RISK ASSESSMENT OF CONSUMPTION OF MERCURY CONTAMINATED FISH

CETESB • Regional Centre for Stockholm Convention on POPs for Latin America and Caribbean Region

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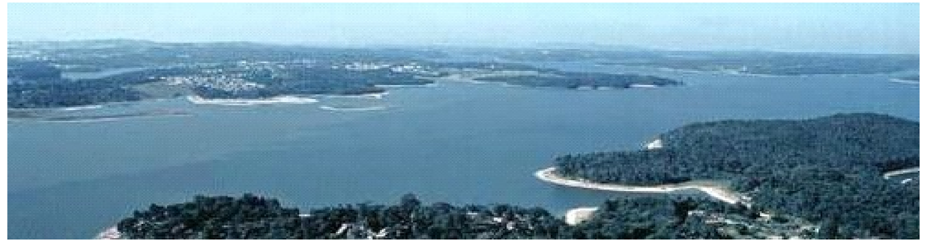
1.INTRODUCTION

Rio Grande Reservoir is one of the most important water bodies in the São Paulo Metropolitan Region. This reservoir was built in the 1920's and initially was one of the branches of the Billings Reservoir. For many years, its waters presented low quality due to contamination with organic sewage from the Metropolitan Region. In 1982, the Rio Grande Reservoir was separated from the Billings Reservoir in an attempt to preserve its water quality. Nowadays, Rio Grande Reservoir is used for drinking water supply, it is also used for leisure and fishing.



Once mercury reach the surface water, it attached to aquatic sediments and it is subject to microbial conversion to methyl mercury (MeHg), which upon it enters the aquatic food chain. It reaches its highest concentrations in long-lived predatory fish. Thus, fish monitoring serves as an important indicator of contaminated sediments and water quality problems. The previous use of Hg in these areas (Rio Grande) coupled with fish consumption, indicate the necessity of chemical analyses to evaluate such contaminant in fish as part of the comprehensive water quality monitoring program of CETESB (São Paulo State Environmental Agency). This study aimed to assess the health risk arising from fish consumption from Rio Grande reservoir, since contaminated fish is the main intake route for such compounds as MeHg.

2. MATERIAL AND METHODS

Fish samples (n= 435) were collected in several sites located in the Rio Grande reservoir in three different years (2009, 2015 and 2016). Fish species (n = 7) were caught using different types of nets in order to sample a large variety of species and to represent the fish community that occupies the studied sites. 37 fish muscle composite samples were analyzed.

In 2009, the total mercury was determined by cold vapour atomic spectrometry (CV-AAS). In 2015 and 2016, the total mercury was determined by thermal decomposition, amalgamation, and atomic absorption spectrophotometry.

3. RESULTS AND DISCUSSION

Astyanax sp., Hoplias malabaricus, and Rhamdia quelen were selected for risk assessment due to their different eating habits and habitats of these species and to the fact that the local population may consume them.

TOXICITY

For a more conservatively risk assessment, the total mercury present in fish was taken as 100% in the form of MeHg. Based on Reference dose for MeHg (RfD) = 0.1 µg/kg.day (USEPA, 2001), Provisional Tolerable Weekly intake (PTWI) of 0.7 µg/kg.week was estimated.

EXPOSURE

Concentration of total mercury in fish species (µg/g wet weight)

Fish species	Site 1*	Site 2*	Site 3*	Site 4 (2015)	Site 4 (2016)
Astyanax sp	0.160	NC	0.110	NC	NC
R. quelen	NC	NC	0.110	0.270	0.775
H. malabaricus	NC	0.260	0.180	0.440	0.470

Note: NC = Specie not caught in this site; *2009

Group of population	Body weight - BW (kg)	Fish consumption (g/week)
Gen	70	420
Subsistence Fisher	70	868
Children de 1-4 years	14.4	70
Children 5 -11 years	26.4	98

Note: "Gen" refers to general adult population

Probably weekly intake (µg/kg.week)

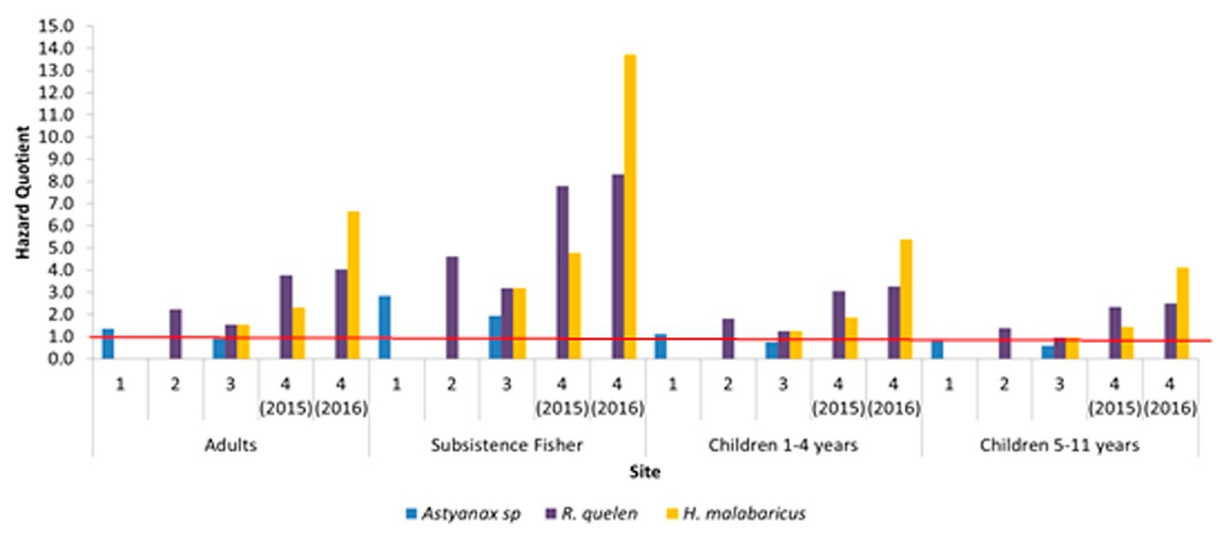
$$PWI = \frac{\text{Fish consumption} \times C_{MeHg}}{BW}$$

Site	Fish species	Gen	Subsistence Fisher	Children 1-4 years	Children 5-11 years
1	*Astyanax sp*	1.37	2.83	1.11	0.85
2	*R. quelen*	2.23	4.61	1.81	1.38
3	*R. quelen*	1.54	3.19	1.25	0.95
	Astyanax sp	0.94	1.95	0.76	0.58
	H. malabaricus	1.54	3.19	1.25	0.95
4 (2015)	*R. quelen*	3.77	7.79	3.06	2.33
	H. malabaricus	2.31	4.78	1.88	1.43
4 (2016)	*R. quelen*	4.03	8.33	3.26	2.49
	H. malabaricus	6.64	13.73	5.38	4.11

RISK

Hazard Quotient

$$HQ = \frac{PWI}{PTWI}$$ HQ ≤ 1 No risk



Daily fish consumption limits (g/d)

$$CR_{lim} = \frac{RfD \times BW}{C_{MeHg}}$$

Site	Fish species	Gen	Children 1-4 years	Children 5-11 years
1	*Astyanax sp*	43.75	9.00	16.5
2	*R. quelen*	26.92	5.54	10.15
3	*R. quelen*	38.89	8.00	14.67
	Astyanax sp	63.64	13.09	24.00
	H. malabaricus	38.89	8.00	14.67
4 (2015)	*R. quelen*	15.91	3.27	6.00
	H. malabaricus	25.93	5.33	9.78
4 (2016)	*R. quelen*	14.89	3.06	5.62
	H. malabaricus	9.03	1.86	3.41

Number of fish meals/month

$$CR_{mm} = \frac{CR_{lim} \times T_{ap}}{MS}$$

Tap = 30.44 days
MS (meal size) = 124 g

Site	Fish species	Gen	Children 1-4 years	Children 5-11 years
1	*Astyanax sp*	11	2	4
2	*R. quelen*	7	1	2
3	*R. quelen*	10	2	4
	Astyanax sp	16	3	6
	H. malabaricus	10	2	4
4 (2015)	*R. quelen*	4	1	1
	H. malabaricus	6	1	2
4 (2016)	*R. quelen*	4	1	1
	H. malabaricus	2	0	1

4. CONCLUSION

The daily fish consumption limit, the hazard quotient and the monthly number of fish meals provide the same information, but in order to facilitate understanding and risk management, the three estimates are presented. When comparing the PWI, calculated based on the scenario adopted for the present risk assessment, with the USEPA reference dose, through the QP, it is noted that there is a risk to health if there is unrestricted consumption of these species, being a greater risk for children, because the number of meals allowed is quite restricted.

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