch Belges Med Soc et Hyg 38:237-245.
- Renon P, Cantoni C (1977) Ricerca sul contenuto di Pb nel mangime e suoi livelli nei tessuti di galline ovaiole. Arch Vet Ita 28:49-51.
- Toscano M (1985) Agricoltura e Alimentazione. In: Istituto IPSOA (ed.) Annali dell'Economia Italiana (Vol. XIV). Italia, Milano, p.13
- Travis CC, Etnier EL (1982) Dietary intake of cadmium in the United States : 1920-1975. Environ Res 27:1-9.

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