

The level of dioxins and dioxin-like PCBs in perch (*Perca fluviatilis*) in Latvia's inland bodies of water

In accordance with the agreement concluded between the United Nations Development Programme Latvia Projects Office and the state agency "Latvijas Zivju resursu aģentūra" (Latvian Fish Resources Agency), five perch samples from Latvia's inland bodies of water were prepared in November 2008 for determining the concentration of dioxins and dioxin-like PCBs. Fish (perch) samples were taken at the following locations:

1. Lake Ķīšezers,
2. Lake Liepāja,
3. Lake Burtnieks,
4. River Lielupe near Jelgava,
5. River Daugava near Aizkraukle.

Perch samples were taken from inland bodies of water near populated areas in various districts of Latvia, except for Lake Burtnieks, where there are no large populated areas; a sample was taken there for the purpose of comparison. Perch samples were taken from fish caught in nets.

Perch samples required for analysing the level of dioxins and dioxin-like PCBs were prepared as follows:

- the weight (g), the length (cm) and gender of the fish were determined and registered;
- the head and the caudal fin was cut off, and fishbones were removed; the right-side muscles of the fish's back and stomach (the right side of the dorsal-ventral muscle) were removed separately;
- the weight of each sample was at least 500g;
- the prepared fish samples were placed in hermetic packaging;
- the prepared samples were kept cold until the moment they were sent to the laboratory.

Preparation of samples complied with the requirements according to which only those parts of fish had to be analysed that are used for food. Both male and female fish were used as samples. The average biological parameters of perch in the prepared samples are shown in Table 1.

Table 1
The average biological parameters of perch in the collected samples

No.	Place of sampling	Average length (cm)	Average weight (g)	Average age (years)
1	Lake Ķīšezers	23.1	150.1	6.7
2	Lake Liepāja	23.5	178.1	8.3
3	Lake Burtnieks	26.0	368.8	8.1
4	River Lielupe near Jelgava	20.7	119.3	7.6
5	River Daugava near Aizkraukle	22.6	149.0	6.8

The analysis of dioxins and dioxin-like PCBs was carried out in the certified laboratory ALS in the Czech Republic. The results of the analysis are summarised in Table 2. During the analysis of the perch samples, the level of dioxins and dioxin-like PCBs (polychlorinated biphenyls) was determined. A small number of PCBs exhibit toxicological properties similar to dioxins; therefore, they are often termed dioxin-like PCBs. In order to assess the toxicity of these various substances, the concept of toxic equivalency factors (TEFs) has been introduced. This means that the analytical results relating to all the individual dioxin and dioxin-like PCB congeners of toxicological

concern are expressed in terms of a quantifiable unit, namely the "TCDD toxic equivalent" (TEQ). (Commission Regulation (EC) No.199/2006 of 3 February 2006).

Table 2

The level of dioxins and dioxin-like PCBs in perch samples taken from Latvia's bodies of water

No.	Place of sampling	Dioxins WHO TEQ (pg/g fresh weight)	Dioxin-like PCBs WHO TEQ (pg/g fresh weight)	Total WHO TEQ (pg/g fresh weight)
1	Lake Ķīšezers	0.41	0.32	0.73
2	Lake Liepāja	0.10	0.42	0.52
3	Lake Burtnieks	0.07	0.12	0.19
4	River Lielupe near Jelgava	0.11	0.19	0.30
5	River Daugava near Aizkraukle	0.09	0.17	0.26

The dioxin level found in all samples was considerably lower than the limit values set by the European Union: the maximum level of dioxins – 4.0 pg/g fresh weight; the maximum level for the sum of dioxins and dioxin-like PCBs – 8.0 pg/g fresh weight. In general, the results correspond to characteristics associated with the prevalence and occurrence of dioxins in bodies of water. The highest dioxin level was found in lakes near populated areas, namely in Lake Ķīšezers and Lake Liepāja, where the water exchange is much less intensive than in rivers. The lowest dioxin level and dioxin-like PCBs was found in Lake Burtnieks in whose vicinity there are no large populated areas; this location was chosen in order to compare the contamination level in perch taken from bodies of water located near populated areas and those taken from a relatively less polluted body of water.

The dioxin level in perch was also determined in 2003, when samples were collected from bodies of water in the city of Riga. Since in 2003 the European Commission's limitations applied only to the level of dioxins in foodstuff, fish samples were analysed only with regard to the dioxin level. The dioxin level found in samples taken in 2003 was approximately three times lower than the permissible norm; nevertheless, it was two and a half to three times higher than the level in 2009 (Table 3). These differences may be attributed both to a decreased dioxin level in the environment and to distinctive properties of the collected samples; other studies also reveal rather significant differences between the dioxin level in different samples of the same species of fish.

Table 3

The dioxin levels and the average parameters of perch samples in 2003

Sampling location	Dioxin level (pg/g fresh weight)	Average length (cm)	Average weight (g)
River Daugava, Kundziņsala	1.18	16.72	91.7
Lake Ķīšezers, Mežaparks	1.47	20.75	184.9
Lake Ķīšezers, northern part	1.37	22.43	236.7
Lake Ķīšezers, Vecmīlgrāvis	1.45	21.16	212.7
River Daugava, reservoir of the hydroelectric power station	1.04	20.29	155.1

Dioxins accumulate in animals' adipose tissue; the older the animal, the more dioxin it contains. Analysis of the perch samples collected in 2003 revealed a relatively clear correlation between the dioxin level and the average weight of perch (Figure 1). It would not be valid to carry out such a comparison with regard to samples collected in 2008 because sampling was done in different places with different levels of pollution. In Latvia, samples collected from catches of fish, namely, Baltic herring (caught in the Gulf of Riga) and sprat, revealed a very close correlation between the age of the fish and the dioxin level in them. For various sample groups, it ranged from 0.73 to 0.99; the average value was 0.88 (Figure 2). A similar correlation with regard to these fish species has also been found in other parts of the Baltic Sea (Roots, Zitko, 2006).

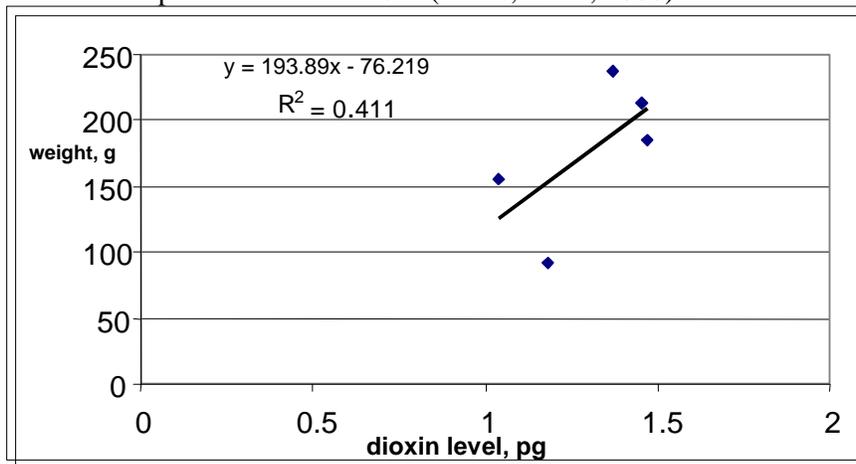


Figure 1
The dioxin level and the average weight of a perch in samples collected in 2003 from bodies of water in Riga.

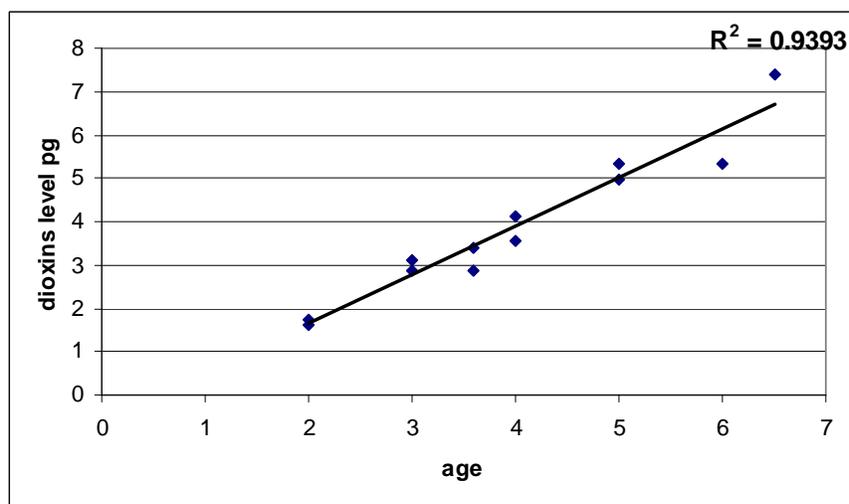


Figure 2
The correlation between the age of Baltic herring and their dioxin level found in samples collected from the Gulf of Riga in January 2003

With regard to the level of dioxins and dioxin-like PCBs in perch, the results of the analysis show that perch caught in Latvia's water bodies can be safely used for food. Studies on the level of toxic substances in inland-water fish of the Baltic Sea Region show that it has usually been lower than the set norm. In Sweden, the permissible level of dioxin was exceeded only in several cases regarding salmon and char. Also in Finland, the dioxin level in freshwater fish, including perch, has been below the permissible norm.

In the Baltic Sea Region, an increased level of dioxins and dioxin-like PCBs has usually been found only in fish with high fat content – e.g., salmon, Baltic herring and sprat. Therefore, several countries have imposed restrictions regarding the sale of salmon. In Latvia, it is forbidden to sell Baltic salmon whose length exceeds 72 cm and which weigh more than 4 kg. Sweden and Finland have been granted exceptions to release on their market for internal consumption fish from the Baltic Sea Region which have a higher dioxin concentration than is allowed by the EC regulation. These member states have met the requirements with regard to informing consumers about dietary recommendations. These countries have annually informed the European Commission about the dioxin concentration in fish samples from the Baltic region, and they have reported on the measures they have taken to reduce the effect upon people of dioxin found in the fish of the Baltic region. Consumers are informed about the dioxin level in these fish and about health risks caused by too frequent consumption of these fish.

Perch are relatively lean fish because the amount of fat in muscle tissues is low. The amount of fat found in muscle tissues of the collected samples ranged from 0.3% to 0.49% (the average indicator was 0.38%). In general, it can be considered that the contamination levels found during the analysis matched the levels that were expected and that perch from Latvia's water bodies can be safely used as food.

Roots, O., and Zitko, V. 2006. The effect of age on the concentration of poly-chlorinated dibenzo-p-dioxins, dibenzofurans and dioxin-like polychlorinated biphenyls in Baltic herring and sprat. *Fresenius Environmental Bulletin*, Vol. 15, No. 3, pp. 207-219.

Roots, O., Schramm, K.-W., Simm, M., Henkelmann, B., and Lankov, A. 2006. Polychlorinated dibenzo-p-dioxins and dibenzofurans in Baltic herring and sprat in the north-eastern part of the Baltic Sea. *Proc. Estonian Acad. Sci. Biol. Ecol.*, Vol. 55, No. 1, pp. 51-60.

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