UCRL 2674

UNIVERSITY OF CALIFORNIA

# Radiation Laboratory

## PURIFICATION OF MILK FOR CALCIUM AND STRONTIUM WITH DOWEX-50 W RESIN

TWO-WEEK LOAN COPY

*This is a Library Circulating Copy which may be borrowed for two weeks. For a personal retention copy, call Tech. Info. Division, Ext. 5545*

**DISCLAIMER**

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

UCRL-2674
Health and Biology Distribution

UNIVERSITY OF CALIFORNIA

Radiation Laboratory
Berkeley, California

Contract No. W-7405-eng-48

# PURIFICATION OF MILK FOR CALCIUM AND STRONTIUM WITH DOWEX-50 W RESIN

W. E. Nervik, M. I. Kalkstein and W. F. Libby

August 12, 1954

Printed for the U. S. Atomic Energy Commission

# PURIFICATION OF MILK FOR CALCIUM AND STRONTIUM WITH DOWEX-50 W RESIN

W. E. Nervik, M. I. Kalkstein and W. F. Libby*

Radiation Laboratory
University of California, Berkeley, California

August 12, 1954

## ABSTRACT

Purification of milk for radiostrontium by treatment with Dowex-50 W resin in the sodium form, both by a column and a bulk technique, has been shown to be effective. Nearly 90 percent of the tracer isotopes of both calcium and strontium have been removed. Spectrographic analysis shows exchange to have been essentially complete since the bulk calcium present in the milk had been removed to about the same percentage.

* Present address: Institute for Nuclear Studies, University of Chicago, Chicago, Illinois.

# PURIFICATION OF MILK FOR CALCIUM AND STRONTIUM WITH DOWEX-50 W RESIN

W. E. Nervik, M. I. Kalkstein, and W. F. Libby*

Radiation Laboratory
University of California, Berkeley, California

August 12, 1954

## I. INTRODUCTION

The occurrences of radioactive strontium in milk at a level of about 2 Sunshine units (1 Sunshine unit = 2.2 disintegrations per minute of $Sr^{90}$ per gram of calcium) has led Professor Wendell M. Latimer[1] to suggest that ion-exchange resins might be used to remove the alkaline earths from milk. This would result in the removal of the radiostrontium. Following the purification the calcium content of the milk could be restored by addition of nonradioactive calcium gluconate or some other appropriate calcium salt.

## II. PROCEDURE

About 10 million disintegrations per minute of $Ca^{45}$ (620,000 counts per minute on a nearly carrier-free basis in an end-window counter on shelf 1) and about 10 million disintegrations per minute of $Sr^{90}$ freshly purified of its yttrium daughter (875,000 counts per minute on a weight-free basis in the same end-window counter on shelf 1) were added to 100 cc portions of commercial milk samples--Golden State homogenized Vitamin D fortified milk purchased at the Seven Palms Food Center, 1801 Euclid, Berkeley, California on August 9, 1954. Four samples were prepared; one containing $Ca^{45}$ only, the next containing $Sr^{90}$ only, the third containing both $Ca^{45}$ and $Sr^{90}$, and the fourth was used as a control. Columns 13 mm in diameter were filled with 13 cc Dowex-50 W resin (weighing 16 gm when wet), 200-400 mesh, in the sodium form. As filled, the columns each contained about 4 cc

* Present address: Institute for Nuclear Studies, University of Chicago, Chicago, Illinois.

of wash water. The 100-cc portions as noted were passed through the columns at a rate of about 1 cc per minute under about 1 atmosphere of excess pressure. It was found necessary to apply the excess pressure since the rate of flow of milk through the column was very much less than that observed for pure water. The purified milk was collected in 10-cc portions and a final 10 cc of wash water was added at the end. This resulted in 11 10-cc samples which were counted by the evaporation of 0.1-cc portions taken from each sample. The evaporation was performed on flat aluminum dishes of 1 $cm^2$ area by means of infrared lamps. The samples were counted on the first shelf of a standard end-window counter. The geometry factor was about 0.1. The window of the counter was 3.5 $mg/cm^2$ in thickness and the sample was about 4 or 5 mm from the window. Results of the treatment of the purification by the column technique are given in Table II and in Figure 1. Table I gives the data on the milk samples used for the experiment.

The effectiveness of treating the milk with resin in bulk as possibly a simpler method of purification was tried. A 10-cc portion of wet resin was added to 100 cc of milk containing the same amount of $Ca^{45}$ as the sample used in the column test. The mixture was stirred vigorously with a laboratory stirrer for 15 minutes at room temperature. It then was allowed to settle and 0.1-cc portions of the supernatant milk were removed and counted as described above. The data are given in Table III.

A check was made for the presence of $Ca^{45}$ on the resin used in the column purification of the $Ca^{45}$ milk solution. An area of 1 $cm^2$ of wet resin was counted in the same aluminum counting vessels used for the other samples. The count rate observed was 411 ± 13 counts per minute. Since the reciprocal of the absorption coefficient for the $Ca^{45}$ beta ray is about 10 $mg/cm^2$ the total $Ca^{45}$ contained on the resin (total weight of the resin, 16 gm) was calculated by multiplying the observed count by the ratio 16 gm to 10 mg. The result is 660,000 counts per minute, in good agreement with the total $Ca^{45}$ added to the milk.

The fractions obtained in the $Ca^{45}$ column purification were assayed spectrographically by J. G. Conway and R. D. McLaughlin for calcium content. The data are given in Table IV and in Figure 2. These data show the total calcium to have been removed to nearly the same extent as the tracer was. We conclude, therefore, that the tracer $Ca^{45}$ exchanged with most of

the calcium present in the milk. Presumably this would be true of the $Sr^{90}$ tracer also.

## III. CONCLUSION

It appears from the cursory data obtained in this preliminary test of the possibility of purifying milk by ion exchange resin that both calcium and strontium are relatively completely removed in either a bulk treatment or the more standard column treatment. The data on the bulk treatment indicate that at least 90 percent of the calcium is removed, and similar conclusions are to be drawn from the column data.

These results are sufficiently encouraging to warrant further laboratory study with other resins and other conditions, and possibly the institution of an engineering study which will give cost estimates for such purification procedures.

This work was done under the auspices of the U. S. Atomic Energy Commission.

---

1. Wendell M. Latimer, private communication (July 22, 1954).

Table I

Count Rates for Radioactive Milk Samples and Amounts of $Sr^{90}$ and $Ca^{45}$ Added

A. Amounts of Isotopes Used

| | |
|---|---|
| $Ca^{45}$ | 620,000 cpm*/100 cc |
| $Sr^{90}$ | 875,000 cpm*/100 cc |

B. Count Rates for Untreated Radioactive Milk Samples

| | | |
|---|---|---|
| $Ca^{45}$ | (0.1 cc of milk evaporated to give about 10 mg of solids on 1 $cm^2$ of area. Self-absorption 37 percent.) | 407 ± 13 cpm |
| $Sr^{90}$ | (0.1 cc of milk evaporated to give about 10 mg of solids on 1 $cm^2$ of area. Self-absorption 21 percent.) | 777 ± 18 cpm |
| $Ca^{45} + Sr^{90}$ | (0.1 cc of milk evaporated to give about 10 mg of solids on 1 $cm^2$ of area. Self-absorption 21 percent.) | 1239 ± 22 cpm |

* Carrier-free. Calculated from activities of carrier-free solutions added to the milk samples. Window (3.5 $mg/cm^2$) absorption was 29 percent. Shelf 1 end window counter, approximately 10 percent geometry.

± Carrier-free. Window absorption 14 percent. $Y^{90}$-free. Shelf 1 end window counter, approximately 10 percent geometry.

Table II

Count Rates for Column Resin Purified Radioactive Milk Samples

(13 cc Dowex-50 W; 200-400 mesh; sodium form; 13 mm column diameter; 16 gm wet)

| Purified milk fractions | Counts per 0.1 cc (Evaporated to give about 10 mg on 1 $cm^2$) | | |
|---|---|---|---|
| | $Ca^{45}$ | $Sr^{90}$ | $Ca^{45} + Sr^{90}$ |
| Original | 407 ± 13 cpm | 777 ± 18 cpm | 1239 ± 22 cpm |
| 0-10 cc (about 4 cc wash water) | 0.8 | 2.0 | 2.4 |
| 10-20 | 2.5 | 1.6 | 8.4 |
| 20-30 | 0.0 | 2.9 | 27.2 |
| 30-40 | 3.7 | 25.8 | 53.4 |
| 40-50 | 6.8 | 31.0 | 155.2 |
| 50-60 | 13.0 | 49.7 | 128.8 |
| 60-70 | 21.6 | 62.2 | 125.6 |
| 70-80 | 26.6 | 81.4 | 124.0 |
| 80-90 | 32.9 | 86.8 | 149.0 |
| 90-100 | 49.7 | 98.1 | 178.0 |
| 100-110 (about 6 cc wash water) | 3.1 | 47.4 | 53.8 |

Table III

Count Rates for Bulk Resin Purified Radioactive Calcium Milk Samples

(10 cc Dowex-50 W; 200-400 mesh; sodium form; 12 gm wet weight)

| Sample | Count rate per 0.1 cc (Evaporated to give about 10 mg solids on 1 $cm^2$) |
|---|---|
| Original ($Ca^{45}$ labelled milk, cf Tables I and II) | 407 ± 13 cpm |
| After 15 minutes stirring with resin at room temperature and decanting | 43 ± 4 cpm |

Table IV

Spectrographic Analysis of Milk for Calcium Content

(Samples were taken from each of the $Ca^{45}$ purified milk samples of Table II)

| Purified milk fractions | Calcium content (mg/cc) |
|---|---|
| Original milk | 4 ± 1 |
| 0-10 cc (about 4 cc wash water) | 0.004 |
| 10-20 | 0.006 |
| 20-30 | 0.004 |
| 30-40 | 0.020 |
| 40-50 | 0.060 |
| 50-60 | 0.080 |
| 60-70 | 0.120 |
| 70-80 | 0.140 |
| 80-90 | 0.200 |
| 90-100 | 0.400 |
| 100-110 (about 6 cc wash water) | 0.140 |
| bulk milk sample of Table III (after stirring and decanting) | 0.400 |

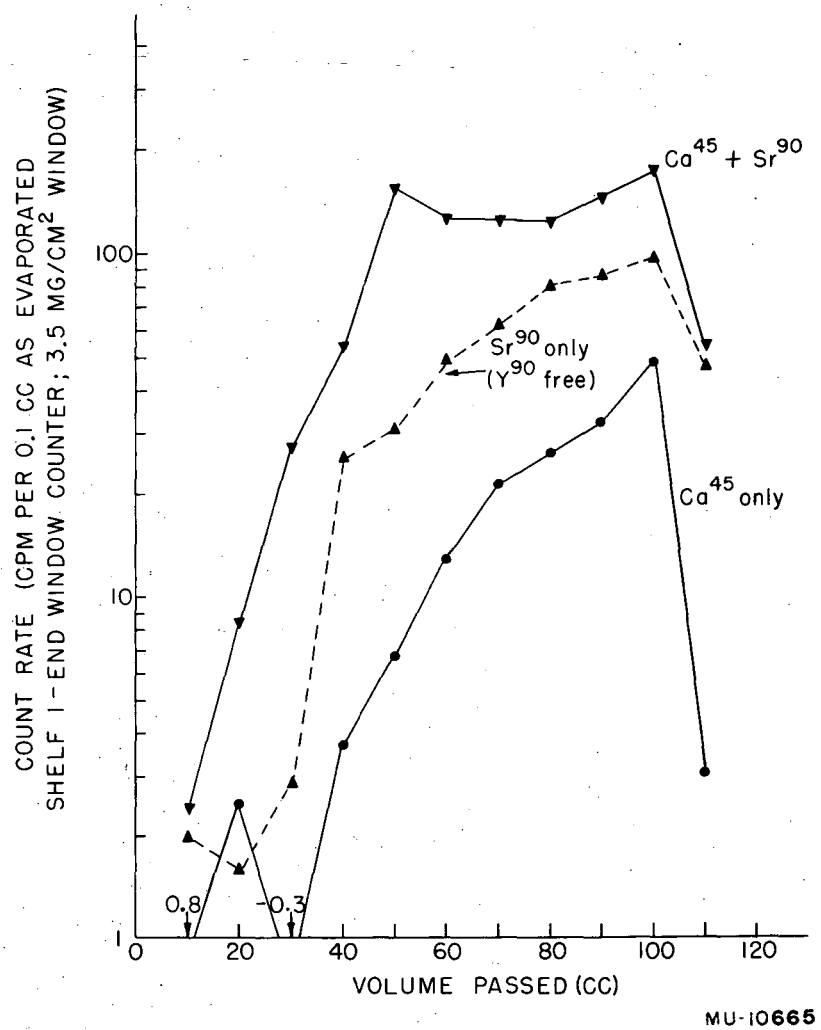


Fig. 1 Counting rates of column purified milk samples.

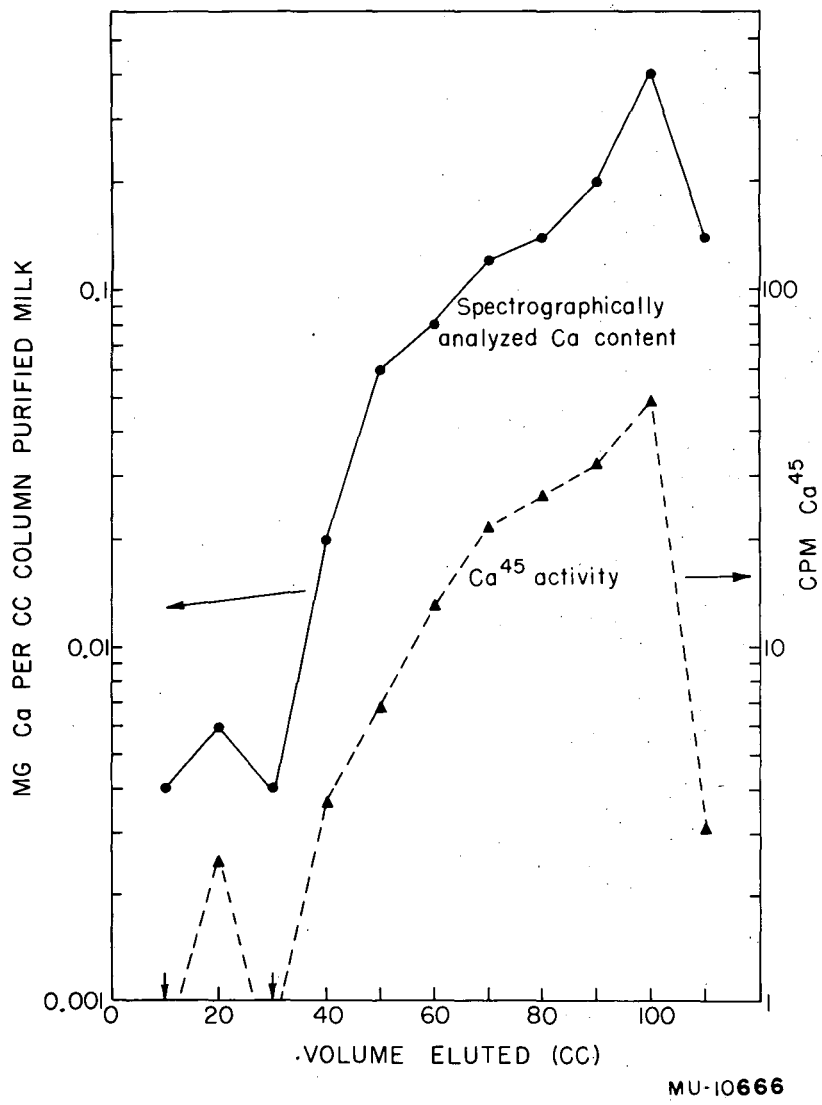


Fig. 2 Calcium analysis of column purified milk samples.