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The effects of citrates, malates and phosphates upon the calcium balance and the calcium content of the blood.

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Most of the literature concerning the action of the citrates, malates, phosphates deals with the toxicity, tolerance, excretion and cumulative effects of these substances. The experiments briefly presented in this paper were carried out to ascertain whether the repeated administration of various acid radicals, commonly classified as "calcium precipitants," would, (1) result in a permanent decrease of the calcium content of the blood and, (2) if the calcium balance would be affected in any way.

Rabbits receiving a calcium-rich diet (daily intake of 0.44–1.24 gm. of Ca¹ were used as experimental animals. The calcium balance was determined at weekly intervals; the calcium content of the whole blood and plasma at intervals of 3–7 days.

CITRATES

Five rabbits received 5–45 daily (subcutaneous) injections of 0.26–1.23 gm. per kg. of one of the following: tri-sodium, tri-potassium, di-sodium citrate and citric acid. The experiments show that all of the animals maintained a highly positive balance and that there were no abnormal variations in the calcium content of the blood. On the first day of the injection period one animal received (during 1½ hours) two subcutaneous doses (50 c.c. each) of 4 per cent tri-sodium citrate. Thirty minutes after the second dose the plasma showed a decrease of 14 per cent. in its calcium content. Four days later the same animal received two doses (50 and 55 c.c.) of the same solution of sodium citrate. Thirty minutes after the first injection the plasma showed a decrease of 16 per cent. in its calcium content. Autopsy was performed on three of the animals and no macroscopic lesions of the urinary system were found. Polyuria was a usual result—definite diuresis was observed in only one case.

¹ See under Phosphate for exceptions.

MALATES.

Two rabbits received 12-33 daily doses (subcutaneous) of 0.16-1.10 gm. per kg. of 4 per cent. di-sodium malate. Both animals maintained a highly positive calcium balance. No abnormal variations in the calcium content of the blood were observed. Autopsy of one animal showed no macroscopic lesions of the urinary system.

PHOSPHATES.

Four rabbits received 5-34 daily doses (subcutaneous) of 0.16-0.51 gm. per kg. of 4 per cent. di-sodium phosphate. All of these animals maintained a highly positive calcium balance even though two of them were on a much lower calcium intake. (Rabbit No. 5, 0.13-0.16 gm. Ca per day; Rabbit No. 10, 0.17-0.31 gm. Ca per day.) Five days after receiving the first injection of phosphate, Rabbit No. 5 showed a decrease in the calcium content; 35 per cent. in whole blood and 28 per cent. in the plasma. Six days after receiving the first phosphate injection, Rabbit No. 10 showed a marked decrease in the calcium content of blood (23.0 per cent.) and plasma (30 per cent.). The average of 8 determinations during the injection period (35 days) showed a decrease in the calcium content of 20 per cent. in whole blood and 26 per cent. in plasma.

An intermittent albuminuria was observed in all animals receiving phosphates.

SUMMARY.

1. Repeated subcutaneous injections of citrate, malate or phosphate have no effect on the calcium balance of animals receiving a calcium-rich diet.
2. The calcium content of the blood may be temporarily decreased by the injection of large doses of citrate.
3. Animals on a low calcium intake may, after phosphate injection, exhibit a decrease of 20-26 per cent. in the calcium content of the blood and still maintain a positive calcium balance. This observation emphasizes the suggestion that animals may adjust themselves to different "calcium levels" just as is true of nitrogen.