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# Effects of Environmental Cadmium Pollution in Fattening of Veal Calves

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An important source of cadmium exposure to dairy cattle is supposed to be the feed. It was shown that grazing dairy cattle in the Dutch region De Kempen, an area with a well documented cadmium pollution, experience a higher cadmium body burden than animals from other areas (Spierenburg et al. 1988; Wentink et al. 1988; Kessels et al. 1990; Copius Peereboom-Stegeman and Copius Peereboom 1989).

For veal calves in this area however the situation is expected to be quite different because these calves are fattened with a milk replacer only. In general neither the calves used for fattening nor the milk replacer originate from the area where the calves are fattened. The constituents for milk replacer production are trade products, mixed by specialized companies that get their raw materials from all over the world. The calves are bought on arbitrary auction markets in The Netherlands. It was observed that the frequency of severe iron deficiency anaemia in veal calves raised in the region De Kempen was very high early in the fattening period already (Wensing et al. 1986). In addition it was found that large amounts of iron could be supplied to the calves without there being to red meat at slaughter. These two observations indicate effects on iron absorption and iron utilization which result from cadmium either absorbed with food or dust in the stables or inhaled with the air.

The aim of this study was to examine whether veal calves in the region De Kempen, in spite of the origin of both milk replacer and calves, are still subject to the cadmium polluted environment. Therefore liver and kidney samples were collected from calves fattened in De Kempen as well as from control calves fattened elswhere in The Netherlands in a non cadmium polluted area. Cadmium, zinc, copper and iron were determined in all samples. All calves were raised using milk replacer supplied by one and the same company.

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## MATERIALS AND METHODS

Liver and kidney samples from Dutch veal calves, bought arbitrary at auction markets in The Netherlands and fed the same milk replacer that was produced from raw materials that originated from all over the world, were collected at slaughter. The calves were raised in Cd contaminated regions (De Kempen, three farms and Baarle Nassau, two farms) and in a non Cd contaminated control region (De Veluwe, two farms). All calves were housed in individual wooden pens and fattened in accordance with the same feeding regime and management. Calves were fed the same milk replacer and as the fattening period was identical in all fattening units, the amount of milk replacer consumed during the fattening period was the same. The milk was always prepared using tap-water containing less than 0.2 ppb cadmium and thereby meeting the Dutch statutorial requirements for drinking water.

The collected samples were analysed immediately for metal contents or stored at -24°C until analysis was performed. The analytical procedure started by cutting small pieces of about two grams from the organs. Pieces from the kidneys always were taken from the outmost parts of the organs while liver slices were taken from more central parts. Next the pieces of tissue were dried in a stove at 110°C for 16 hours. Small crumbs were cleaved from the dried material and using a micro balance dry weight portions around 20 mg. (exact weights registrated) were transferred to teflon tubes with screw caps. The dry tissue crumbs then were destructed in 1 ml 70% nitric acid for 16 hours during which the teflon tubes were placed in a water bath set at 70°C. After destruction the samples were diluted with distilled water to final volumes of 10 ml. The metal concentrations of the destruate were determined by means of atomic absorption spectrometry. For cadmium the graphite oven technique was used on an Instrumentation Laboratory model Video 12 A.A.S. while zinc, iron and copper were determined with the flame technique using a Perkin-Elmer A.A.S. model 305B. All samples were determined in fourfold. The results were calculated as nanograms metal per gram dry matter and the "one way AOV" test (computer program Statistix) was used for evaluation of the data.

## RESULTS AND DISCUSSION

Fattening results were the same in all five fattening units and there was no significant difference in the frequency that ilness occurred. In The Netherlands supplementation with iron, of calves having a too low blood hemoglobin concentration during the first eight weeks of the fattening period, is part of the management in veal calf fattening (Wensing and others 1986). In that respect both the number of calves that have been supplied with extra iron ($FeSO_4.7H_2O$) and the amount of iron that had to be supplemented were somewhat higher in fattening units located in the cadmium contaminated area. The iron, copper, zinc and cadmium contents of liver samples are presented in table 1. Cadmium, zinc as well as iron contents appeared to be statistically significant higher in the livers of calves fattened in the cadmium polluted area. The extra iron supplementation to calves in the cadmium contaminated regions probably caused the increased liver iron content. The copper contents of livers from the polluted area was also higher but this was found not to be statistically significant.

Table 1. Cadmium, zinc, copper and iron content (ng per g dry matter) in liver samples. $p < 0.05$ means that the difference is statistically significant.

| metal | control area ( n = 42 ) | Cd contaminated area ( n = 98 ) | p value |
|---|---|---|---|
| cadmium | 342.3 ± 25.2 | 413.9 ± 15.6 | 0.015 |
| zinc | 220.6 ± 55.6 | 303.1 ± 7.8 | 0.000 |
| copper | 1145 ± 63.7 | 1208 ± 32.6 | 0.329 |
| iron | 55.8 ± 1.8 | 69.0 ± 2.4 | 0.001 |

In the kidneys (Table 2) higher cadmium and zinc contents were found in samples from calves raised in the cadmium polluted area. Only for cadmium the higher kidney values appeared to be statistically significant. Finally the copper contents of kidneys originating from the cadmium polluted area appeared to be statistically significant lower than copper contents of kidneys from the control area.

Table 2. Cadmium, zinc, copper and iron content (ng per g dry matter) in kidney samples. $p < 0.05$ means that the difference is statistically significant.

| metal | control area ( n = 42 ) | Cd contaminated area ( n = 98 ) | p value |
|---|---|---|---|
| cadmium | 2313 ± 118.3 | 3098 ± 137.1 | 0.001 |
| zinc | 156.3 ± 6.2 | 165.7 ± 4.4 | 0.234 |
| copper | 46.4 ± 6.8 | 27.4 ± 1.3 | 0.000 |
| iron | 95.9 ± 1.8 | 93.6 ± 1.6 | 0.432 |

The results obtained demonstrate that, in spite of the fact that all calves received the same milk replacer, the liver and kidney cadmium concentration is higher in the calves raised in the cadmium contaminated area. The finding that the zinc concentration in liver and kidneys of these calves is higher too, supports the supposition that both metals originate from the same source, the local zinc refining industry. These observations, and the fact that all calves originated from all over The Netherlands, indicate that the calves in the contaminated area are able to absorb or inhale cadmium and zinc from the environment. Taking into account the fact that the calves are fattened for a period of about six month only makes the observed differences in liver and kidney cadmium content even more striking.

The observation that the increase in cadmium content is most obvious in the kidneys is in accordance with earlier findings (Spierenburg et al.1988; Wentink et al.1988). In rats it was demonstrated that cadmium interferes substantially with iron absorption (Schafer and Forth 1984; Huebers et al. 1987). Obviously the increased cadmium and zinc absorbtion of the calves fattened in the contaminated area has a negative effect on iron absorbtion and thus results in the more frequent observed iron deficiency anaemia in the region De Kempen (Wensing et al. 1986) In future research attention has to be paid to the route via which cadmium and zinc enter the calves and lead to the observed higher levels of these metals in organs of calves raised in De Kempen.

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