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THE EFFECT OF ETHIONINE FEEDING ON THE RETENTION OF A SINGLE PER OS DOSE OF METHYL MERCURY ON RAT*

By

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PEKKANEN, TIMO J. and KALEVI SALMINEN: *The effect of ethionine feeding on the retention of a single per os dose of methyl mercury on rat.* Acta vet. scand. 1972, 13, 319—322. — Six adult female rats were daily fed a diet containing DL-ethionine during three weeks. One daily rat dose was 30 mg of ethionine. Six similar rats, the controls, were kept on the same diet without ethionine. On the 21st day of the experiment all rats were given one dose of ^{203}Hg labeled methyl mercury by stomach tube. Each rat received 163 μg in terms of metallic mercury. Ninety hrs. after the mercury administration all rats were sacrificed and the mercury contents of the brains, livers, caudal femoral muscles, erythrocytes and blood plasma were determined. The mean plasma mercury content was significantly ($P < 0.01$) greater in the ethionine fed rats when compared to the controls.

methyl mercury retention; ethionine.

The methyl mercury compounds have a great affinity to the sulfhydryl groups of proteins and amino acids (*Bahr & Moberger 1954, Hughes 1949, 1957, Hughes et al. 1950*). The reaction is known to occur more readily with the thiol groups of reduced glutathione than with the thiol groups of proteins (*Webb 1966*).

Rats which have been fed a diet with added ethionine during three weeks show an increased reduced glutathione content of the liver (*Hsu & Geller 1967*).

The aim of the present investigation was to study the effect of a three week ethionine diet on the retention of a single per os

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dose of methyl mercury in the liver and also in the brain, muscle tissue, erythrocytes and blood plasma of the rat.

MATERIAL AND METHODS

Six adult female rats of the Sprague Dawley strain were fed a daily diet containing DL-ethionine over a period of 21 days. Six similar rats, the controls, were fed the same diet without the ethionine. The weight of the rats varied between 218 and 230 g at the end of the experiment.

Commercial rat food pellets (Orion, Helsinki, Finland) were ground and divided into portions of 12 g each. Each of these 12 g portions was mixed with 30 mg DL-ethionine (Fluka AG, Buchs SG, Switzerland), and this constituted one daily rat dose. Except for water ad libitum no other food was given to the test animals during the course of the experiment. On the 21st day of the experiment, under light ether anesthesia, all 12 test animals were given (by stomach tube) 0.5 ml ^{203}Hg labeled methyl mercury nitrate (Ab Atomenergi, Studsvik, Sweden) in 10.9 % NaCl water solution. The total mercury content of the solution was 326 μg Hg per ml. The ^{203}Hg labeled methyl mercury nitrate solution contained 25 % inorganic mercury in the form of $\text{Hg}(\text{NO}_3)_2$.

During the subsequent four days all the test animals were given commercial rat food pellets without added ethionine. On the fourth day, 90 hrs. after the mercury administration, all the test animals were sacrificed by decapitation and their brains, livers, caudal femoral muscles and whole heparinized blood were taken for determination of the ^{203}Hg content by a NaJ scintillation detector. Part of the heparinized blood was centrifuged at 3000 r.p.m. for 10 min. and the plasma thus obtained was used for ^{203}Hg determination as above. The packed cell volume of the blood was determined by the microhematocrit method.

The calculation of the erythrocyte mercury content which was obtained by subtracting the share of the plasma mercury content from the whole blood mercury content, followed the formula

$$\text{erythrocyte Hg content } \mu\text{g/ml} = \frac{100 \times \text{Hg content } (\mu\text{g/ml}) \text{ whole blood} - \text{plasma} \times \text{plasma Hg content } (\mu\text{g/ml})}{\text{packed cell volume } (\%)}$$

RESULTS

The mercury contents of the brains, livers, caudal femoral muscles, erythrocytes and blood plasma of the test animals, as calculated by their content of ^{203}Hg , are shown in Table 1.

Table 1. The effect of ethionine feeding on the retention of a single per os dose of methyl mercury in rat. The mercury concentrations are expressed on a wet weight basis in terms of metallic mercury.

	Number of animals	The mean mercury content, m. \pm s				
		brains $\mu\text{g/g}$	livers $\mu\text{g/g}$	caudal femoral muscles $\mu\text{g/g}$	erythrocytes $\mu\text{g/ml}$	blood plasma $\mu\text{g/ml}$
The ethionine fed rats	6	0.283 \pm 0.020	0.934 \pm 0.075	0.522 \pm 0.072	8.469 \pm 0.549	0.046 \pm 0.006
The control rats	6	0.294 \pm 0.024	0.972 \pm 0.090	0.491 \pm 0.032	8.631 \pm 0.658	0.040 \pm 0.004
Difference between the means		0.011	0.038	0.031	0.162	0.006
P		< 0.1 > 0.05	< 0.2 > 0.1	< 0.3 > 0.2	< 0.4 > 0.3	< 0.01 > 0.005

DISCUSSION

Ethionine fed to rats increases the reduced glutathione content of the liver and the erythrocytes. It also increases the glutathione reductase activity of the liver and decreases its ascorbic acid content (*Hsu & Geller 1967*). Little is known about the effect on the blood plasma in this respect. Since the dose of the ^{203}Hg labeled methyl mercury given per os to the rats, which were of about the same weight, was the same for all the animals, the results of the present experiments (Table 1) indicate an increased affinity of the blood plasma to bind mercury or a decreased secretion rate from the blood plasma resulting from the ethionine. The results further show that ethionine does not significantly affect the retention of mercury in the brain, liver, muscle or erythrocytes of rats given methyl mercury.

Nevertheless a small and statistically not significant decrease in the mean mercury content of the brains, livers and the erythrocytes and an increase in the mean mercury content of the muscles of the ethionine fed rats could be observed compared to the control animals.

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SAMMANFATTNING

Inverkan av etioninutfodring på retentionen av en per os dos av metylkvicksilver på råttor.

Sex fullvuxna hanrättor utfodrades dagligen under tre veckor med ett foder som innehöll DL-ethionin. Den dagliga dosen för en råttor var 30 mg ethionin. Sex likadana rättor, kontrollerna, fick samma foder utan ethionin. På den tjugoförsta dagen från experimentets början gavs alla rättor med en magsond 163 µg ²⁰³Hg märkt metylkvicksilver. Nittio timmar efter kvicksilvergivan avlivades rättorna och kvicksilverhalten i deras hjärnor, leverar, kaudala femorala muskler, röda blodkroppar och i blodplasma bestämdes. Plasmans genomsnittliga kvicksilverhalt var signifikant ($P < 0,01$) större i de med ethionin utfodrade rättorna jämfört med kontrollerna.

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