

Recent contaminant analyses
indicate potential for health risks
to humans from consumption of
Norwegian whale meat



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Summary

Eight pieces of raw or frozen minke whale meat were purchased from four grocery stores in Norway and from two Norwegian online shopping websites from March to September 2023.¹ The samples were frozen and sent in their original packaging to Akvaplan-niva in Tromsø, where they were analyzed for a range of contaminants in September 2023.² Akvaplan-niva is a non-profit research and development institute with expertise in all aquatic environments that provides accredited laboratory services for chemical analysis.³

The most significant finding was that perfluorooctane sulfonate (PFOS) was found in all the whale meat samples, with levels ranging from 1.1 to 7.2 $\mu\text{g}/\text{kg}$ and averaging 3.23 $\mu\text{g}/\text{kg}$.⁴ PFOS is among a class of chemicals known as per- and polyfluoroalkyl substances (PFAS).⁵

At the average level identified in the samples, consumption of just 100 grams of whale meat a week – approximately the size of a deck of playing cards – will cause a human weighing 70 kg (154 lbs) to exceed the tolerable weekly intake (TWI)⁶ for PFOS established by the European Food Safety Authority (EFSA).⁷

The Norwegian Food Safety Authority is concerned about the impacts of PFAS consumption; it has advised the public against eating fish with levels of PFAS comparable to that found in the whale meat samples tested.⁸ However, it does not currently give any advice relating to the levels of these substances in marine mammal products for human consumption.

The research raises concerns that people who eat whale meat are risking their health. With just one small meal, a person may consume levels of PFAS chemicals that exceed safe limits. This is of special concern for children and adolescents. A recent study by the Norwegian Institute for Public Health (NIPH) found that more than one in four (28.6%) Norwegian children tested at PFAS levels in excess of what is considered safe.⁹

PFAS and PFOS chemicals

PFAS – per- and polyfluoroalkyl substances – are a class of man-made chemicals that have been used for over 50 years in a number of products, including food packaging, frying pans, waterproof clothing, electronics, fire extinguishing foam, cleaning products, and certain types of ski lubricants.¹⁰ Known as “forever chemicals”, their widespread use and persistence in the environment has resulted in extensive environmental contamination, especially in water systems.¹¹ The presence of PFAS in human food is primarily the result of bioaccumulation in aquatic and terrestrial food chains. A study from Norway showed that diet was the predominant source of human exposure to PFAS.¹²

PFOS – perfluorooctane sulfonate – is one of more than 7,000 types of PFAS.¹³ It is among the most-studied of these chemicals, along with perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), and perfluorohexanesulfonate (PFHxS).

Health effects of PFAS

In 2020, the European Food Safety Authority issued a statement about the health risks associated with the presence of perfluoroalkyl substances in foodstuffs.¹⁴ EFSA concluded that PFOS, PFOA, PFNA and PFHxS can have adverse effects on human development and well-being, including reduced antibody response to vaccination, increased propensity for infection, increased serum and LDL cholesterol levels (risk factors for cardiovascular disease), reduced birth weight, and harmful impacts on the liver and to the immune system. EFSA considered the immune system effects to be the most serious and set an overall TWI of 4.4 ng/kg body weight for the sum of PFOS, PFOA, PFNA and PFHxS. The tolerance limit for PFAS is stated per week, to take into account that the substances accumulate in the body over time.

EFSA concluded that exposure to these four substances exceeds the TWI for parts of the European population, which gives cause for concern. Studies have shown associations between exposure to PFAS and serious health effects, including altered immune and thyroid function, cancer, liver disease, kidney disease, lipid and insulin dysregulation, and adverse reproductive and developmental outcomes.¹⁵

Toddlers and other children are the most exposed population groups, with prenatal exposure (when the chemicals can be transferred to a foetus through the placenta) and breastfeeding being the main contributor to PFAS levels in infants.¹⁶ PFAS have been linked in particular to increased incidence of gestational diabetes, preeclampsia, fetal growth restriction, and childhood obesity.¹⁷

Methodology

A brief summary of the methodology used to test for each contaminant is provided in Appendix 2.

Results

The analysis revealed the following results:

Sample	1	2	3	4	5	6	7	8	Ave.
PFOS $\mu\text{g}/\text{kg}$	1.5	1.1	7.2	1.8	1.1	3.5	4.6	5.0	3.23

A person weighing 70 kg who consumes 100 grams of whale meat containing the average level of PFOS (3.23 $\mu\text{g}/\text{kg}$) will exceed EFSA's TWI from that meal alone (see calculation in endnote).¹⁸

As this exposure level is based on an average exposure rate from the eight whale meat samples, samples with a higher level of contamination (e.g., sample 3 at 7.2 $\mu\text{g}/\text{kg}$) would significantly exceed the recommended TWI.

Sample size

The sample size was restricted due to both financial and logistical considerations. The aim was to obtain samples that came from different whales, so whale meat products were purchased from a variety of companies, and with different batch numbers.

All the whale meat samples, regardless of whether purchased in a supermarket or online, contained detectable levels of PFOS.



EU Regulation

In 2023, new EU regulations came into effect setting maximum allowed PFAS levels for a number of foods.¹⁹ The EU does not set a PFOS limit specifically for whale meat, but its maximum allowed PFOS levels for other sources of protein are relevant to what limits may be expected for whale meat:

Eggs: 2.0 µg/kg

Muscle meat of most fish if intended for children: 2.0 µg/kg

Crayfish: 3.0 µg/kg

Meat of bovine, pig and poultry: 0.3 µg/kg

Meat from game: 5.0 µg/kg

Higher levels of PFOS are allowed in some categories of food. For example, 7.0 µg/kg are allowed for the muscle meat of sardines and certain other fish species, if not intended for children, and up to 35 µg/kg for anchovies and certain other species, if not intended for children.

These regulations are implemented in Norway.²⁰ During implementation, however, national authorities criticized the allowed levels of PFAS as being too high to protect the population against harmful health effects. Norway's Geotechnical Institute issued the following statement:

The proposed maximum concentrations for fish are significantly higher than limit values which are needed to protect the population against exceeding the EU's Food Safety Authority (EFSA)'s tolerance limit for the sum of PFOS, PFOA, PFNA and PFHxS of 4.4 ng/kg body weight per week. Maximum concentrations in fish should be set at a level that takes into account EFSA's tolerance limit and calculations carried out by The Norwegian Institute of Public Health.²¹

CASE OF A PFAS-POLLUTED LAKE IN NORWAY

The Norwegian Food Safety Authority (Mattilsynet or NFSA) recommends that everyone (adults, children and pregnant women) avoid eating fish from the Tyrifjorden lake in Norway because of high levels of PFOS recorded in the fish.²²

Species	Sum PFOS (µg/kg)
Perch	11.1
Pike	3.2
Crayfish	1.0
Trout	3.1

Table 1: PFOS (µg/kg) in various species of fish and crayfish in the Tyrifjorden lake.

The levels of PFAS in the meat of fish in Tyrifjorden are comparable to levels found in the minke whales sampled in our study. However, NFSA issued the following statement to explain why it does not provide a similar warning to the public regarding consumption of whale meat:

There are many factors that come into play when we choose to issue warnings. Our warnings for fish from freshwater near airports and the Tyrifjorden were given based on an average fish intake (2-3 meals a week) and content of the 4 PFASs for which the overall tolerance limit has been set. We eat significantly more fish than whale meat, and the Norwegian Directorate of Health has dietary advice to eat fish for dinner two to three times a week.²³

The Norwegian government's intention to increase whale meat consumption

According to a poll from 2021, about 2% of Norwegians (around 110,000 people²⁴) eat whale meat regularly.²⁵ And the Norwegian government works to increase consumption of whale meat. This includes subsidising the marketing of whale meat. Each year 275,000 NOK (US\$ 26,067) is allocated from the state budget to "The Norwegian Whale Brand Association – Better public health through active information work on sustainable Norwegian Whale".²⁶ According to Norwegian Whale's website, the goal is "to increase consumption of whale meat in Norway". It

claims, among other things, that “meat from whale is one of the healthiest choices you can make” and that “whale meat has a good composition of nutrients, which makes it particularly suitable for everyday dishes”.²⁷ On occasion, the authorities have also contributed to other consumer-oriented measures through applications from the Norwegian Whale Brand Association.²⁸

The Norwegian government also works to recruit more people into whaling, and has recently changed regulations to make it easier for people to participate in whaling.²⁹ The Fisheries Minister at the time, Odd Emil Ingebrigtsen, stated: “It is important to have access to products and meat if whaling and the market are to be maintained, and I hope these changes will contribute to more people participating in whaling”.³⁰ Cecilie Myrseth, Norway’s previous Fisheries Minister, made the following claim this year:

*If we are to achieve the UN’s sustainability goals, we must eat more food from the sea, not less. Norwegian whaling is a small but important contribution to healthy and locally-produced seafood.*³¹

Surveillance of contaminants in Norway

Norway’s Institute for Marine Research maintains a reference database that compares the levels of contaminants and nutrients in fish and other marine species.³² The highest value of PFOS in any species in the database is 4.45 µg/kg, reported in 2014 for silvery light fish (*Maurollicus muelleri*). The most recent measurement in the database of PFOS in minke whales, 1.90 µg/kg, is from 2012; the previous year, a level of 2.21 µg/kg in minke whale meat was reported.³³ The results from the tests conducted here on whale meat for sale in supermarkets and online for human consumption indicate further research may be warranted in order to provide the most up-to-date information in the database.

Dietary recommendations on consumption of whale meat in the Faroe Islands

The Faroese Environment Agency and the Faroese Food and Veterinary Authority have carried out a risk analysis and created dietary recommendations on the consumption of pilot whale meat.³⁴ Based on the levels of dioxins, PCB and mercury in the meat, they recommend that adults should eat no more than one meal (250 grams) of whale meat a month. Special recommendations are given for women: Women who are breastfeeding, pregnant, or planning a pregnancy within the next three months should refrain from eating whale meat.

Other studies

Another study published in 2023 found even higher levels of PFAS in whale meat than levels revealed by the current research. Andvik et. al. (2023) investigated levels of contaminants in minke whales caught in the Barents Sea in 2019.³⁵ They found nine types of PFAS chemicals in minke whale fetuses and adult minke whales (male and female). As reported, “The highest muscle ΣPFAS levels were quantified in fetuses (23 ± 8.7 ng/g ww), followed by adult males (7.2 ± 2.0 ng/gg ww) and adult females (4.5 ± 1.1 ng/g ww), showing substantial placental transfer from mother to fetus”. The mean value between males and females is 5.85 ng/g (ng/g = µg/kg). Levels of PFOS were similar to the levels in our analysis. In the Andvik study, more sensitive analyses were used, so they were able to detect PFAS at lower levels than documented in this analysis.

In response to Andvik et al., Dr Line Småstuen Haug, Senior Scientist at Norwegian Institute of Public Health, stated:

Based on a person who weighs 70kg, the consumption of more than 53g of whale meat with a concentration of 5.85ng/g of the sum of PFOA, PFNA, PFHxS and PFOS in the course of a week will lead to exceeding the tolerance limit without other food or other sources of exposure being taken into account.³⁶

Discussion

As part of a risk assessment, EFSA calculated the intake of the sum of PFOA, PFNA, PFHxS and PFOS from dietary surveys in Europe. It concluded that a significant proportion of the European population has an intake that exceeds the tolerance limit, which is a cause for concern.³⁷ As illustrated by the current study, consumption of whale meat will contribute to people further exceeding the tolerance limit. Based on results from the 2021 poll on whale meat consumption,³⁸ it is estimated that over 100,000 Norwegians eat whale meat regularly.

Dietary recommendations and maximum allowed levels for PFAS chemicals in whale meat is not currently available from the Norwegian government; this raises potential public health and safety concerns for consumers in Norway and countries that import Norwegian minke whale products. Since 2008, nearly 1.5 million kg of whale meat have been exported to Japan for human consumption.³⁹ The products are sold both fresh and frozen and in various prepared states, including marinated whale beef. During this period, whale meat has also been exported to the Faroe Islands (13,416 kg) and Iceland (16,205 kg).⁴⁰

Norway’s lack of whale-specific maximum allowed levels of PFAS is particularly troubling given the government’s campaigns to promote the consumption of whale meat (including through subsidies for marketing), its efforts to increase sales domestically, and its authorization for exports of whale meat to other countries.

Conclusion and recommendations

It appears that Norwegian government policy is to increase domestic consumption of minke whale meat, and various government-supported publicly available information includes claims that it is healthy. The government also authorizes exports of Norwegian whale meat to Japan, Iceland and the Faroe Islands. However, the analysis conducted during this study indicates high levels of PFAS, specifically PFOS, in some samples of whale meat purchased in Norwegian supermarkets and online in spring and summer 2023. These findings are in line with earlier studies (Andvik et. al., 2023). The levels are comparable to fish caught in a lake from which the Norwegian Food Safety Authority warns against consuming fish and shellfish. The average level found in the eight samples would cause a 70kg person consuming 100 grams of minke whale meat to surpass the TWI of PFOS from that meal alone. Meanwhile, other studies detected even higher PFOS levels, suggesting it might take even less than 100 grams of whale meat a week to surpass the TWI.

PFAS chemicals accumulate in the body and are known to cause a variety of health issues, such as altered immune function, cancer and kidney disease. The results of this study and a previous study suggest that, in view of public health and safety advice for other food items, the Norwegian government should take, as a matter of urgency, the following steps with respect to whale products still being sold in Norway:

- Revise and update the government's national reference surveillance database on contaminants, particularly PFAS, in whale meat.
- Undertake a thorough programme of testing for contaminants in whale meat on sale for domestic human consumption, as well as for export.
- Initiate a regular ongoing sampling programme to guide and inform public health advice.
- Reassess government advice and public information in the light of these findings.
- Create specific dietary recommendations for whale meat for adults, children and pregnant women.
- Share data on contaminant levels with countries that import whale meat from Norway.

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APPENDIX 1 • WHALE MEAT SAMPLES



Sample 1: Batch number 2193 123331. Pieces of whale meat, frozen. Company: Lofothval. Bought at Coop Extra in Leknes 26 July 2023. Expiration date: 31 December 2024.



Sample 2: Batch number 1124 191328. Pieces of whale meat, frozen. Company: Lofothval. Bought at Coop Extra in Leknes 26 July 2023. Expiration date: 31 December 2023.



Sample 3: Cuts of whale meat. Company: Gunnar Klo AS - Stø Villfanget. Bought from Oda.no. Delivered 31 July 2023. Expiration date: 13 August 2023.



Sample 4: Batch number 3170. Loin of whale, frozen. Company: Lofothval. Bought at Holdbart Haugenstua 1 August 2023. Expiration date: 31 December 2025.



Sample 5: Batch number 1140. Ground whale meat, frozen. Company: Lofothval. Bought at Holdbart Haugenstua 1 August 2023. Expiration date: 31 December 2023.



Sample 7: Frozen whale meat. Bought at Kystens Mathus in Tromsø. Packaged 17 March 2023. Expiration date: 22 September 2023.



Sample 6: Batch number LO203. Cuts of whale meat, frozen. Company: Hopen fisk. Bought at Rema 1000 Haugenstua 1 August 2023. Expiration date: 22 July 2023.



Sample 8: Batch number L1212. Tenderized pieces of whale meat, frozen. Company: Myklebust Hvalprodukter AS. Bought online from hvalprodukter.no. Delivered 21 August 2023. Expiration date: 4 September 2025.