THE CONTENT OF LEAD IN THE LIVER OF PIGS AND CATTLE

Roy Nilsson and Kurt Kolar

INTRODUCTION.

The occurence in food of residues of different types of substances as a consequence of the activities of man is a problem of increasing importance. One type of these substances is metals and metalloorganic compounds of which mercury- and lead derivatives are the most important. But whereas the content of mercury compounds in animal products has received much attention only a few papers have dealt with the amount of lead derivatives in this type of food.

Intonti et al (1) found that muscle, liver, brain and heart from healthy cattle contained less then 1 mg lead per kg and McLean et al (2) found in USA that beef liver contained between 0.3 and 0.5 mg lead per kg. In Sweden Lundström (3) has analysed different parts of the sheep and found from 0.1 mg to 1.14 mg lead per kg.

In this paper the results are presented from an investigation into the lead content of beef, pig and reindeer.

MATERIAL AND METHODS.

The investigation was concentrated on the liver of beef cattle and pig. The livers were obtained from four slaughterhouses from different parts of Sweden. One series was analysed in the spring of 1969 another one in the autumn of 1969. Furthermore some samples of calf and reindeer liver, of beef kidney, beef muscle and pig blood were analysed.

The determination of lead was carried out by using a Perkin Elmer Atomic Absorption Spectrophotometer, model 303. Depending on the nature of the material the following pre-treatment procedures were carried out.

Blood: The protein was precipitated by adding Tritan x -100 as described by Hessel (4).

Livers: The liver was ground in a meat mincer. A wighed amount was diluted with distilled water (1:2) and homogenized with Ultra Turrax homogenizer. The protein was precipitated with trichloroacetic acid (5).

Muscle and kidney: The sample was ground twice in a meat mincer. 4-6 g of the sample was accurately weighed in a crucible and ashed at 500° (6,7).

In all cases the lead was transformed to an organic complex by treatment with ammonium pyrolidine dithiocarbamate and then extracted with methyl isobutyl ketone (4,7). This solution was analysed by measuring the atomic absorption at 2833 nm.

RESULTS AND DISCUSSION.

The results of the analyses are shown in tables 1 and 2. In all 99 samples of li-

vers from beefs and pigs were analysed. For beef liver the mean values varied from the four districts between 0.26 mg and 0.45 mg per kg, but the differences are so small that thea are of no pratical impartance. The same is valid for the differences in the mean values between the spring and autumn periods. When looking at the individual values it was found that only 9 out of 50 samples had a lead content exceeding 0.50 mg per kg and none exceeding 1 mg per kg. The highest value found was 0.92 mg per kg.

The lead content of pig liver was about the same as for beef liver, only 4 out of 49 samples had a lead content higher than 0.50 mg per kg. The highest value found was 0.88 mg per kg. There were omly minor differences in the mean values between the samples from the four slaughter houses and between the spring and autumn periods.

It is known that lead is concentrated by the organism in the liver and then excreted by the kidneys, but there is some disagreement regarding the proportion between the concentration of lead in the liver and kidney. We analysed a few samples of beef kidney and found about the same amounts as in liver (table 2).

A few analyses were also made of muscle and blood. As was expected the lead content was very low in these tissues. Beef muscle contained about 0.1 mg per kg and blood still less. (Table 2).

The lead content of the organism may originate from at least two sources. One is the natural content of lead in soil and water giving what may be called a background or minimum lead content. To obtain a measure of the amount of lead coming from this source one has to analyse samples from animals unexposed or exposed for a limited time or extent to other lead sources. As examples we used young animals such as calves but also reindeer, an animal living in the mountains in northern Sweden and therefore thought to be almost unexposed to other lead sources than soil and water.

The lead content in the liver from these animals varied between 0.12 mg and 0.26 mg per kg with an average of 0.14 mg for calf livers and 0.19 mg for reindeer liver.

Lead in excess of these amounts originate from other sources, mainly from the pollution of the atmosphere by the use of fuel for cars containing lead. The lead from this source may reach the organism in two ways, either directly through inhalation or indirectly through vegetable foodstuffs which have absorbed lead from the atmosphere. From our results it is not possible to distinguish between these two ways, but in future work attention will be paid to this problem.

That the lead content of vegetables varies with the distance from heavily used roads has been shown among other by Kloke et al (8).

That there is a certain contribution to the lead content in animal products from this source is obvious, as can be seen by comparing the values for liver in table 1 with those of calf and reindeer liver. But the concentrations obtained are nevertheless small. When evaluating the hygienic consequences of the actua lead concentrations they should be compared with the value of 3 mg per kg. the acceptable limit set by the Swedish Health Autorities. On account of this one may state that liver and other meat products do not contain a sufficient amount of lead to be a hazard to health.

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Slaughter-house	mg lead / kg						
	Kävlinge		Karlskrona		Skara		Uppsala
	spring	autumn	spring	autumn	spring	autumn	spring
Beef liver	0,20	0,24	0,32	0,28	0,42	0,44	0,32
	0,29	0,28	0,26	0,92	0,42	0,32	0,42
	0,17	0,34	0,32	0,40	0,48	0,54	0,28
	0,28	0,40	0,18	0,54	0,30	0,61	0,54
	0,38	0,20	0,36	0,22	0,50	0,36	0,32
	0,22	0,38		0,28			
	0,21	0,24		0,64			
	0,31	0,20		0,20			
	0,30	0,62		0,36			
	0,20	0,54		0,56			
MV	0,26	0,34	0,29	0,44	0,42	0,45	0,38
Pig liver	0,22	0,42	0,26	0,30	0,30	0,34	0,26
	0,18	0,32	0,28	0,20	0,37	0,72	0,32
	0,33	0,88	0,30	0,42	0,42	0,32	0,56
	0,26	0,40	0,42	0,26	0,56	0,34	0,36
	0,22	0,36	0,42	0,24	0,29	0,46	
	0,29	0,33		0,38			
	0,21	0,28		0,44			
	0,30	0,50		0,34			
	0,21	0,28		0,26			
	0,36	0,48		0,30			
MV	0,26	0,43	0,34	0,43	0,39	0,44	0,38

Table 1. Lead content in liver from cattle and pig.

Product	mg lead / kg					
Calf liver	0,13	0,16	0,13			MV 0,14
Reindeer liver	0,16	0,26	0,20	0,12		MV 0,19
Beef kidney	0,32	0,28	0,37			MV 0,32
Beef muscle	0.09	0,08	0,11	0,11	0,08	MV 0,09
Pig blood	0,06	0,07	0,06			MV 0,06

Table 2. Lead content in liver from calf and reindeer, in beef kidney, beef muscle and pig blood.