Courses and Training

The Lab offers courses and practical training in order to promote the transfer of technical and methodological expertise in the field of toxicological analyses.

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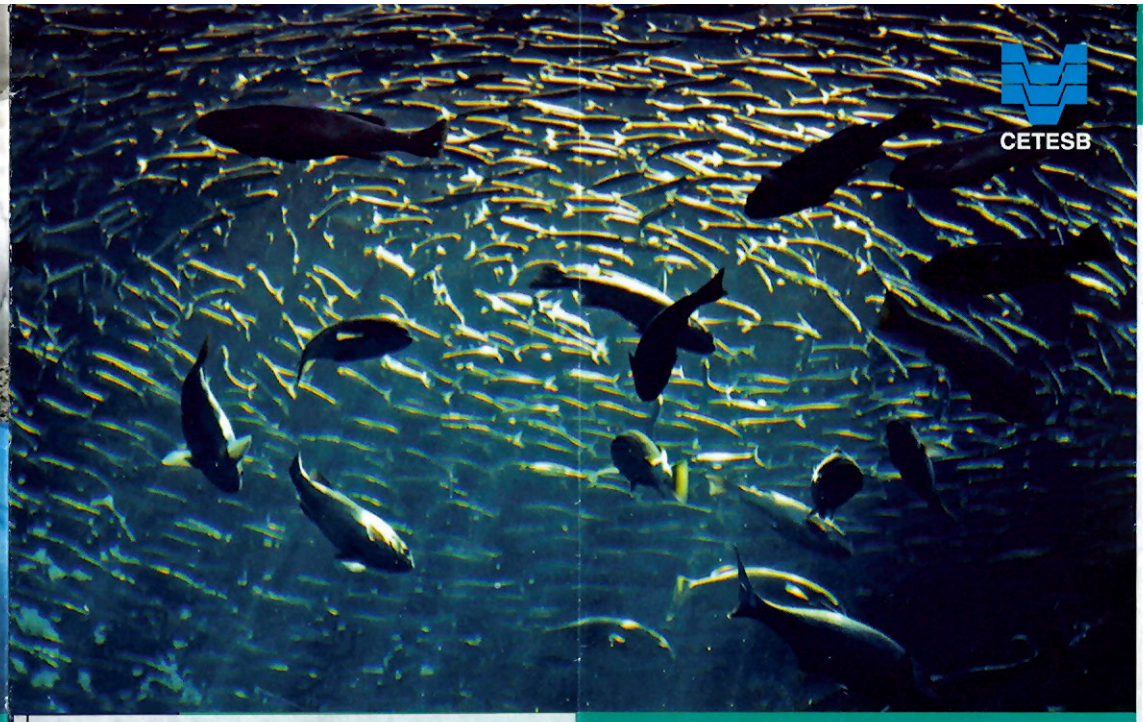

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MERCURY IN HAIR

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TOXICOLOGICAL ANALYSES LABORATORY

References

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UNEP. United Nations Environment Programme. **UNEP**

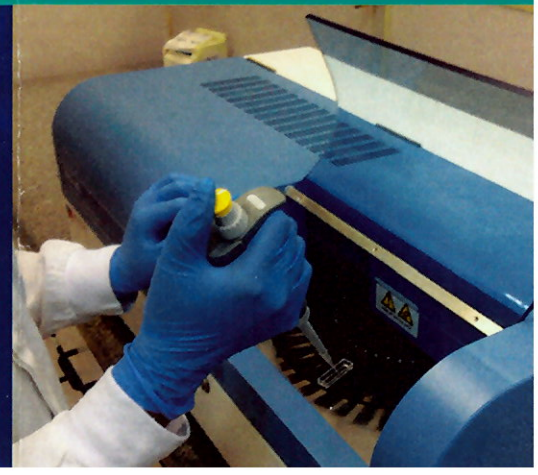
Mercury

Mercury in elemental form occurs as silver liquid at room temperature. Furthermore, mercury can be found basically in other chemical forms: inorganic mercury expressed as Hg^{2+}, HgX_2, HgX_3^-, HgX_4^{2-} (where $X = OH^-$, Cl^-, Br^-, I^-, S^{2-}) and organic mercury such as CH_3Hg^+, CH_3HgCl, CH_3HgOH, $(CH_3)_2Hg$ and $C_2H_5Hg^+$.

It is important to point out that the most toxic form of mercury is Methylmercury (CH_3Hg) that can be produced in industrial processes or naturally in soils and sediments by bacterial activity known as methylation.

When it comes to biochemical properties, mercury has affinity for sulfur (S) and sulfhydryl groups as (R–SH) or disulfide linkage (–S–S–). These forms are found in many structures as proteins, carbohydrates, lipids and nucleic acids.

All these forms of mercury induce toxic effects in humans and other mammals. The extent of the adverse effects depends on the chemical form of mercury, duration of exposure and routes of exposure (inhalation, ingestion, dermal contact, etc.), dose, the age of the exposed person (the fetus is the most susceptible) and the health of the exposed person.



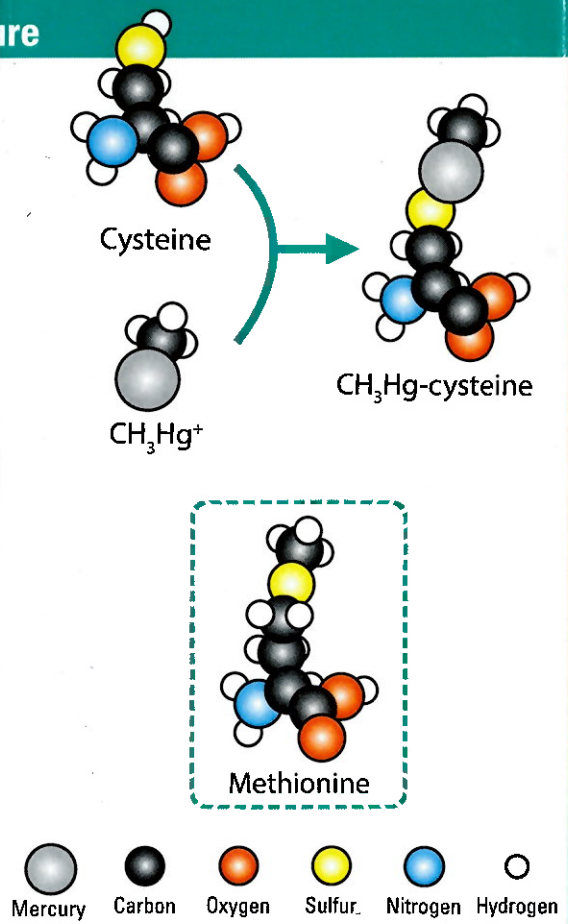
Biomarkers of Mercury Exposure

The body burden of mercury is estimated by the measurement of this metal in different human biological samples such as blood, hair, urine, nails, milk and cord blood.

- **Blood:** Mercury in blood indicates current or recent exposure. WHO (World Health Organization) considers the normal mean concentration of mercury in whole blood to be 5 to 10 µg/L.
- **Urine:** Mercury in urine indicates recent exposure to its elemental or inorganic forms. According to WHO, normal urinary mercury is less than 5 µg/g.
- **Cord Blood:** This matrix has been found to be better in characterization of children´s prenatal methylmercury exposure than maternal hair.
- **Milk:** Mercury in human milk reflects intake during pregnancy and most of the time it does not correlate with mother´s hair mercury. In general, milk shows excretion of lipophilic compounds.
- **Nails:** Since mercury binds to proteins such as keratin, mercury in fingernail and toenail can be used to measure the body burden.
- **Hair:** The presence of mercury in human hair is largely used as a biomarker of exposure to organic mercury compounds, whose levels are associated with consumption of fish and other seafood. According to the National Institute for Minamata Disease (NIMD) - Ministry of the Environment of Japan, people who eat fish occasionally have mercury in their bodies. In fact, no one has a hair mercury level of zero.

Methylmercury is absorbed into the human body and binds to an amino acid called cysteine. It results in a complex whose structure is similar to another amino acid, methionine. This complex Methylmercury-Cysteine is finally incorporated into tissues including brain and fetus.

The structures involved in the reaction are shown as follows:



Source: (NIMD, 2013).

Reference for Level of Mercury in Hair

920 ppm: highest level in Kumamoto Minamata disease (1960 hair average: roots 430 ppm, ends 1.855 ppm).
338 ppm: average for nine patients with severe symptoms (diagnosed with Kumamoto Minamata disease in 1959)
70 ppm: 30% risk for pregnant women (International Program on Chemical Safety, 1990)
50 ppm: below this level causing no neurological damage in adults (World Health Organization, 1990)
50 ppm: standard for recommendation against pregnancy (1965: Niigata Minamata Disease)
39.8 ppm: average in men of a Portugal village (Bull. Environ. Contam. Toxicol. 56, 860-5, 1996)
20 ppm: level causing no effects (International Program on Chemical Safety, 1990)
18 ppm: average in women of Brazilian Amazon (Int. J. Environ. Health. Res. 13, 239-248, 2003)
16 ppm: average in women of a Portugal village (Bull. Environ. Contam. Toxicol. 56, 860-5, 1996)
14 ppm: the concentration in maternal hair methyimercury that would not cause appreciable adverse effects on offspring in two study populations of Seychelles Islands (JECFA, 2004)
11 ppm: level causing no effects for pregnant women (Food Safety Committee of Japan, 2005)
10~20 ppm: 5% risk for pregnant women (International Program on Chemical Safety)
6.8 ppm: average level for mothers at time of birth in Seychelle Islands (1989-1990 survey)
5 ppm: a former safe exposure level of methylmercury for adults (3.3 µg/kg/week) (WHO, 1973)
4.5 ppm: median for mothers at time of birth in Faroe Islands (1986-1987 survey)
2.8 ppm: provisional tolerable weekly intake level of methylmercury for adults (3.3 µg/kg/week) (JECFA, 2004)
2.5 ppm: average for Japanese men National Institute for Minamata Disease, 2000-2004)
2.2 ppm: provisional tolerable weekly intake level of methylmercury (1.6 µg/kg/day) (JECFA, 2004)
1.8 ppm: average for men in Rio de Janeiro (Quím. Nova, 25, 37-45, 2002)
1.6 ppm: average for Japanese women (National Institute for Minamata Disease, 2000-2004)
1,3 ppm: average for women in Rio de Janeiro (Quím. Nova, 25, 37-45, 2002)
<1,00 ppm: level for people that don't eat fish.

Analytical Sequence

1. Collect about twenty hair strands using stainless steel scissors.
Note: Remember to wear talc-free gloves when handling hair samples.
2. The hair strands should be cut at 3 cm from their roots. These hair samples can be stored in plastic or paper bags.
3. Weight hair samples directly into the sample boat using an analytical scale.
4. The sample boat is placed in the carousel and then introduced into Direct Mercury Analyzer (DMA) without any pretreatment. The mercury content is determined according to US. EPA Method 7473.
5. Data analysis.