



Scientific Facts on Fluoride

Source document:

IPCS (2002)

Summary & Details:

GreenFacts

Context - Food and drinking water typically contain at least small amounts of fluorides. They occur in the environment both naturally and as a result of human activities.

Fluorides are commonly added to dental products – and sometimes to tap water – to prevent cavities.

Under what conditions can fluoride exposure be beneficial or detrimental to human health?

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This Digest is a faithful summary of the leading scientific consensus report produced in 2002 by the International Programme on Chemical Safety (IPCS):
"Environmental Health Criteria for Fluorides (EHC 227)"

The full Digest is available at: <https://www.greenfacts.org/en/fluoride/>

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- Each question is answered in Level 1 with a short summary.
- These answers are developed in more detail in Level 2.
- Level 3 consists of the Source document, the internationally recognised scientific consensus report which is faithfully summarised in Level 2 and further in Level 1.

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1. What are fluorides?

1.1 Fluorides are organic and inorganic compounds containing the fluorine element. Only inorganic fluorides are the focus of this study, particularly those which are most present in the environment and may affect living organisms.

1.2 Generally colourless, the different fluoride compounds are more or less soluble in water and can take the form of a solid, liquid, or gas. Fluorides are important industrial chemicals with a number of uses but the largest uses are for aluminium production, drinking water fluoridation, and the manufacture of fluoridated dental preparations.

2. Where are fluorides found?

2.1 In the environment, fluorides occur both naturally (e.g., rock weathering, volcanic emissions) and because of human activities (e.g., phosphate rock mining and use, aluminium manufacturing, drinking water fluoridation).

2.2 Fluorides can be present:

- in air, as gases or particulates;
- in water, mostly as fluoride ions or combined with aluminium;
- in soils, mainly combined with calcium or aluminium; and
- in living organisms.

2.3 Fluoride levels in the environment depend on the proximity to both natural and human fluoride emission sources.

2.4 Animals accumulate fluoride in their skeleton and plants in their leaves.

3. How are humans exposed to fluorides?

3.1 In **drinking water**, fluoride can either be naturally present due to the specific geological environment from which the water is obtained, or artificially added for the prevention of dental caries.

3.2 All **foodstuffs** contain at least small amounts of fluoride, but in some the concentrations can be higher. Fluoride concentration in food can be increased by the presence of fluoride in water used for its preparation.

3.3 In **dental products** such as toothpaste, fluoride is present in significant amounts.

3.4 The consumption of foodstuffs and drinking water is the principal route of exposure to fluoride for adults, while the ingestion of toothpaste by young children makes a significant contribution to their total intake of fluoride.



Fluoridated toothpaste
Source: Micro Application

3.5 Humans retain 60 to 90% of the fluoride taken in and accumulate almost all of it in their bones and teeth.

4. Can fluorides affect health?

4.1 Various harmful effects were observed in a series of animal laboratory studies, such as effects on the formation and hardening of bones, and delayed fracture healing.

4.2 Animal laboratory studies did not conclude that fluoride increases the frequency of any tumour.

4.3 Fluoride does not cause mutations but it has been shown to cause damage to chromosomes at high doses in studies in cell cultures. This has not been shown in most studies on test animals fed with fluoride.

4.4 Drinking water containing fluoride has not affected reproduction or development of the foetus in most studies on test animals. Microscopic changes in reproductive organs have been seen at high doses in some studies.

5. What effects have actually been seen in humans?

5.1 The many studies on fluoride artificially added to drinking water have not found a link to cancer. Workers exposed to high levels of fluoride in air showed an increased frequency of cancer but they were also exposed to other known cancer-causing chemicals.

5.2 Fluoride can help prevent cavities, but as the amount taken in increases it can also harm teeth (dental fluorosis) and bones (skeletal fluorosis).

5.3 Studies on human populations have not attributed any other health effects to fluoride exposure.

6. To what extent can fluoride exposure be harmful to organisms in the environment?

6.1 Different organisms living in water are more or less sensitive to fluoride. It can affect their growth, activity, or survival above certain concentrations.

6.2 In plants, high levels of fluoride can lead to the yellowing of leaves and slowed growth, as shown by studies where fluoride was deposited on leaves.

6.3 In birds, laboratory tests showed high levels of fluoride could affect chick growth or survival. In deer, cattle, and sheep it was observed that high fluoride intake affected weight, joints, teeth, and bones, milk production and reproduction.

7. What are the risks posed by fluorides?

7.1 The most serious effect of fluoride is its accumulation in bones from long-term excessive exposure, which can lead to skeletal fluorosis and bone fractures.

7.2 Fluoride discharges from human activities can be toxic to aquatic organisms and pose a risk to local sensitive plant species on land. High fluoride content in plants near emission sources or due to fertilizer use is a potential risk to animals that eat them.

8. What are the beneficial effects of fluoride on teeth?

An "optimum" level of fluoride in drinking water, associated with the maximum level of dental caries protection and minimum level of dental fluorosis, has been determined.

8.1 Historically, populations benefiting from fluoridated drinking water have developed fewer cavities. Today, many other fluoridated products are more extensively used and contribute to protecting a wider population.



Oral fluoride is considered as an effective means of reducing dental caries.
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8.2 There is a variety of fluoridated products: fluoridated drinking water, toothpaste, mouth solutions, gels or varnishes, salt, milk, and supplements.

9. Does water fluoridation pose risks?

9.1 The intake of excessive amounts of fluoride can lead to dental fluorosis, preventing the normal maturation of the enamel, but only during the period of tooth development in children, up to 6–8 years old.

9.2 The increase in the frequency of dental fluorosis over the past 30 to 40 years is generally attributed to the widespread use of fluoride products other than drinking water. Dental fluorosis is common in certain areas of the world, such as China, where fluoride is naturally present at high levels in minerals and water.

9.3 The greater the amount of fluoride incorporated into bone, the more severe the skeletal fluorosis-associated effects on bones.

9.4 In certain areas of the world where high levels of fluoride are naturally present, skeletal fluorosis is widespread, mainly due to an increased intake of fluoride from foodstuffs and drinking water. However, other factors, such as nutrition and climate, may also be important.

10. Conclusion

Fluoride can help prevent cavities, but at high intakes it can harm tooth development (dental fluorosis) and bones (skeletal fluorosis); there is a narrow range between intakes which are beneficial and those which are detrimental. Populations consuming artificially fluoridated drinking water or other fluoridated products, such as fluoridated toothpaste, develop fewer cavities.

In areas of the world with high levels of fluoride naturally present in minerals and water, skeletal fluorosis is common. This crippling disability, which includes increased risk of bone fracture, affects millions of people in various parts of Africa, China and India.

All organisms both on land and in water are exposed to fluoride released from natural sources and/or by human activities. Excess exposure poses a risk to them.

There is a need to better characterize the biological effects of exposure to different levels of fluoride.