Methylmercury

Methylmercury (Methyl-Hg) belongs to the group of organic mercury compounds. Organic Hg compounds are mainly derived from Hg(II) and are bound to one or two alkyl or aryl groups by covalent bonds. Organic Hg cations often form water-soluble salts with inorganic and organic acids, they have a high affinity for thiol groups and are lipophilic (especially the chloride) [1, 2].

Not only methyl-Hg but also ethyl-Hg, methoxyethyl-Hg and phenyl-Hg compounds were used, in some cases globally, as fungicides and seed protection agents [2]. Plant protection agents on the basis of organic Hg compounds have been completely prohibited in the Federal Republic of Germany since 1988 [3]. Today organic Hg compounds are used only rarely, e.g. the ethyl-Hg compound thiomersal (CH_3CH_2-Hg-S-C_6H_4-COOH) as a preserving agent in vaccines, immunoglobulin preparations and in nose and eye drops [4].

Methyl-Hg is the most relevant representative of the organic Hg compounds on account of its marked bioaccumulation in the aquatic food chain and its high toxicity. Methyl-Hg is formed in the environment largely as a result of biomethylation of inorganic mercury from natural and anthropogenic sources. The general population is mainly exposed to methyl-Hg as a result of consuming fish and other seafood [1]. The proportion of methyl-Hg in the total mercury content in fish is 80 to 90% [5].

Methylation of mercury by bacteria in the intestines and the oral cavity has been shown *in vitro* [6, 7]. However, as far as quantity is concerned *in vivo* methylation of inorganic mercury in humans is only of minor importance compared with the intake of methyl-Hg with fish [8, 9].

The toxicological properties have been discussed in several review articles and monographs [1, 4, 10, 11]. Organic mercury compounds (comprising methyl-Hg, ethyl-Hg and phenyl-Hg) were assigned to carcinogen category 3 B by the Deutsche Forschungsgemeinschaft's Committee for the Investigation of Health Hazards of Chemical Compounds in the Work Area on account of their suspected carcinogenic effects [12].

The average quantity of methyl-Hg taken in daily with nutrition is 2 µg or 0.03 µg/kg body weight and day [4]. The PTWI (provisional tolerable weekly intake) defined by the WHO is 3.3 µg/kg body weight or 0.47 µg/kg body weight and day, but the RfD (reference dose) of the U.S. EPA is only 0.1 µg/kg body weight and day [4].

In accordance with the recommendation of the Human Biomonitoring Commission (HBM) of the Federal German Department for the Environment [Umweltbundesamt] the intake of Hg species is quantified and evaluated for the purpose of environmental medicine by measurement of the total Hg content in various indicator materials. The total mercury content in the indicator materials blood and hair reflects the intake of organic mercury, which is generally equivalent to exposure to methyl-Hg as a result of consumption of fish. The total content of mercury in the urine is a measure of the exposure to inorganic mercury and is correlated to the number of dental fillings [4].

The reference values for the internal exposure to organic mercury (as total mercury) were determined as 1.5 µg/L in the blood of children or 2 µg/L in the blood of adults without amalgam fillings (consumption of fish up to three times a week) [4]. The relevance of the internal levels to health can be classified using the ratings proposed by the HBM Commission (HBM values). HBM I (test or control value) and HBM II (intervention or action value) are based on blood levels. The HBM I value was stipulated as 5 µg/L blood, the HBM II value is 15 µg/L blood [4].

Investigations into exposure to methyl-Hg are usually performed on blood. However, the selectivity of the measured parameter, total mercury, is limited, as inorganic mercury from occupational exposure or from amalgam fillings is also determined. In view of the differing sources of exposure and the varying toxicity of the individual Hg species, selective assay of these compounds is of increasing interest to environmental medicine. Methods for direct determination of methyl-Hg are already used for routine analysis of blood [13, 14], urine [8, 15], hair [16] and tissue [17].

More than 300 blood samples of people who were not exposed to Hg at the workplace were analysed under routine conditions using the method presented here. The following population indices in µg/L blood were found (Table 1).

Table 1. Methyl-Hg content in blood samples of members of the general population who are not occupationally exposed to the substance (n=356)

	Methyl-Hg concentration in the blood [µg/L]
Mean value	1.7
Median	1.1
95^{th} percentile	5.2
Minimum	0.5
Maximum	29.5

The study showed that the HBM I value for organic mercury (5 µg/L blood) was exceeded in 6% of the investigated cases. 49 of these blood samples were investigated for methyl-Hg and total mercury (by means of cold vapour AAS) in parallel. Both parameters showed good correlation (r^2=0.868). The mean proportion of methyl-Hg of the total mercury was 67% (range: 20 to 100%).

Author: *H. W. Hoppe*, Tox-Labor, Biomonitoring, DFG
Examiner: *R. Heinrich-R*