

CS-137 RADIOACTIVITY DATA IN BRAZIL

Ieda I.L. Cunha⁽¹⁾, Edson L. Fabra⁽²⁾

Instituto de Pesquisas Energéticas e Nucleares- IPEN
Comissão Nacional de Energia Nuclear - CNEN-SP ⁽¹⁾
Coordenadoria para Projetos Especiais - COPESP (LARELI) ⁽²⁾
C.P.11049, CEP 05422-970, São Paulo - Brazil

SUMMARY. Cesium-137 concentrations in seawater and fish samples from the Brazilian coast were determined. Cesium-137 levels in seawater ranged from 0.8 ± 0.2 to 1.7 ± 0.2 Bq.m⁻³ and for fish ranged from 14 to 220 mBq.Kg⁻¹ of the edible part. Data obtained are used as cesium-137 reference levels in Brazil as well as to dose assessments to the Brazilian population from radioactivity in the marine environment.

Key words: cesium-137, radioactivity levels, marine samples

INTRODUCTION

Many artificial radionuclides have been produced in cyclotrons and research and power reactors and from nuclear weapons tests as well as from the nuclear accidents.

Between 1945 and 1980, atmospheric nuclear weapons tests conducted by different countries totaled 423. A great number of fission products were produced. The last reported nuclear explosion in the atmosphere took place at China in 1980. The accident of reactor at Chernobyl in 1986 resulted in substantial release of radioactive material into the atmosphere.

Cesium-137 is the dominant contributor to the individual dose from fallout due to weapons tests. Cesium-137 contributes about 40% to the total collective dose to the European Community's population up to the year 2500.

The aim of our research programme is to estimate the cesium-137 levels present in marine samples as well as to obtain radionuclide reference levels to our country. This knowledge is

necessary as a baseline for the detection of any future contamination.

Cesium-137 levels in seawater and fish from the Brazilian coast, between the southern coast (Rio Grande do Sul State, 32°11'S) and the southern coast (Para State, 00°26'S) were determined.

The research is being performed in collaboration with the Copesp and the Oceanographic Institute (USP), who are responsible for the sampling.

MATERIALS AND METHODS

SAMPLING

The surface seawater was sampled at the fixed stations (see Figure 1). After the collection, the samples were acidified to pH 1 by adding concentrated hydrochloric acid and then stored in 20L polyethylene containers.

Fish samples were purchased from fishermen's cooperative associations, where the point of collection is known. Edible parts were used for the measurements. The main fish species analysed were sardine, weak fish, white grunt, mullet, saw fish, mutton snapper and Atlantic croaker.

CESIUM-137 ANALYSIS

The techniques used for seawater and fish analysis have been described in detail elsewhere¹.

The accuracy of the methods has been tested, by participation in the intercomparison exercises organized by the International Atomic Energy Agency (IAEA) and by the United State Environmental Protection Agency (USEPA).

To each 100L of seawater, 10mg of cesium carrier cesium were added. Cesium was adsorbed on the ammonium phosphomolybdate (AMP), synthesized in our laboratory. The precipitate was decanted overnight. After filtering and drying, the precipitate was transferred into a standard plastic pot. Cesium-137 was assayed by gamma counting.

The edible parts of the most consumed fish species by the local population were taken for cesium-137 analysis. Each sample was weighed and dried in the muffle at 110°C for one week. Later on,

the temperature was gradually increase up to 450^oC to destroy the organic matter. Ashes were transferred to a plastic pot and counted in a low background hyper pure Ge detector (Ortec - Model 60210P).

RESULTS AND DISCUSSION

Cesium-137 levels in seawater and fish found at each local are shown in the Tables 1 and 2. Cesium-137 levels in seawater range from 0.8 ± 0.2 to 1.7 ± 0.2 Bq.m⁻³ and in fish from 14 to 220 mBq.Kg⁻¹. The error of the analyse is of 40 % for fish analysis.

TABLE 1 - Cesium-137 Levels in Seawater (Bq.m⁻³)
(year 1993)

STATE	Feb Mar	Apr May	June July	Aug Sep	Oct Nov	Dec	Annual Average
Rio G. Sul	1.1	1.1	0.6	0.6	0.8	---	0.8 ± 0.2
Paraná	1.4	1.6	1.4	0.9	0.9	---	1.2 ± 0.3
R. Janeiro	1.3	---	1.4	1.2	1.1	---	0.8 ± 0.5
Bahia	1.3	1.9	1.7	1.7	1.8	1.8	1.7 ± 0.2
Pernambuco	1.7	1.6	1.4	1.2	1.7	1.7	1.6 ± 0.2
Ceará	1.5	1.2	1.6	1.5	1.2	1.3	1.4 ± 0.2
Pará	0.9	0.8	---	1.4	0.8	1.4	1.1 ± 0.3

TABLE 2 - Cesium-137 Levels in Fish (mBq.Kg⁻¹)

STATE	Feb-Mar/93		Apr-may/93		Jun-Jul/93	
Rio G. Sul	weak fish 22	mullet 28	Atlantic croaker 14	saw fish 110	Atlantic croaker 32	weak fish 17
Paraná	weak fish 35	sardine 48	weak fish 44	sardine 37	mullet 15	mullet 40
R. Janeiro	Atlantic croaker 30	sardine 53	mullet 23	sardine 22	D.L.	D.L.
Bahia	---	---	horse eye jack 54	lane snapper 43	yellowtail snapper 77	lane snapper 52
Pernambuco	yellowtail snapper 68	horse eye jack 189	yellowtail snapper 63	saw fish 220	mutton snapper 79	saw fish 13
Ceará	---	---	white grunt 32	saw fish 165	saw fish 94	white grunt 99
Pará	white mullet 22	---	Atlantic croaker 76	mullet 21	mullet 46	weak fish 19

D.L. = Detection limit

At these points of collecting there is no nuclear power plant discharges and nuclear testing was not carried out directly in our country. So, the observed radioactivity has external sources due to global fallout, resulting from nuclear accidents and nuclear tests occurred in the northern hemisphere.

Bettencourt et al² carried out cesium-137 analysis of fish and water samples in Portuguese oceanic waters. Levels in seawater were of 3.2 Bq.m⁻³ and in fish ranged from 0.11 to 1.7 Bq.Kg⁻¹. These measured concentrations are typical values due to fallout deposition in this region of the Atlantic. No significant

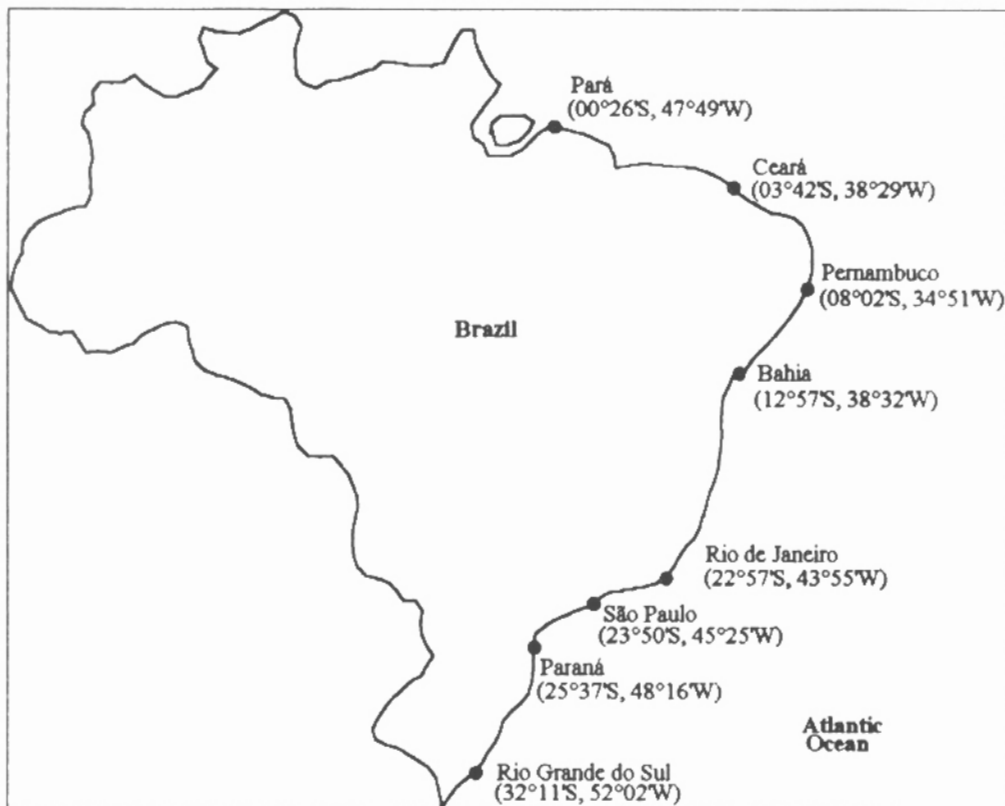


Figure 1: Points of Sampling in Brazil.

differences were observed relative to the data obtained in Japan³. Cs-137 levels in seawater samples varied from 2.2 to 4.0 Bq.m⁻³ and fish ranged from 0.12 to 0.34 Bq.Kg⁻¹.

Areas like northwest coast of Scotland and northern Ireland⁴ are influenced by the input from Sellafield (cesium-137 levels 100-200 Bq.m⁻³) and the Irish Sea contains the highest concentration determined (>200 Bq.m⁻³). NE Atlantic is a special case, its situation is a dynamic process due to the different sources of contamination (reprocessing facilities and the fallout from the Chernobyl accident).

In this work, cesium-137 levels in marine samples are in agreement to the values from regions not affected directly by nuclear accidents or nuclear reprocessing plant discharges and they can be considered reference levels to Brazil.

These data are used to calculate the doses received by the Brazilian population due to Cs-137 radioactivity from marine food chain⁵.

ACKNOWLEDGEMENTS

The authors wish to acknowledge financial support from the COPESP, CNEN and from the IAEA (Research Contract No. 7825 Rb).

REFERENCES

1. Cunha, I.I.L.; Munita, C.S.; Paiva, R.P.; Teixeira, A., 1993. Levels of Cesium-137 in Seawater and Fish from the Brazilian Coast. *Journal The Science of the Total Environment* 139/140:431-435.
2. Bettencourt, A.O.; Ferrador, G.C.; Elias, M.D.T., 1991. Plutonium - 239+240, Americium-241, Cesium-137 in Fish and Waters of the Portuguese Coast. LN ETI/DP. SR-A No.3, Sacavem.
3. Radioactivity Survey Data in Japan, 1991, ISSN 0441-2516, NI RS-RSD-95, National Institute of Radiological Sciences, Chiba, Japan.
4. Calmet, D., 1989. GESAMP the State of the Marine Environment. GESAMP Report and Studies No.39, IAEA, Vienna.
5. Cunha, I.I.L.; Rodrigues Jr., O.; Figueira, R.C.L. Dose Assessments to the Brazilian Population from Marine Food Radioactivity. To be published.