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Received May 23, 1966. P.S.E.B.M., 1966, v122.

Effects of Hydrobiotites on Sr^{89} Absorption and Deposition in Chicks.* (31376)

L. B. COLVIN, C. R. CREGER, J. R. COUCH AND M. N. A. ANSARI
Departments of Biochemistry and Nutrition and Poultry Science, Texas A & M University,† College Station

The invasion of food products by radioactive contaminants constitutes a potential health hazard; consequently, the efforts of many laboratories have been directed toward a practical means of preventing or limiting the absorption and deposition of various radionuclides. Reports have appeared in the literature concerning numerous means of limiting absorption of radionuclides from the intestinal tract(1,2,3). Based on the assumption that if the absorption of the radionuclides (radiostrontium in particular) from the gastrointestinal tract can be limited, then the radionuclide must be effectively bound in the intestinal tract and subsequently excreted.

The use of cation-binding agents, such as Amberlite IRC-50, has been shown to be partially effective in increasing the amount of radionuclide excreted(4). Vermiculite (a cation-binding agent) has been investigated in this respect and has met with varying degrees of success(4,5).

In this investigation, a highly refined vermiculite (verxite) produced by thermal exfoliation of hydrobiotite was included in the chicks' diet to determine if absorption from the gastrointestinal tract and subsequent deposition of Sr^{89} in the bones could be prevented.

Material and methods. Forty-day-old male chicks were randomly divided into 8 groups of 5 chicks each and fed a standard broiler starter diet (Texas A&M University, Poultry Research Center) supplemented with 0.25% and 1.00% commercial vermiculite (verxite) granules and flakes both untreated and acid activated with 25% (w/w) H_3PO_4. The birds were placed on the above diets 3 hours before administering the initial doses of Sr^{89}. Each chick was given 0.86 μc of Sr^{89} orally, twice daily, for 5 days, so that each bird received a total of 8.6 μc Sr^{89}. In addition one group of 5 birds was given Sr^{89} and fed a diet containing no verxite, and a final group of 5 birds served as a control and received neither Sr^{89} nor verxite.

At the end of the 5-day experimental period all birds were killed and the right and left tibiotarsus taken for analysis of Sr^{89} content by the method of Ansari *et al*(6). Total feces were collected once daily and analyzed for Sr^{89} content by the above method. All calculations were made by computers using the program of Ansari *et al*(6). To facilitate

* Supported in part by USPHS Grant RN 00354-NTN.
† Contribution of Texas Agric. Exp. Station.

TABLE I. Effect of Dietary Verxite on Deposition of Orally Administered Sr^{89} in Chick Tibiotarsus* and Total Excretion per Bird.

Treatment	Sp activity ash (μc/g ash)	% dose	μc Sr^{89} excreted	% dose excreted
Sr^{89} only	.450	1.55	5.91	68.7
Sr^{89} + .25% Verxite granules	.381	1.32	6.23	72.5
Sr^{89} + 1.00% " "	.471	1.62	5.60	65.1
Sr^{89} + .25% " " (activated)	.313	1.21	5.45	63.4
Sr^{89} + 1.00% " " "	.427	1.60	4.87	56.6
Sr^{89} + .25% " flakes	.431	1.53	5.13	59.7
Sr^{89} + 1.00% " "	.392	1.54	5.29	61.6
Sr^{89} + .25% " " (activated)	.515	1.58	5.11	59.5
Sr^{89} + 1.00% " " "	.359	1.41	5.93	68.9
Control (no Sr^{89}, no Verxite)	—	—	—	—

* Average value for 5 right and 5 left bones.

reading, a maximum of 3 significant figures was used in reporting the data, and are not indicative of the sensitivity of the experiment or the method.

Results. The specific activity (μc/g ash) and the per cent dose recovered in bone are shown in Table I. These data indicate that as the level of verxite granules, untreated or activated, was increased from 0.25% to 1.00% the amount of radiostrontium deposited in the bone was increased from 0.381 μc Sr^{89}/g ash (1.32% of total dose) to 0.471 μc Sr^{89}/g ash (1.62% of total dose) in the untreated and from 0.313 μc Sr^{89}/g ash (1.21% of total dose) to 0.427 μc/g ash (1.60% of total dose) in the case of the activated granules. As can be seen from Table I, the acid activation of the granules resulted in an insignificant reduction in the deposition of the isotope in the bone at both levels of inclusion of verxite into the diet. However, both activated and unactivated granules resulted in a higher per cent of the total dose being deposited in the bone than a diet containing no verxite.

Verxite flakes showed more favorable results than granules in reducing the Sr^{89} in bone ash. As the dietary level of verxite flakes was increased from 0.25% to 1.00% of the diet, the concentration of radiostrontium deposited in bone was reduced from 0.431 μc/g ash to 0.392 μc/g ash in the case of the untreated verxite flakes. The concentration of Sr^{89} observed in the bone of those birds receiving 0.25% acid activated flakes, which was 0.515 μc/g ash (1.53% of the dose) was actually higher than the 0.450 μc/g ash (1.55% of the dose) observed in the birds receiving Sr^{89} but no verxite. Increasing the level of activated verxite to 1% decreased the deposition of Sr^{89} to a level of 0.359 μc/g ash, which was also lower than that observed with 1.0% untreated verxite (0.392 μc/g ash).

Also shown in Table I is the total amount of Sr^{89} excreted per bird and the per cent of the dose excreted. From these data it can been seen that only in the group receiving 0.25% untreated granules was more radiostrontium excreted than in the group receiving no verxite. In the group receiving only Sr^{89} and no verxite 68.7% of the total dose of Sr^{89} had been excreted by the end of 5 days. However, in the group that received 0.25% untreated verxite granules, 72.5% of the total dose was excreted in 5 days. In all other groups less radiostrontium was excreted than in the group receiving no verxite, except the group which was given 1% acid activated flakes, which excreted 68.9% of the total dose in 5 days. The authors are unable to explain this observation.

Discussion. From these data it is difficult to justify the proposal that verxite is effective in reducing the gastrointestinal absorption and skeletal deposition of radiostrontium by means of chelation in the gut and subsequent excretion of the complex, although Sr chelation has been demonstrated *in vitro*(5).

In this study, when verxite granules were included in the diet the deposition in bone was increased as the dietary amount of verxite was increased. A possible, but perhaps unlikely, explanation for this observation is that some component of this ore was apparently absorbable and was physiologically active in increasing the deposition of the radionuclide in the skeletal structure of the chicks. An alternate explanation may be that an absorbable Sr-complex was formed similar to that reported with Sr-lactate complexes(7). These findings are in direct contrast to those reported using verxite in ruminant animals(5) using Sr^{89} and Cs^{137} and those in rats using Cs^{134} and Rb^{86}(4). The use of flakes of verxite in place of granules, however, showed an inverse relationship between the dietary amount of verxite and the deposition in the bone, although those groups receiving the lowest level of verxite flakes deposited essentially as much or more of the radiostrontium than those which received the radiostrontium but no verxite.

If radiostrontium were chelated by verxite ore and the complex formed was unabsorbable, the rate of excretion of radiostrontium would be expected to be directly proportional to the amount of dietary vermiculite supplied. However, this was not the case. In fact the opposite relationship was observed, indicating increased retention of the radioisotope as the dietary verxite was increased.

Summary. Data from an investigation of oral administration of radiostrontium (Sr^{89}) to chicks indicates that feeding either untreated or acid activated verxite, a high purity hydrobiotite, is not effective in preventing absorption and deposition of radioactive strontium in the chick.

The authors wish to express their appreciation for the technical assistance of Mrs. Jennifer Newton and Miss Sue Herbert. The verxite used in these experiments was furnished by W. R. Grace and Co., Skokie, Ill.

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Received May 23, 1966. P.S.E.B.M., 1966, v122.

An Automated Basal Metabolism Apparatus for Small Animals.* (31377)

W. H. CLINE, JR.† AND D. T. WATTS
Department of Pharmacology, West Virginia University Medical Center, Morgantown

Various devices have been described for determining the basal metabolic rate (BMR) of small animals(1,2,5). However, except for one complex apparatus(1), none of these allow the investigator to eliminate periods of stimulated oxygen consumption due to physical activity of the animal from the determination of the BMR. The system to be described allows for the detection, and therefore the elimination from the BMR calculation the increased oxygen consumption periods due to physical activity as well as other factors which influence this measurement. This apparatus automatically records oxygen consumption, respiratory rate and physical activity using equipment which is readily available in many laboratories. The method is based on the principle that oxygen consumption is proportional to the decrease in pressure in a closed system(2). An equilibration device returns the internal pressure to atmospheric at approximately one-

* This investigation was supported in part by a Nat. Inst. of General Med. Sciences Grant 5 T1 GM 76-05 and by Nat. Inst. of Mental Health Grants 5 RO1 MH 05972-04.

† Present address: Dept. of Pharmacology, Univ. of Missouri Med. Center, Columbia.