Levels PCDD/Fs in omul from Lake Baikal

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Introduction

The omul (*Coregonus autumnalis migratorius*) is a relative of the whitefish native to Lake Baikal. Due to its excellent taste and the large population in the lake (an estimated 30,000 tonnes (1)), it is a popular sport and commercial fish and makes up a significant portion of the diet of many people in the Lake Baikal region. Given the reports of high levels of PCDD/Fs in the Lake Baikal environment (2), concern arose that Omul might be a significant route of human exposure to these compounds. In order to investigate this issue we undertook to analyze PCDD/Fs in several omul.

To provide a basis of comparison, two other fish species were analyzed: *Rutilus rutilus lacustris* (plotva, soroga) and *Perca fluviatilis* (okun). These species inhabit the delta of the Upper Angara river which drains a remote virtually unsettled area with no known sources of PCDD/Fs.

Experimental Methods

Omul were purchased fresh from local fisherman during the summer of 1997. *Rutilus*

Table 1: Characteristics of the fish samples

Sample	Location	Time of sampling	Age (yr)	Lipids (%)
Coregonus autumnalis migratorius (omul)	South Basin	August 1997	5	3.7
Coregonus autumnalis migratorius	Maloye More	July 1997	8-9	7.2
Coregonus autumnalis migratorius	North Basin	July 1997	6-7	4.2
Rutilus rutilus lacustris (plotva, soroga)	Delta of Upper Angara River	July 1997	6-12	2.8
Perca fluviatilis (okun)	Delta of Upper Angara River	July 1997	4-5	2.9

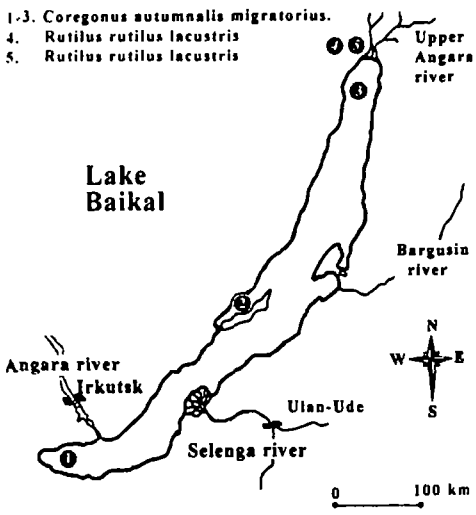

Figure 1: Map showing the sampling sites.

rutilus lacustris and *Perca fluviatilis* were supplied by the North-Baikal fishery (see Fig.1). The age of the fish was estimated from scales (see Table 1). The fish were frozen, transported to the laboratory, gutted, dried and refrozen at –20°C until transport to the University of Bayreuth for analysis.

Composite samples of 5-10 fish of the same age were analyzed. The extraction and cleanup is summarized in ref 2. The analyses were conducted using HRGC/HRMS at a mass resolution of 10,000. The 2,3,7,8-substituted PCDD/F congeners were quantified. The toxicity equivalents (TEQs) were calculated using the TEFs for human recently proposed by the WHO working group.

Results and Discussion

The results are summarized on a TEQ basis in Figures 2 and 3. The concentrations in

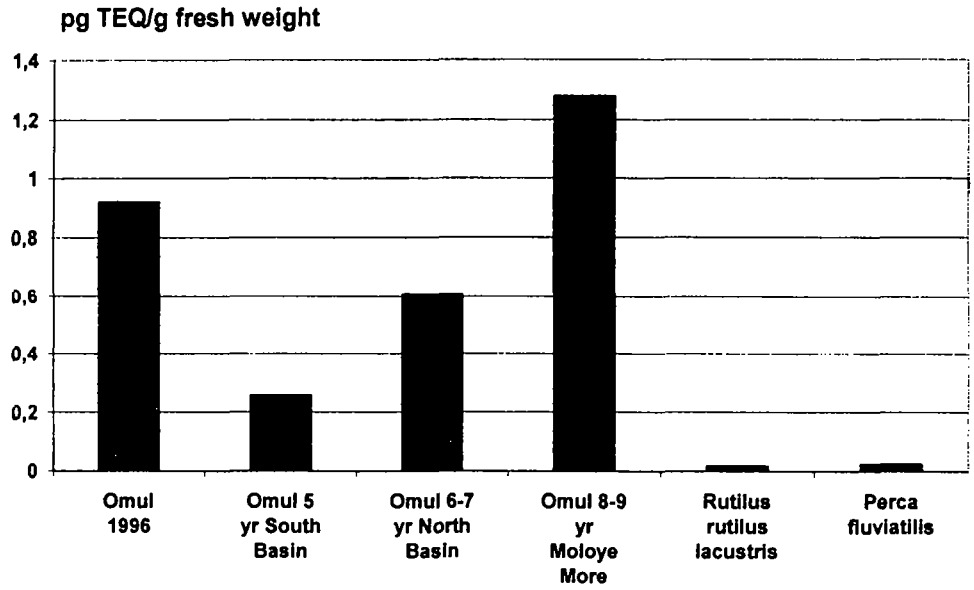

Figure 2: PCDD/F concentrations in omul on a fresh weight basis (TEQs calculated using the WHO TEFs for humans).

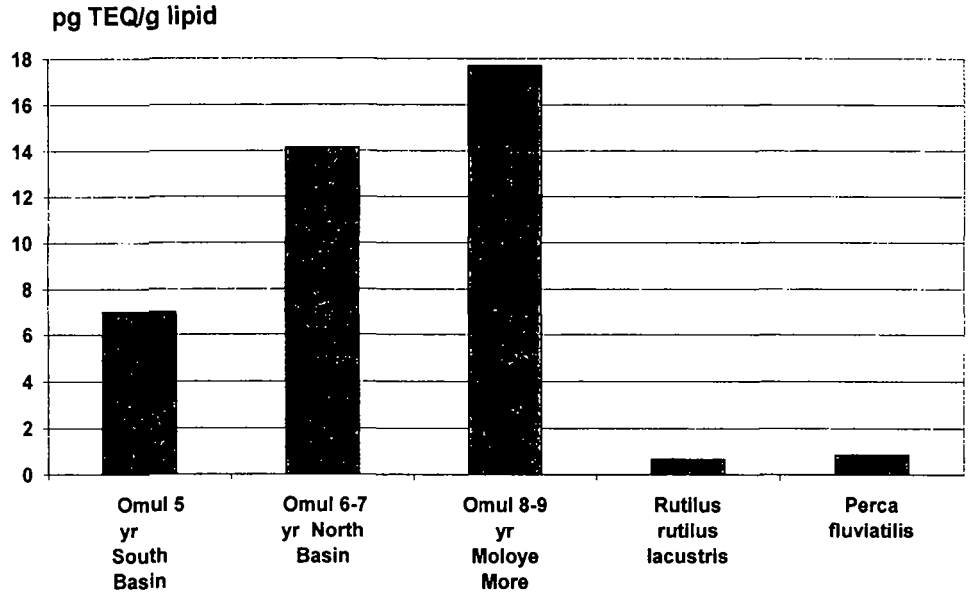

Figure 3: PCDD/F concentrations in omul on a lipid weight basis (TEQs calculated using the WHO TEFs for humans)

omul were more than an order of magnitude higher than the concentrations in the two fish species inhabiting the delta of the uncontaminated river. This is further evidence that Lake Baikal has been subject to PCDD/F inputs well above the continental background.

The concentrations in omul on both a fresh weight and a lipid weight basis increase with the age of the fish. While it might be argued that the differences are related to the sampling location, omul are highly migratory and move constantly throughout the lake (in contrast to the pelagic sculpin *Comephorus* (3)). Hence the PCDD/F levels likely reflect the average overall level of lake contamination more than the local level. The differences in levels between the 3 samples are more likely to reflect an increase in bioaccumulation with age.

Figure 2 also includes the average TEQ concentration measured in 3 samples of 5-6 year old omul that were collected in 1996 (2). This value agrees quite well with the levels determined in this study, the average levels in 1996 lying about 2 times higher than in omul of the same age from 1997.

A person with a high average fish consumption who consumed 100 g/d of the most contaminated fish in this study (1,28 pg TEQ/g fresh weight) would ingest 128 pg TEQ/d or ~1.9 pg TEQ per day and kg body weight. This is comparable to the average TEQ uptake in Germany at the beginning of the 1990's (4). Expressed in another way, the average concentration in the 3 omul samples of 0.72 pg TEQ/g fresh weight is comparable to that in European butter. Thus omul can be a significant source of PCDD/F uptake.

Acknowledgments

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