

## **Alternative low cost method for mercury semi-quantitative determination in fish: Training of local users in Itaituba, Brazil and Manado, Indonesia**

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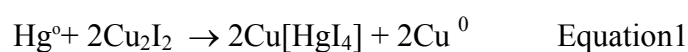
**Abstract:** A new semi-quantitative analytical method for mercury determination in gold prospecting areas, and 16 new local users, 5 in Itaituba-Brazil and 11 in Manado-Indonesia, were trained for using it as an alternative and low cost method for mercury determination in fish in August and September 2003. This experience demonstrated the spreading potential throughout those areas of such low-cost method and new users accomplished an application study for mercury semi-quantitative determination on fish from local market.

**Key words:** semi-quantitative mercury determination, Itaituba, Manado, low-cost

### **Introduction**

The huge extension where mercury polluted areas are to be found, the lack of laboratory infrastructure and the difficult access (Hacon. 1997) to those places associated to the high cost of analysis by conventional methods (Herber, 1994) has inspired the development of a semi-quantitative, low cost and easy operational method (SMQ), which attends the WHO recommendations (Yallouz, 1997 and Yallouz, 2000). It is important to highlight that this method was idealized so that community agents can easily manage it, after being trained under the supervision of qualified technicians (Yallouz, 2002).

For mercury determination on fish, 10 g of sample is digested with an oxidant mixture, containing sulphuric acid, nitric acid and vanadium pentoxide. To the clear solution containing the ionic mercury, a reducing agent (acid solution of stannous chloride) is added and the formed elemental mercury is forced, through an air stream, this time as mercury vapour, to pass through a detecting paper covered with an emulsion containing cuprous iodide (Cu<sub>2</sub>I<sub>2</sub>). The Figure 1 and Figure 2 show the lab wares needed to perform the analysis. A colourful complex is formed (Equation 1), with a characteristic reddish colour; whose the colour intensity is proportional to the mercury concentration in the sample.



The standard solutions are chosen according to the expected analytical results. For example, one chooses as calibration standards the concentrations that can be used to

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classify fish samples for safe fish consumption according to the WHO recommendations.

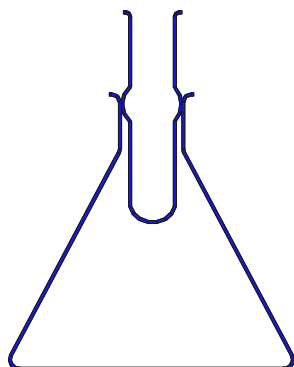


Figure 1: Digestion system  
Erlenmeyer with cold finger

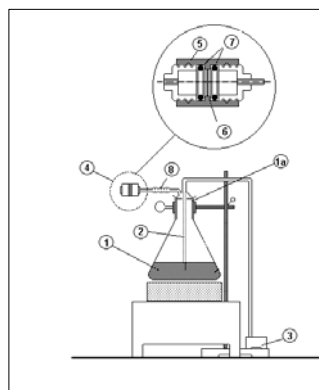


Figure2: Determination system  
Glass made flasks and simple materials

The results are given in concentration range, according to chosen standards. Another possibility is to use this method for screening tests, using only one concentration. Similar colours from the one developed in analytical tests are shown in Figure 3.



Figure 1: Similar colours to those developed in the detecting papers, using standard solutions equivalent to 0, 300, 600 and 1000 ng/g

For quality assurance, the semi-quantitative method has been compared to the cold vapour atomic absorption, whereas since February 2002, the semi-quantitative results are being followed by quarterly performance evaluations coordinated by the Canadian Food Inspection Agency. The results obtained showed that the method is sufficiently accurate even in a semi-quantitative level (Yallouz, 2004a).

### Objectives and Methodology

To introduce the SMQ as a training program, for local users from two small scale gold mining areas - one in the municipality of Itaituba and the second at Manado City, Indonesia, as one of the activities developed by the Global Mercury Project (GMP), under the general coordination of the United Nations Industrial Development Organization (UNIDO).

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Local labs were used in each city and community's leaders indicated the new users. The theoretical concepts were discussed using posters placed on the lab walls and during formal lecture and round table discussion. Each participant received the detailed work instructions and the copy of the transparencies used for lectures. For practical use of the method an intensive and individual training were performed for each of the 16 new users (5 in Itaituba and 11 in Manado) and analytical quality assurance concepts were emphasised. A small application study, using fishes from the city local market, was performed to demonstrate the applicability of the method. The size and length of those fishes, was registered and most of them were pictured. The samples were stored in plastic bags and frozen until the analysis. The used criteria to choose the samples to be analysed was to choose the sample fish habits, the size, and the local consumer preference. It was chosen, whenever possible, to work with 3 different sizes from the same species.

## Results and discussion

During the theoretical lectures the participants had the opportunity to learn about the comparison of the SQM with conventional methods, the importance of this work, the chemical pathways of mercury in the environment and the toxicology of mercury species. New users performed by themselves, under supervision, an application study with fish samples from the local market (29 from Itaituba and 20 from Manado). The results shown in Table I were used as examples for discussion.

Table I – Semi-quantitative mercury analysis of fish samples from the fish market at Itaituba, Brazil and Manado Indonesia, performed by new local users

Popular name	Scientific name	Locality	N	Mercury content (ng/g)
Tucunaré	<i>Cichla ocellaris</i>	Itaituba	4	<100 to 600
Filhote	<i>Brachyplatystoma filamentosum</i>	Itaituba	2	100 to 300
Surubim	<i>Pseudoplatystoma fasciatum</i>	Itaituba	1	600 to 1000
Pirarucu	<i>Arapaima gigas</i>	Itaituba	2	600 to >1000
Pescada	<i>Piaçioscion</i> sp.	Itaituba	2	100-300
Pirapitinga	<i>Colossoma brachypomum</i>	Itaituba	3	<100
Pacu	<i>Metynnis hypsauchen</i>	Itaituba	3	<100
Acari	<i>Panaque</i> sp.	Itaituba	3	<100
Tamoatá	<i>Hoplosternum thoracatum</i>	Itaituba	3	<100
Mapará	<i>Hypophthalmus marginarius</i>	Itaituba	3	<100 to 100-300
Aracu	<i>Laemolva petiti</i>	Itaituba	3	<100
Pani	<i>Thunus</i> sp	Manado	3	~100 to 300-600
Tuna	<i>Thunus</i> sp	Manado	1	~300
Cakalang	<i>Katsuwonus pelamis</i>	Manado	3	<100
Deho	<i>Euthynnus</i> sp.	Manado	1	~100
Malalugis	<i>Decapterus</i> sp.	Manado	3	<100 to ~100
Tude	<i>Selaroides</i> sp.	Manado	1	100-300
Nila	<i>Tilapia nilotica</i>	Manado	6	100-300
Mas -1	<i>Cyprinus carpio</i>	Manado	2	100

The Health Secretary of Itaituba, demonstrated its interest to apply immediately the technique for a screening study. A questionnaire to check the population preference will be applied by health agents (there are about 85 ones, each of them covering about 100 families). Following this step, the most consumed species and the most vulnerable ones will be analysed by the alternative method and the results will be used for an education program with all involved population.

### **Conclusions and further applications**

The experience in Itaituba and Manado was very useful to evaluate and confirm the possibility of SQM training of new local users from polluted areas. As the same lab ware can be used for mercury determination in soils, sediments and mining residues (Yallouz, 2004b), and for mercury determination in urine samples, to help identifying a preliminary elemental mercury intoxication (Yallouz, 2004c), in the near future, both new procedures will be included in training programs. Further applications includes also, continuous monitoring programs to be done in regions where mercury pollution was already described, comparing preference intake of the different groups of fish consumers and the mercury content in fish, to evaluate the risk of contamination. The results may be used to relax the population or to give guidelines about the safer consumption habits.

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