DETERMINATION OF MERCURY IN TOTAL OF WILD FELINES BY THE RESERVES OF MAMIRAUÁ AND AMANÃ

Lopes MCB[1], Lino AS[1], Ramalho EE[2], Meire RO[3], Bernardo RR[3], Torres JPM[1], Malm O[1].

1. Laboratório de Radioisótopos Eduardo Penna Franca, Instituto de Biofísica (IBCCF), Universidade Federal do Rio de Janeiro (UFRJ), Rio de Janeiro/RJ, Brasil.

2. Instituto de Desenvolvimento Sustentável Mamirauá, Estrada do Bexiga, 2584 Bairro Fonte Boa,Tefé, AM.

3. Universidade Federal do Rio de Janeiro. Instituto de Biofísica, Pólo de Xerém, Estrada de Xerém, Nº 27, Xerém – Duque de Caxias - RJ. CEP: 25245-390.

Introduction

Mercury (Hg) is one of the most fascinating metals found on the planet because of its fluidity at room temperature and has been known since ancient Greek times. Each year, about 10 tons is produced and used in the factory, dental and/or mining sector[1]. In Brazil, records indicate that gold mining in the Amazon began during the 18th century and was intensified in the 1970s for the development of the region where the search for gold took an inordinate population growth, one described beyond the imbalance of biodiversity and local habitats. Mercury was used in gold extraction process and its residue was discarded on the banks of rivers, soil, and/or air[2]. Once in the environment, this mercury can be transformed into methyl mercury (CH_3Hg) and enter the food chain through aquatic systems and terrestrial animals. Through this transformation, bioaccumulation, and biogmagnification, human and animal health can be severely impacted[1].

Mercury has affinity for proteins in their groups of sulfides as well as carboxylic acids and phosphates. As well, it denatures the same and interferes with the metabolic functions of cells such as neurotransmitters in brain. It can also cause serious damage to the kidneys, liver, and/or the central nervous system[3]. Methyl mercury has a teratogenic factor, which affects reproduction and embryonic development in humans and animals[3]

The aim of this study was to determine the total Hg in hair samples of the following specieis: *Leopardus pardalis*, *Panthera ounce, Panthera concolor and Leopardus wiedii,* in the Mamirauá and Amanã reserves of the Middle Solimões, Amazonas State.

Materials and methods

The hair samples were collected from the Mamirauá and Amanã reserves in the Amazon. We analyzed hair samples from the following species: *Leopardus pardalis* (n=8) *, Panthera onça* (n=14)*, Panthera concolor* (n=3) and *Leopardus wiedii* (n=1).

The hair samples (10 - 20 mg) were excised with clean stain less steel implements and washed with EDTA 0.01% for 2 hours to remove superficial grease and dust to avoid external metal contamination. They were then rinsed twice with double-distilled and deionized water and dried overnight at 40 °C. All samples were weighed and mineralized for the determination of mercury. In the hair samples, 5ml of concentrated H_2SO_4 and HNO_3 (1:1) was added and they were then placed in a water bath at 60 °C for 15 min and allowed to cool down. After, 5ml of 5% $KMnO_4$ solution was added and the extracts were left overnight at room temperature in a dust-free atmosphere. Extracts were neutralized with some drops of a 12% $HONH_3Cl$ solution and a final volume of 25 ml was made up using double-distilled and deionized water before analyses[4].

The Hg analyses were performed by atomic absorption spectrometry with an AA 1475 Varian instrument equipped with a cold-vapor generator accessory (Varian VGA-76) and sodium boro hydride as a reducing agent at the Laboratório de Radioisótopos Eduardo Penna Franca from the Federal University of Rio de Janeiro according to Malm et al. (1991)[5].

Accuracy of the mercury concentration was assesed by comparison with a certified reference from the *Institute of environmental medicine Karolinska Institutet Humano Hair* 4.79 mg/g. All samples were performed in triplicate, which allowed for an estimation of analytical variability, and all reagents were p.a. degree.

Results and discussion

Several factors like location, age, sex, and others reported in the literature have been associated with differences in mercury concentration in wild mammals[6]. In Tables 1 and 2, presents the values of Hg in the hair samples. The method was very sensitive and the average value of the reference is 4.79 □g/g (*Institute of environmental medicine Karolinska Institutet Humano Hair*).

Table 1. Mercury concentrations (□g/g) detected in the hair samples.

Species	mean HgT (μg/g)	Species	mean HgT (μg/g)	Species	mean HgT (μg/g)	Species	mean HgT (μg/g)
L. pardalis	31.1	*P onca*	47.6	*P concolor*	4.4	*L wiedii*	0.5
L pardalis	10.6	P onca	16.5	*P concolor*	0.3		
L padalis	24.6	*P onca*	5.8	*P concolor*	0.1		
L pardalis	36.1	*P onca*	38.7				
L pardalis	38.6	*P onca*	35.1				
L pardalis	7.6	*P onca*	19.8				
		P onca	30.4				
		P onca	2.9				
		P onca	5.2				
		P onca	3.9				
		P onca	48.0				
		P onca	38.3				
		P onca	5.6				
		P onca	10.0				

Table 2. The mean of HgT (□g/g) of species

Species	mean HgT (μg/g)
L. pardalis (n=6)	**24.7**
P onca (n= 14)	**21.9**
P concolor (n=3)	**1.6**
***L wiedii* (n=1)**	**0.5**

The average mercury detected in animal hair varied from 0.5-24.7 □g/g. This initial study allows us to observe the wide variation of mercury in the hair of these cats. These results reveal habitat contamination probably because of mining and the use of mercury indiscriminately. However, it is difficult to identify a mercury level interface that is toxic to these animals as it varies through solubility and susceptibility of mercury. The results found by Sheffy & Amant[7] (1982) revealed that a mercury concentration in the range of 1 to 5 □g/g in otter hair is a normal result for the giant otter. A study conducted by Fonseca et. al. (1991) revealed that the mercury concentration for giant otters present Rio Negro is 2.94 to 3.68 □g/g[4].

Compared with the initial results from Table 1, the species *P ounce* only had two samples that are in 14 analyzes of hair, only 2 are in the range of Sheff & Amant (1-5 □g/g). All hair *L. pardalis* (n = 6) are above the reference values. The species *P. concolor* and *L wiedii* values in the range presents however with few analyzes (n = 3 and 1) respectively.

Initial analyzes of this study show that these species ounces are very important for the balance of the entire food chain, as well as the forest. But are endangered today by the major sources of threats are deforestation also caused, mostly, by mines, leading to contamination and the destruction of vegetation as the environment, thus preventing the reproduction of other animals that serve as food for jaguars, occurring fragmentation of forests and the consequent genetic isolation of these populations.

Acknowledgments

CNPq and Conselho Regional de Farmácia do Rio de Janeiro (CRF-RJ).

References

1. Kasper D., Forsberg, B.R, De Almeida, R., Bastos, W.R., Malm, O. (2015) *Quim. Nova,* 38, 410-418.

2.De Sá, A.L. , Herculano, A.M., Maria da Conceição Pinheiro, M.C., Silveira, L.C.L., Do Nascimento,J.L.M., Crespo-López M.E (2006) *Revista Paraense de Medicina* V.20, 19-25.

3. Micaroni, R.C.C.M., Bueno, M.I.M.S., Bueno, Jardim, W.F. (2000) *Quim. Nova* 23 (4), 487-495.

4. Fonseca, F.R.D., Malm, O., Waldemarin, H.F (2005) *Environmental Res.* 98, 368–371.

5. Malm, O., Pffeifer, W.C., Reuther, R.E., Souza, C.M.M., (1991) Ambio 19, 11–15.

6. Wren, C.D. (1986) *Environ. Res*. 40, 210–244.

7. Sheffy, T.B. & St. Amant, J.R., (1982). *J. Wildl. Manage*. 46, 1117–1120.