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HEALTH CONSULTATION FOR MILK PRODUCED NEAR THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT FERNALD, HAMILTON COUNTY, OHIO - JUNE 1995 - FINAL REPORT

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ATSDR PUBLIC
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REPORT

Health Consultation

FOR MILK PRODUCED NEAR THE

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

FERNALD, HAMILTON COUNTY, OHIO

JUNE 1995

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Office of Regional Operations
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members.

This document has previously been released for a 30 day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The health consultation has now been reissued. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conlusions previously issued.

7029

HEALTH CONSULTATION

FOR MILK PRODUCED NEAR THE

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

FERNALD, HAMILTON COUNTY, OHIO

CERCLIS NO. OH6890008976

Prepared by

Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Federal Facilities Assessment Branch
Energy Section B

3

STATEMENT OF ISSUES AND SUMMARY

The Agency for Toxic Substances and Disease Registry (ATSDR) initiated this health consultation which addresses whether milk produced from dairy farms near the Fernald Environmental Management Project (FEMP) at Fernald, Ohio, is safe to drink, in response to concerns expressed by members of the community surrounding the site.

ATSDR has been actively engaged since 1993 in a program to collect environmental samples in and around Fernald, Ohio. The purpose of this program is to collect data to address specific concerns expressed to ATSDR by people living near the FEMP about the safety of their environment. We have enlisted the assistance of the U.S. Environmental Protection Agency's (EPA) National Air and Radiation Environmental Laboratory (NAREL), Montgomery, Alabama, to help us collect and analyze environmental samples for radioactivity.

This health consultation presents the results of the milk samples we collected in June and August 1994.

Based on the information we collected, ATSDR believes the milk produced near Fernald is safe to drink.

BACKGROUND AND RESULTS

In June 1994, we collected two milk samples from a dairy farm on the southeast portion of the Fernald property and two additional milk samples from another dairy farm approximately six miles northwest of the site. We took the second set of milk samples to compare to the first. We chose the location of the second farm because it is in the direction from the site toward which the wind blows the least and, thus, is least likely to be affected by airborne releases of radionuclides from Fernald. We collected the same number of milk samples from the same two farms in August 1994.

We verified with the farmers at both farms that all the cows which contributed milk to the holding tanks had grazed on locally grown feed only, and had been drinking local water. All of the milk is combined into single holding tanks at each farm and we believe the milk collected at the coolers was representative of milk which was routinely obtained from these farms.

The NAREL laboratory analyzed the milk samples for three uranium isotopes as well as for other elements that emit gamma radiation. The gamma spectrometer is capable of detecting most radionuclides which emit gamma radiation, including many isotopes of bismuth, radium, thorium, cesium, and others.

4

The quantities of the radioisotopes found in the milk are provided in Tables 1 and 2 below. The results in the tables are presented in picocuries per liter (pCi/L)[1] and millibecquerels per liter (mBq/L) of milk, which are units of radioactivity per volume, and represent the concentrations, or quantities, of the radionuclides in the milk.

Table 1. JUNE 1994 FERNALD MILK SAMPLES
In picocuries per liter (pCi/L) and millibecquerels per liter (mBq/L)[a].

LOCATION	ON FERNALD PROPERTY		6 MILES NW OF FERNALD	
NAREL SAMPLE #	1	2	3	4
URANIUM ANALYSIS RESULTS				
U-234	0.049 (1.8)	0.310 (11)	0.330 (12)	0.110 (4.1)
U-235	0.006 (0.2)	ND[b] (ND)	0.006 (0.2)	0.049 (1.8)
U-238	0.026 (0.96)	0.093 (3.4)	0.110 (4.1)	0.049 (1.8)
GAMMA SPECTROSCOPY RESULTS				
K-40	1,270 (46,990)	1,300 (48,100)	1,330 (49,210)	1,380 (51,060)
Pb-212	ND (ND)	ND (ND)	ND (ND)	ND (ND)

a First numbers given are picocuries per liter (pCi/L); millibecquerels per liter (mBq/L) are given in parentheses. 1 pCi = 37 mBq.

b ND = Radioisotope Not Detected in the sample.

One picocurie (1 pCi) equals 37 millibecquerel (37 mBq). The becquerel is the radioactivity unit in the SI (*International System of Units*) system.

5

Table 2. AUGUST 1994 FERNALD MILK SAMPLES
In picocuries per liter (pCi/L) and millibecquerels per liter (mBq/L)[a].

LOCATION	ON FERNALD PROPERTY		6 MILES NW OF FERNALD	
NAREL SAMPLE #	5	6	7	8
URANIUM ANALYSIS RESULTS				
U-234	0.300 (11.1)	0.510 (18.9)	0.280 (10.4)	0.360 (13.3)
U-235	0.055 (2.0)	0.120 (4.44)	0.084 (3.1)	0.160 (5.92)
U-238	0.170 (6.29)	0.094 (3.5)	0.250 (9.25)	0.120 (4.44)
GAMMA SPECTROSCOPY RESULTS				
K-40	1,370 (50,690)	1,480 (54,760)	1,300 (48,100)	1,370 (50,690)
Pb-212	4.7 (170)	ND[b] (ND)	ND[b] (ND)	ND[b] (ND)

a First numbers given are picocuries per liter (pCi/L); millibecquerels per liter (mBq/L) are given in parentheses. 1 pCi = 37 mBq.

b ND = Radioisotope Not Detected in the sample.

6

DISCUSSION

All of the radioisotopes we detected in these milk samples are natural components of the earth's crust and small quantities of these radioisotopes are present in many foods [1,2,3].

We examined recent nationwide milk survey data for potassium-40 (K-40) and lead-212 (Pb-212). In 1994, NAREL analyzed five hundred and seventy-one milk samples through its Environmental Radiation Ambient Monitoring System (ERAMS) program [2]. These nationwide samples were analyzed by gamma spectrometry, which detects K-40, Pb-212, and other gamma emitting radionuclides. (Gamma spectrometry is not an effective method for quantifying uranium in milk.) The K-40 and Pb-212 results from the milk samples collected nationwide are presented in the following table.

Table 3. SUMMARY OF 1994 NATIONWIDE ERAMS[a,b] MILK SAMPLING In picocuries per liter (pCi/L) and millibecquerels per liter (mBq/L)[c].

571 Samples Analyzed	Number of Samples with Detection	Range of Results	Average Concentration ± SD[d]
K-40	571	720 - 1,590 (26,640 - 58,830)	1,350 ± 64 (49,950 ± 2,400)
Pb-212	35	2.4 - 10.2 (89 - 377)	5.1 ± 2.0 (190 ± 74)

a ERAMS is the Environmental Radiation Ambient Monitoring System, conducted by NAREL.
b This data, reference 2.
c First numbers given are picocuries per liter (pCi/L); millibecquerels per liter (mBq/L) are given in parentheses. 1 pCi = 37 mBq.
d SD is one Standard Deviation of the Average Concentration.

The milk samples we collected at Fernald contain the same amount of K-40 and Pb-212 as in the nationwide milk samples. We also calculated the total potassium in the milk based on the radioactive potassium (K-40) levels, and compared this level with data from the National Dairy Council [4,5]. Our total potassium levels varied from those reported by the National Dairy Council for whole milk by less than 1 percent. Both the ERAMS data and the data from the National Dairy Council indicate that the K-40 and Pb-212 detected in our samples are from naturally occurring sources.

7

We do not have recent milk survey data for uranium isotopes. NAREL analyzed uranium in milk as part of the ERAMS program prior to 1986. However, these analyses were discontinued because uranium concentrations in milk samples collected nationwide never exceeded levels of concern.

We examined the levels of uranium in the milk samples from the two farms where we collected them. We note that the uranium concentration in the soil at the farm in the southeast corner of the Fernald property is approximately 8 milligrams per kilogram of soil (8 mg/kg); the concentration of uranium in soil six miles northwest of Fernald is approximately 2.5 mg/kg [6]. Although cows which graze on these farms likely ingest some soil, we do not see any more uranium in the milk from the farm on the Fernald property than in the milk from the more distant farm.

A wide variety of human and animal studies have shown that very little ingested uranium is able to pass through the stomach and intestinal walls and into the bloodstream [7]. Also; the uranium present in the soils is mostly present in insoluble chemical forms[2] that are particularly unlikely to cross the intestinal walls and into the cow's blood. Most of the uranium contamination the cows ingest passes through the cows and out in their feces. Therefore, the uranium in the soils does not appear to be getting into the milk. Possible sources of the trace amounts of uranium that we detected in the cows milk include feed, water, air, soil and fertilizer.

We calculated a radiation dose to a person who would drink the milk for 70 years beginning at infancy. The radiation dose from all the radionuclides we measured in the milk is 214 millirems (214 mrem; also, 2.14 millisieverts or 2.14 mSv)[3] over 70 years; or, approximately 3 mrem per year (0.03 mSv per year).

The largest component (greater than 99 percent) of the total radiation dose (214 mrem, or 2.14 mSv) in our milk samples is due to the radioactive potassium (K-40). The uranium isotopes (U-234, U-235, U-238) contribute approximately 2 mrem (0.02 mSv) for the entire 70 years and the lead-212 contributes much less than 1 mrem (0.01 mSv).

For our dose calculations, we assumed all the uranium measured in the milk is soluble. If we had assumed some of the uranium in the milk was insoluble, the radiation dose would be smaller because less of the insoluble uranium gets into the blood than the soluble uranium. Even when we calculated the maximum radiation dose from the uranium in this way, it came out to be much less than 1 mrem (0.01 mSv) per year. A person normally receives approximately 300 mrem (3 mSv) in a single year from naturally occurring radiation sources [9].

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[2] Tetravalent uranium oxides and uranium fluorides [8].

One rem (1 rem) equals 0.01 sievert (0.01 Sv). The sievert is the dose unit in the SI (*International System of Units*) system.

8

When we consider chronic ingestion of low concentrations of uranium, we are concerned with the toxic effects to the kidneys from the uranium metal (nephrotoxicity), which occur at lower chronic doses than radiation toxicity (bone sarcoma). The uranium "loading" to the kidneys that results in toxic effects is measured in micrograms per gram of kidney tissue. Therefore, we are most concerned with the dose to infants, because they have the smallest kidneys and the least developed immune and repair systems and they drink about twenty times more milk for their body size than an adult [10].

ATSDR estimates that 3 micrograms of uranium per gram of kidney tissue will result in kidney damage [1]. However, an infant would have to ingest approximately 2,000 micrograms of uranium per day to result in a steady state loading of 3 micrograms of uranium per gram of kidney. Therefore, ATSDR believes that for ingestion, amounts greater than 2,000 micrograms of uranium per day is a level of concern. At the uranium levels we measured in the milk samples at these dairies, a person would have to drink approximately 2,500 liters (660 gallons) of milk a day to ingest 2,000 micrograms of uranium per day.

Potassium is an essential nutrient and is found in all living things. Radioactive potassium (K-40) occurs in about 0.01 percent abundance wherever there is potassium [4]. For example, a banana contains about 396 mg of potassium; about 0.04 mg (0.01%) is K-40 [11]. A 70 kg man contains about 140 g of potassium, mostly in muscle; about 14 mg would be K-40 [12]. This corresponds to about 120,000 pCi (4.4 million mBq) of radioactivity (from just potassium) and a radiation dose to soft tissue of about 18 mrem per year [3,12]. K-40 is the predominate source of naturally occurring radiation within our bodies and the predominate source of gamma radiation from one person to another.

CONCLUSION

The radiation dose a person would receive from drinking the milk we sampled is the same dose a person would receive from drinking any milk in the United States.

Since we evaluated only the radiation hazard in the milk, we cannot comment on the presence or absence of non-radioactive contaminants such as pesticides or pathogenic microbes. Therefore, we do not conclude that the milk is safe from all contamination. However, based on our evaluation of the radioactivity in the milk samples we collected, ATSDR concludes the milk is safe to drink.

RECOMMENDATIONS

No recommendations.

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