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MERCURY AND CADMIUM CONCENTRATIONS

IN MILK IN PUERTO RICO

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MERCURY AND CADMIUM CONCENTRATIONS IN MILK IN PUERTO RICO

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An earlier study (1), using instrumental neutron activation analysis (INAA), found that a high daily intake of mercury and cadmium by the average Puerto Rican is primarily due to the consumption of market milk. In this study more milk samples were analyzed to determine mercury and cadmium concentrations statistically, using INAA.

EXPERIMENTAL PROCEDURES

Collection of Samples

Milk samples were collected from three different areas of the island of Puerto Rico, divided according to milk production and processing, (2). About 25 samples were analyzed from each area over a period of four months, from September to December 1974, on a monthly basis.

Preparation of Samples and Standard

A freshly prepared standard, containing 10 micrograms each of mercury and cadmium was used for each irradiation. Milk samples and a standard were sealed in quartz ampoules which were cleaned with aqua regia and double-distilled, deionized water both before and after the process. One millilitre of milk was used per sample with no pretreatment made before or after the irradiation.

For each irradiation a batch consisted of seven samples, one standard and one empty ampoule.

Irradiation and Counting

Each batch was placed inside a plastic container and irradiated at a thermal flux of approximately 5×10^{12} , usually for a period of 12 hours.

After a cooling period of from three to four days, the irradiated ampoules were again cleaned to remove surface activities and were then counted for 2 hours using a 25cc coaxial Ge(Li) detector and a 4096 channel pulse-height analyzer.

The concentrations of the metals were computed with a computer routine employing Wasson's method of photopeak integration (3); the program included decay correction for the samples. For mercury and cadmium the 77.3 kev peak of Hg^{197} and the 336 kev peak of $\text{In}^{115\text{m}}$ were used, respectively.

RESULTS

The mean values of the concentrations in milk of mercury and cadmium are tabulated with their standard deviations in the Table. In general, insignificant differences in mercury concentrations from one sampling period to another, as well as from one area to another, were noted for both metals.

With the exception of the high average mercury content of 0.080 ppm in area No. 3 for the month of October, the values varied between 0.040 and 0.059 ppm. The mercury concentration was found to be about four times higher than the values reported in the United States (4) and for some months slightly higher than the safe range as set by the World Health Organization (WHO) on food (0.05 ppm).

The observed variations in cadmium concentrations were also small. The values obtained by INAA were found to be about six times higher than the values reported in the United States (5); however INAA was found to be relatively insensitive for the determination of cadmium and a significant peak was not observed in the energy range used for the determination. In addition to INAA, atomic absorption spectrophotometry was used to determine cadmium concentration. Most of the results obtained by this method varied

between 0.01 and 0.03 ppm, in good agreement with results published in the United States (5).

Conclusions relative to the merits of the two methods were not made since they require further studies.

CONCLUSION

The results show that the mercury content in-market milk in Puerto Rico is slightly higher than the value set by the WHO on food products.

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TABLE OF RESULTS

MEAN VALUES OF MERCURY AND CADMIUM CONCENTRATION IN MILK
(VALUES ARE IN PPM BASED ON WET WEIGHT)

MERCURY:

Sampling Time	Area No. 1*	Area No. 2*	Area No. 3 *
September	0.056 $\pm$ 0.013	0.051 $\pm$ 0.008	0.057 $\pm$ 0.011
October	0.048 $\pm$ 0.004	0.040 $\pm$ 0.01	0.080 $\pm$ 0.008
November	0.059 $\pm$ 0.006	0.056 $\pm$ 0.008	0.056 $\pm$ 0.008
December	0.042 $\pm$ 0.009	0.050 $\pm$ 0.008	0.046 $\pm$ 0.008

CADMIUM:

September	0.189 $\pm$ 0.030	0.344 $\pm$ 0.079	0.136 $\pm$ 0.024
October	0.143 $\pm$ 0.030	0.153 $\pm$ 0.035	0.118 $\pm$ 0.044
November	0.161 $\pm$ 0.042	0.183 $\pm$ 0.018	0.137 $\pm$ 0.028
December	0.126 $\pm$ 0.041	0.133 $\pm$ 0.022	0.138 $\pm$ 0.025

- * Area No. 1 : Represents the Western, and part of the Northern section of the island, including the cities of Mayaguez and Arecibo
- Area No. 2 : Represents the Northern and Eastern part of the island, including the cities of San Juan and Caguas
- Area No. 3 : Represents the middle and Southern part of the island including the city of Ponce