¹²⁹I In Deer Thyroids From the Savannah River Site (U)

Conf-9410138--2

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A document prepared for HEALTH PHYSICS TOPICAL MEETING at Springfield from 10/11/94 - 10/14/94.

DOE Contract No. DE-AC09-89SR18035

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^{129}I IN DEER THYROIDS FROM THE SAVANNAH RIVER SITE

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INTRODUCTION

Abstract — ^{129}I can be released in many forms, most of which can be incorporated into animals, metabolized, concentrated and stored in the small thyroid gland. Atmospheric nuclear weapons tests added ~ 0.37 TBq of ^{129}I to the ~ 1.48 TBq naturally present in the earth, oceans, and atmosphere. Previous investigators showed that during 1965 - 1969, thyroids of most cattle in USA contained less than 0.001 Bq $^{129}\text{I}/\text{g}$ (wet weight) of thyroid. From 1984 through 1993 we measured ^{129}I in 19 to 143 deer thyroids per year from the 316 square miles Savannah River Site (SRS) in SC. Most of these thyroids have averaged 0.1 to 2.8 Bq $^{129}\text{I}/\text{g}$. The storage and release of ^{129}I at the SRS has been extensively reviewed (Kantelo et al., 1993). That report shows between 1954 and 1989 approximately 0.1 TBq of ^{129}I was released into seepage basins, 0.2 TBq released into the atmosphere and 0.3 TBq retained in waste storage tanks. From 1985-1987 the annual medians of $^{129}\text{I}/\text{g}$ deer thyroid from SRS were sustained at 0.03 - 0.06 Bq g^{-1} thyroid. In 1988 the median was highest at 0.12 Bq/g thyroid. The medians then decreased and in 1992 and 1993 they were 0.028 and 0.032 Bq $^{129}\text{I}/\text{g}$ thyroid. The annual average concentrations showed a similar trend with a maximum in 1989 of 2.3 Bq/g thyroid and in 1992 and 1993 the averages were reduced to 0.12 and 0.34 Bq $^{129}\text{I}/\text{g}$. ^{129}I in thyroid glands may be a minimal biohazard but it is a convenient biological index of contamination by a long-lived fission product.

Key words: ^{129}I ; thyroid; Savannah River Site

^{129}I may be the longest-lived fission product of uranium and plutonium ($T_{1/2} = 1.57 \times 10^7$ y). Its natural incidence is approximately 10^{-13} atoms ^{129}I per atom of stable ^{127}I . The total release from atmospheric nuclear tests has been estimated as 0.37 TBq, which may have doubled the concentration of ^{129}I on the surface of the earth.

The isotope disintegrates to ^{129}Xe by emitting 0.04 keV gamma radiation and K-capture x-rays. Biologically, the critical organ is the thyroid, which in normal human beings contains 12 mg of iodine. This mass of carrier-free ^{129}I would be 8.5 μCi . Environmentally, ^{129}I is concentrated in the small thyroid of grazing animals but its maximal radiation cannot exceed 0.1 Gy/y.

The relative concentration of ^{129}I is usually expressed as its specific activity, i.e., atoms ^{129}I per atom of ^{127}I , and twenty years ago Brauer et al. (1974) reported $^{129}\text{I}/^{127}\text{I}$ atom ratios in bovine thyroids throughout USA; 77% of the mean ratios were less than 100×10^{-9} (Fig. 1).

Fig. 1 $^{129}\text{I}/^{127}\text{I}$ atom ratios $\times 10^{-9}$ in bovine thyroids 1964-69. [Re drawn from Brauer et al. 1974 (1).]

MATERIALS AND METHODS

Releases of ^{129}I at SRS have been continually calculated (Kantelo, et al. 1993, chap. 5, p 13). From 1955 through 1973 the average annual release was 0.21 Ci/yr. It was reduced in 1974-1981, and again reduced to < 0.09 Ci/y from 1982-1989. During the past 9 years we have monitored ^{129}I by x-ray spectroscopy, of deer thyroids from the SRS (Van Middlesworth 1993).

RESULTS

All our data are shown in Fig. 2. The ^{129}I is expressed as Bq/g (wet weight) of thyroid. Deer thyroids were analyzed chemically by other authors and the $^{129}\text{I}/^{127}\text{I}$ atom ratios were estimated.

Fig. 2. ^{129}I in deer thyroids, SRS, 1985-1993.

The ranges of individual values cover 5 orders of magnitude, and numerical averages may be misleading. The maximal 5% of all 400 animals suggest that animals containing the highest concentrations were found, primarily, in the central area of the 316 sq. mi. SRS, (Fig. 3).

Fig. 3. Distribution of maximum 5% of ^{129}I in deer thyroids, Savannah River Site 1990-1992.

DISCUSSION

When only the median values were plotted, the pattern suggests that the maxima were in 1988 and there may have been reduced levels after 1989 (Fig. 4).

Fig. 4. Median concentration of ^{129}I in thyroids shown in Fig. 2.

Fig. 5. Ninety-five percentile confidence intervals of ^{129}I in thyroids, shown in Fig. 2.

The data were examined by logarithmic transformation and the ninety-five percentile confidence intervals were expressed (Fig. 5). These results (Fig. 5) show no overlap of the ninety-five percentile intervals of 1992 with the interval from 1987-1991 ($p < 0.05$).

CONCLUSIONS

The concentrations of ^{129}I in thyroids of deer from SRS ranged over 5 orders of magnitude

during the past 9 years. The highest concentrations were in animals killed in the central and west-central parts of SRS. In 1992 most of the deer thyroids had lower concentrations of ^{129}I than in the preceding five years.

Acknowledgments-The authors wish to express appreciation to James Karas, who supplied the statistical evaluation of the data and to N.R. VanMiddlesworth for technical and graphic assistance.

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