Valuable facts about Icelandic seafood

matís

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Quality and safety of Icelandic marine products

In 2003, the Icelandic Ministry of Fisheries initiated a project aimed at monitoring undesirable substances in the edible portion of marine catches in Iceland. Matís was assigned the responsibility of carrying out the surveillance programme. The goal of the surveillance programme is to gather information on various pollutants in a number of economically important marine species for Icelandic export. These species are captured in Icelandic fishing grounds and are monitored for: heavy metals, polychlorinated dibenzo dioxins and dibenzo furans (commonly called dioxins), dioxin-like polychlorinated biphenyls (PCBs), marker PCBs, polybrominated flame retardants (PBDEs), polyaromatic hydrocarbons (PAHs), 29 pesticides and their breakdown products.

Scientific data maintains a positive image of seafood products

The purpose of the surveillance programme is to gather information and evaluate the status of Icelandic seafood products regarding undesirable substances. The monitoring also provides scientific evidence that Icelandic seafood products conform to regulations on seafood safety and can therefore help to maintain a positive image of Icelandic seafood products. In addition, the project aims to provide independent scientific data for food authorities, fisheries authorities, industry, markets and consumers. The information will also be utilized for risk assessment and to establish maximum values that are constantly under revision within the European Union (EU), one of the most important market for Icelandic seafood products.

The project fills in gaps of knowledge regarding the level of undesirable substances in economically important marine catches. It is considered to be a long-term project where extension and revisions are constant.

Norway lobster
Nephrops norvegicus

Saithe, pollock
Pollachius virens

Catfish
Anarhichas lupus

Plaice
Pleuronectes platessa

Redfish, ocean perch
Sebastes marinus

Haddock
Melanogrammus aeglefinus

Herring
Clupea harengus

Schrimp
Pandalus borealis

Greenland halibut
Reinhardtius hippoglossoides

Cod
Gadus morhua

Monitoring is necessary to ensure quality and safety

In this brochure, the results from the Icelandic surveillance programme for various pollutants from the past five years are compiled and illustrated graphically for ten economically important marine species. The pollutants/undesirable substances are measured in the edible part of the seafood, and the results are presented based on the average level of each pollutant measured from 2003 to 2008. The marine species presented here provide an example of the type of data available from the Icelandic surveillance programme and are intended to shed a light on the status of the levels of undesirable substances in Icelandic seafood products. Additional data, for other marine species and fisheries products, as well as fish meal and fish oil for feed, have been published in annual reports from the Icelandic surveillance programme. These reports are open to the public and can be accessed at the Matís homepage (www.matis.is).

Levels of pollutants in the edible part of Icelandic seafood are low in comparison to available EU maximum limits. The level of dioxins and dioxin-like PCBs in the edible part of the seafood is approximately 1/10 of the limit set by the EU. The concentration of marker PCBs is also found to be low, compared to existing maximum limits in Europe. The concentrations of heavy metals, e.g. cadmium (Cd), lead (Pb) and mercury (Hg) in Icelandic seafood are generally well below the maximum limits set by EU.

One of the main exposure routes to the undesirable substances presented in this brochure is through food. It is therefore important to monitor how much of these undesirable substances are present in food in order to ensure the safety and well-being of consumers. Following is a short description of the different chemicals and chemical groups that are of main concern in connection with to seafood consumption.

About Matís

Matís is an independent research institute with 100 percent governmental ownership. The total turnover in 2009 was about $USD 10 million working capital, of which 39% was coming from the Icelandic Government. Matís is located in seven cities or towns around Iceland. Matís' employees are many of Iceland's most competent scientists in the field of food technology, food research and biotechnology; food scientists, chemists, biologists, engineers and fisheries scientists. Several of Matís employees have a part-time position at universities in Iceland and about 14 Ph.D. students and many M.Sc. students are doing their research at Matís.

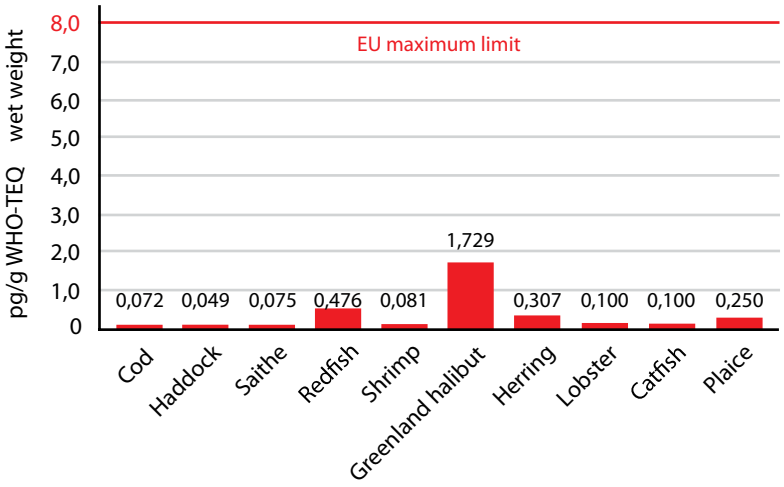
Matís is working in research and development for the authorities, food industry, fisheries and aquaculture. Matís focuses on innovation in food and biotechnology, various services in the food industry in Iceland and abroad and to increase safety and quality of food products.

Dioxins

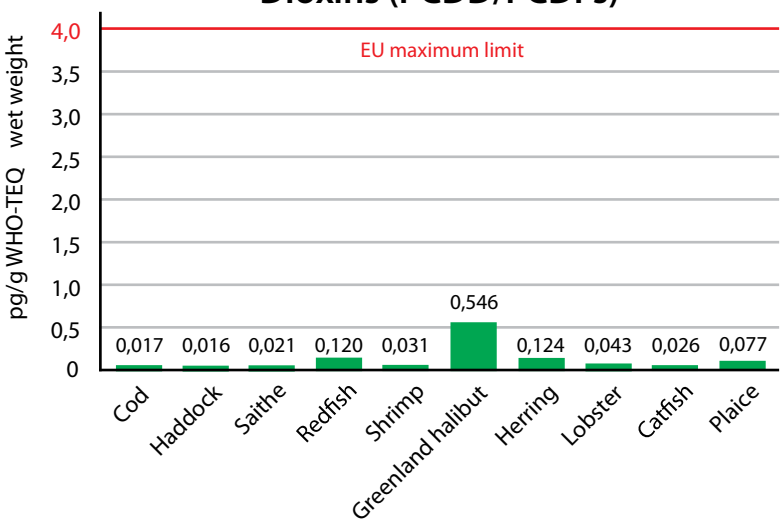
Dioxins are a group of chemicals, all of which have similar structure and properties. Dioxins are formed during incomplete combustion, both due to natural causes (e.g. forest fires and volcanic eruptions) and as by-products in industrial processes such as incineration of chlorine containing waste (e.g. PVC). Dioxins can also form during e.g. bleaching of papers and textiles. When dioxins enter the environment, they break down very slowly and, consequently, their life span in the environment is very long. Within the body, dioxins are mostly found in fat and fatty tissues, were they accumulate during the life of the animal/person. Generally, dioxins are very toxic compounds and the most notorious and toxic is 2,3,7,8-tetrachlorodibenzo-p-dioxin or TCDD. Dioxins can cause reproductive and developmental problems, damage the immune system, interfere with hormones and also cause cancer.

The concentrations of dioxins are commonly very low compared to other compounds as e.g. PCBs. But due to their high toxicity, the concentration is converted into toxic equivalent (TEQ) in order to assist risk assessment and effects on animals and humans. This is done by estimating the toxicity (toxic equivalent factor, TEF) of each dioxin compound from 0 to 1 with TCDD assessed to have TEF = 1. TCDD, the most toxic member of this chemical group, is thus used as reference compound, and all other dioxins are assigned a toxic potency relative to TCDD, based on experimental studies. The concentration of dixions in the samples is then multiplied with TEF, resulting in TEQ.

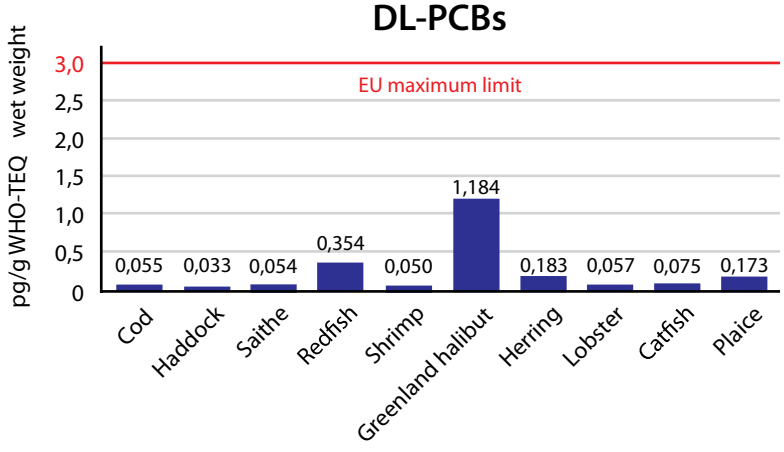
Sum of Dioxins and DL-PCBs

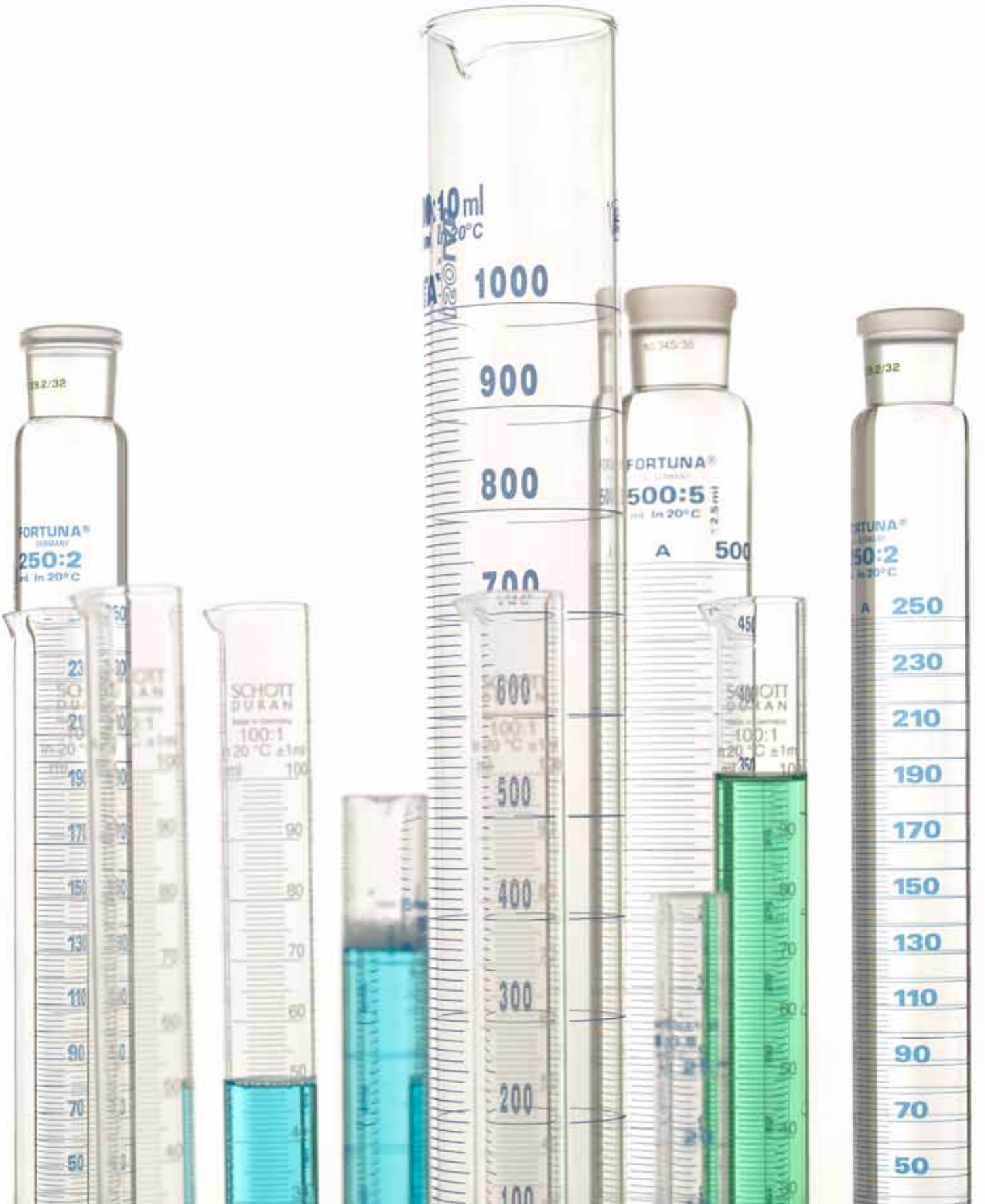


Dioxins (PCDD/PCDFs)



DL-PCBs

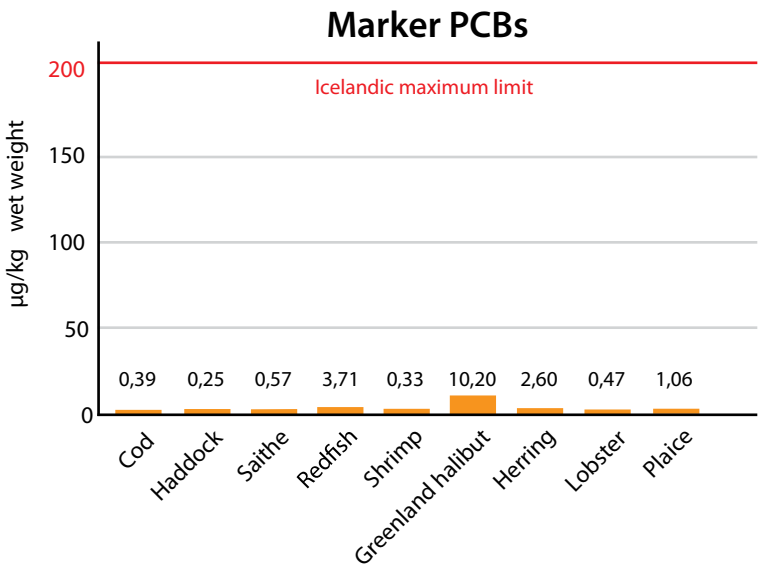



FORTUNA®
250:2
FORTUNA®
500:5
A 500
SCHOTT
DURAN
100:1
1000
900
800
700
600
500
400
300
200
100
250
230
210
190
170
150
130
110
90
70
50

Marker PCBs

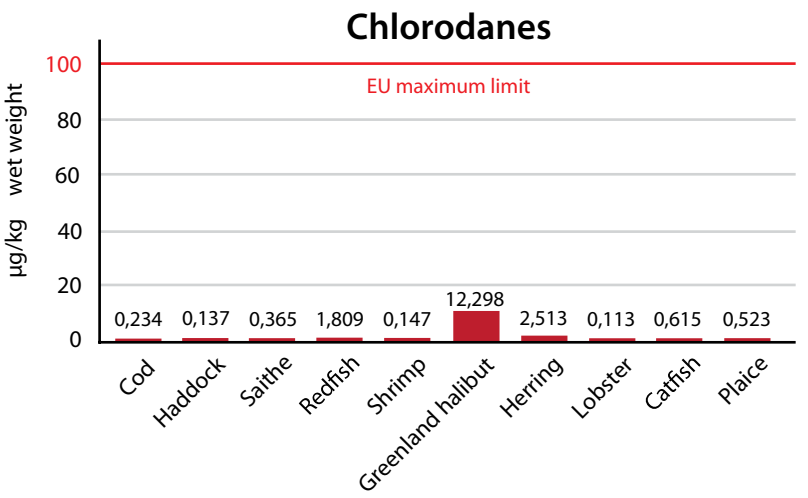
PCBs (Polychlorinated biphenyls) is a group of chemicals consisting of a total of 209 different "congeners". These different congeners are separated with a numbering system (CB-1 to CB-209). PCBs are tolerant to high heat, pressure and are not easily degraded. These properties were utilized when PCBs were used in e.g. lubricant oils and hydraulic fluids, in transformers and capacitors as well as plasticizers in paints and cements, stabilizing additives in flexible PVC coatings of electrical wiring and electronic components. Industrial production started in 1929 but it was not until 1966 that PCBs were first discovered in environmental samples, where they entered the environment both by use and disposal of products containing PCB. Use in open systems was banned in the 1970s and all use of PCBs is banned today. Adverse effects on the environment and organisms have been documented including disruption to the hormonal system and reproduction. Exposure to high concentration of PCBs causes a skin condition called chloracne. Other effects in humans are decreased cognitive development, lower birth-weight, as well as reproductive problems.

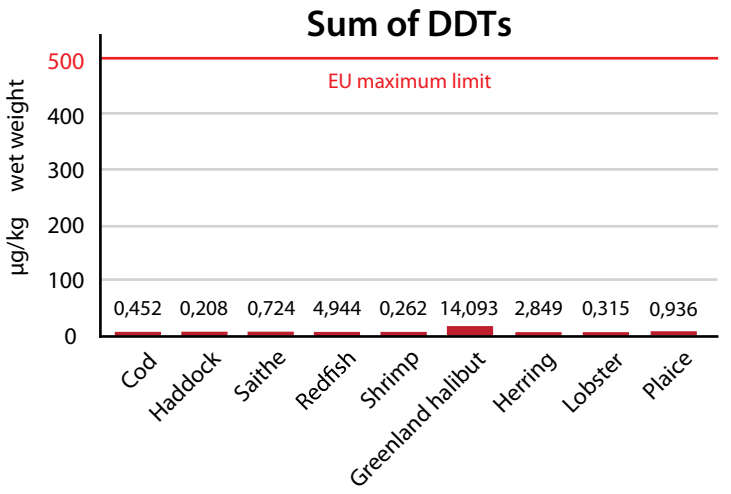
Marker PCBs, sometimes called "Dutch seven" or ICES7, are seven PCBs that have been measured for many years as an indication of the total PCB contamination. Their numbers are: CB-28, CB-52, CB-101, CB-118, CB-138, CB-153, CB-180, where one (CB-118) shows dioxin-like toxicity. These congeners have been selected due to their concentration in environmental samples



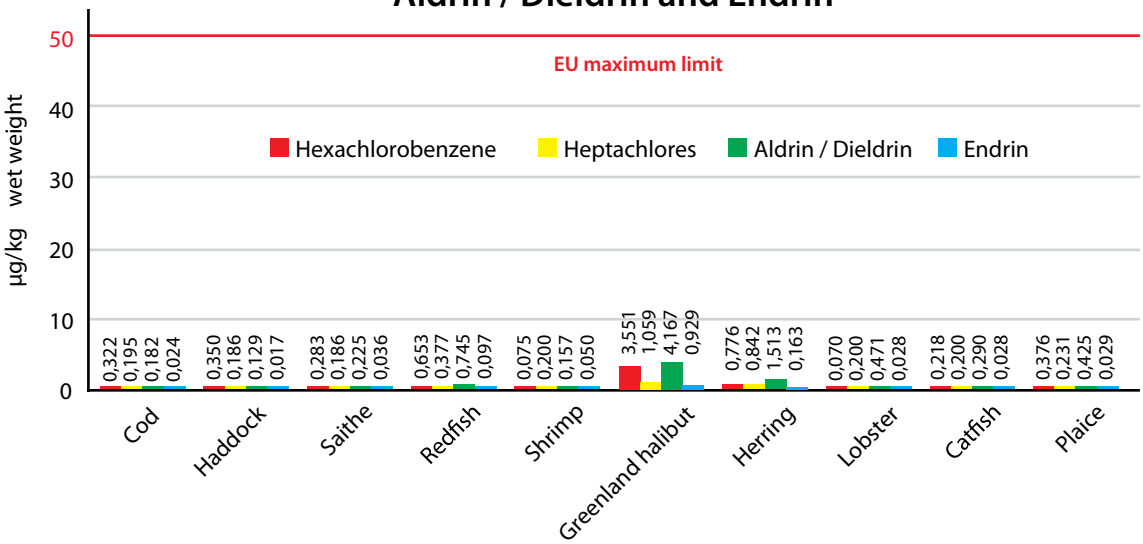
Pesticides

Pesticides are used to control pests of different kind and can be divided into herbicides, fungicides, incecticides, miticides, molluscicides, bactericides etc. Several pesticides used after the Second World War have been shown to be persistent, bioaccumulative and toxic. This means that they break down very slowly in the environment, their concentration increases with age in organisms and cause adverse effects in humans and animals. Due to this, some have been banned. Twelve different pesticides/pesticide groups are monitored in the Icelandic surveillance program, DDT (dichloro diphenyl trichloroethan), HCH (hexachlorocyclohexane, one known as lindane), HCB (hexachlorobenzene), chlordanes, toxaphenes, aldrin, dieldrin, endosulfan and endosulfanates, endrin, heptachlors and octachlorostyrene. Most of these pesticides have now been banned within EU and maximum limits for several of these pesticides in food and feed have been set.



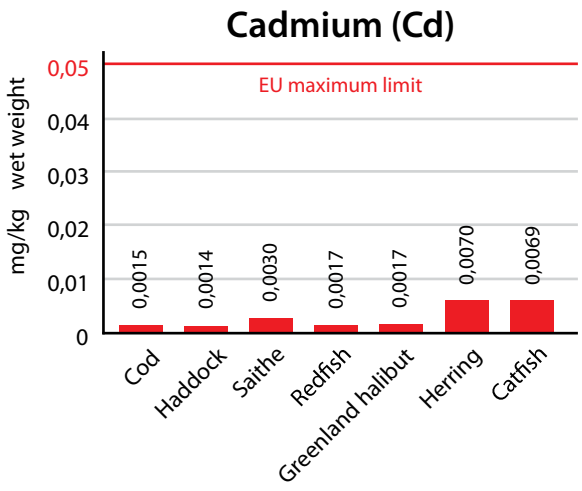


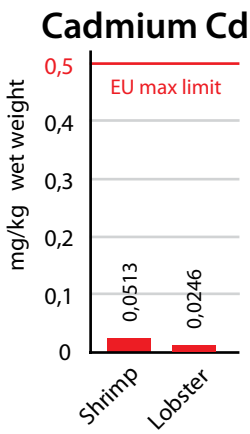
Hexachlorobenzene, Heptachlores, Aldrin / Dieldrin and Endrin

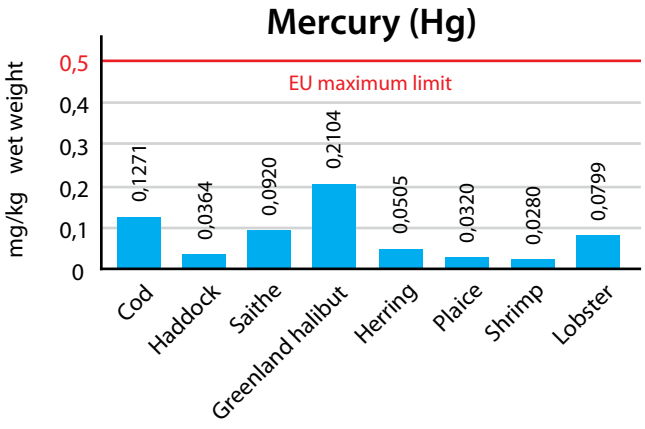


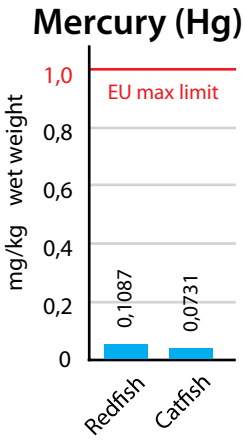
Metals and heavy metals

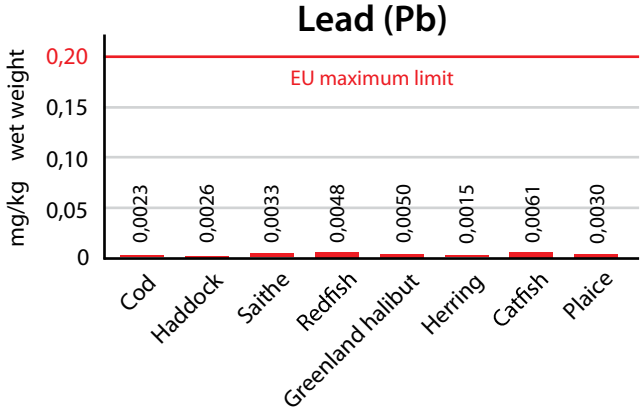
Metals occur naturally in the environment. This means that both natural and human processes and sources emit metals into air and water. Increased human activity, such as mining, incineration and transport, can cause elevated levels of metals. Natural processes that can release metals into the environment are for example erosion, forest fires, and volcanic activity. Different geographical areas can have higher concentration of metals due to e.g. higher volcanic activity, type of rock and soil. Some metals have an essential function in the human body whereas others have no natural function and can cause adverse effects on e.g. foetal development and brain functions in humans and animals. Metals that are monitored in the Icelandic surveillance program are Hg (mercury), Cd (cadmium), Pb (lead), As (arsenic), Se (selenium), Zn (zinc), Cu (copper), Fe (iron) and Cr (chromium). EU has set maximum levels for several metals in food and feed, such as arsenic, lead, mercury and cadmium. Please note that the EU maximum limits for heavy metals depend on the fish species.

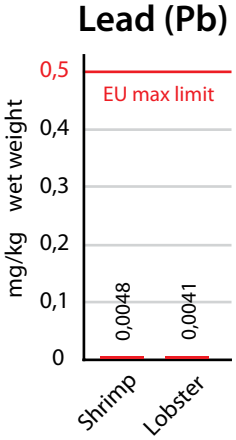

Cadmium (Cd)
mg/kg wet weight
0,05
0,04
0,03
0,02
0,01
0
EU maximum limit
0,0015
0,0014
0,0030
0,0017
0,0017
0,0070
0,0069
Cod
Haddock
Saithe
Redfish
Greenland halibut
Herring
Catfish


Cadmium Cd
mg/kg wet weight
0,5
0,4
0,3
0,2
0,1
0
EU max limit
0,0513
0,0246
Shrimp
Lobster


Mercury (Hg)
mg/kg wet weight
0,5
0,4
0,3
0,2
0,1
0
EU maximum limit
0,1271
0,0364
0,0920
0,2104
0,0505
0,0320
0,0280
0,0799
Cod
Haddock
Saithe
Greenland halibut
Herring
Plaice
Shrimp
Lobster


Mercury (Hg)
mg/kg wet weight
1,0
0,8
0,6
0,4
0,2
0
EU max limit
0,1087
0,0731
Redfish
Catfish


Lead (Pb)
mg/kg wet weight
0,20
0,15
0,10
0,05
0
EU maximum limit
0,0023
0,0026
0,0033
0,0048
0,0050
0,0015
0,0061
0,0030
Cod
Haddock
Saithe
Redfish
Greenland halibut
Herring
Catfish
Plaice


Lead (Pb)
mg/kg wet weight
0,5
0,4
0,3
0,2
0,1
0
EU max limit
0,0048
0,0041
Shrimp
Lobster

PAH

PAHs (Polyaromatic hydrocarbons) consist of two to seven benzene rings that are fused together. Larger PAH molecules also exist, however these are less common. PAHs originate from oil, coal and tar products. As for the dioxins, these compounds are also formed during incomplete combustion, as e.g. in car engines, smoking, industrial incineration at too low temperature. PAHs are not considered persistent and do not bioaccumulate or biomagnify, but due to their extensive occurrence and production they are considered a pollutant of concern. Several PAHs are classified as probable human carcinogens and thus can lead to adverse health effects. PAHs are rarely detected in seafood caught in Icelandic fishing grounds and in case they are, the concentrations of PAH are very low. This is why there is no data presented for PAHs in the selected seafood products in this brochure.

PBDEs

PBDEs (Polybrominated diphenyl ethers) are a group of total 209 compounds, using the same numbering system as for PCBs. These compounds have been used as flame retardants, and are commonly known as brominated flame retardants. Flame retardants are chemicals that are added to products in order to inhibit or resist the spread of fire. PBDEs have been added to e.g. electronics, plastic building material, airplanes and even textiles. Three commercial products were available, pentaBDE, octaBDE and decaBDE, where two of them (penta and octa) were banned by the EU in 2008. Like dioxins and marker PCBs, PBDEs can bioaccumulate and biomagnify in the food chain, causing high concentration in top predators. Adverse effects have been documented, both for animals and humans, such as disruption of the hormonal system and decreased reproduction ability. Recent study indicates that there is a connection between hyperthyroidism in pet cats and high concentrations of PBDEs in their blood. PBDEs are detected in seafood caught in Icelandic fishing grounds but in very low concentrations. This is why there is no data presented for PBDEs in the selected seafood products in this brochure.