Hamburg, 24 November, 2025

THIE statement on fluoride in tea (*Camellia sinensis*)

Position of the tea and herbal infusions industry regarding the setting of an MRL for fluoride in tea (*Camellia sinensis*) in Regulation (EC) 396/2005

- The current MRL for fluoride in tea of 400 mg/kg has been proposed by EFSA as a **tentative** value in 2021, based on a limited scope of valid occurrence data at that time. Additional monitoring data, in line with recent scientific publications clearly demonstrate that the tentative MRL is not reasonably practicable.
- The existing tentative MRL should therefore be revised. According to our monitoring data, 39% of teas do not meet the current MRL.
- THIE therefore requests an adjustment of the current MRL for fluoride in tea according to Regulation (EC) 396/2005 **from 400 mg/kg to 1,000 mg/kg**.
- Fluoride is naturally present in tea plants (*Camellia sinensis*).
- It is well known that the tea plant is a natural hyperaccumulator of fluoride. Scientific studies see tea fluoride levels varying from 30 to ca. 9,000 mg/kg.
- Transfer of fluoride into tea infusions strongly depends on brewing time and is not exhaustive under household brewing conditions. For predominantly recommended brewing times of 3 minutes or even less, a tentative default transfer rate of ca. 60% can be derived from recent scientific reviews. Fluoride levels determined for tea prior infusion are clearly overestimating exposure levels.
- Therefore, more data are needed from well-designed studies with standardised, real-life brewing conditions and validated analytical methods.

- As stated by EFSA in its recent *Updated consumer risk assessment of fluoride in food and drinking water …*, no risk of adverse health effects is seen provided drinking water fluoride levels <1.5 mg/L. Given that 86% of drinking water levels in Europe are below 0.3 mg/L and 97% below 0.7 mg/L it is obvious that occasional consumption of tea with levels above 400 mg/kg does not bear a health risk to such consumers.
- Sensative Consumer groups, i.e., pregnant women and lactating mothers in particular are already receiving considerable education and are more conscious about their diet than the average population. It is not practical to set an unrealistic MRL for a naturally occurring substance.

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Positive properties of fluoride

It is widely known that fluoride is an essential component of dental care and hygiene, which is why some foods such as table salt and mineral water, or cosmetics such as toothpaste, have been artificially enriched with fluoride. Fluoride has the special property of substituting the hydroxy group in hydroxyapatite (HA), the main inorganic phase of human hard tissues, thereby forming fluoridated hydroxyapatite (FHA). FHA is considered as an alternative material for bone repair due to its low solubility and good biocompatibility and it is much more resistant to acids produced by bacteria in the mouth. [1,2] Scientific studies have shown that fluoride strengthens tooth enamel, making it more resistant to acid attacks that cause cavities. It acts by promoting remineralization – restoring minerals such as calcium and phosphate to the enamel – and by inhibiting the demineralization process, helping to repair early stages of tooth decay and reducing the risk of developing cavities by up to 40%.[3]

EFSA has evaluated a health claim regarding fluoride: 'Fluoride contributes to the maintenance of tooth mineralisation.' This statement has been scientifically confirmed and is approved for product labelling under the EU Health Claims Regulation. In its assessment, the EFSA referred to the direct effect of fluoride on teeth and scientifically proved that fluoride contributes to mineralisation and protection against caries. Products that contribute to covering a relevant fluoride content may use this claim in compliance with legal requirements. [4]

Request of the tea and herbal infusions industry

Commission Regulation (EU) 2022/1321 foresees a review of the current MRLs for fluoride. According to the footnote on the MRL for tea, it was possible to provide information and occurrence data on fluoride to the Commission for the review process of this MRL by 29th July 2024. Although the deadline has passed, THIE remains committed to supporting this review process and is happy to share data and relevant information on fluoride in tea, if still useful.

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[1] Gross K. A. and Rodriguez-Lorenzo L. M., 2004; Sintered hydroxyfluorapatites. Part II: Mechanical properties of solid solutions determined by microindentation, https://www.sciencedirect.com/science/article/abs/pii/S0142961203006367

[2] Qu H. and Wei M., 2006; The effect of fluoride contents in fluoridated hydroxyapatite on osteoblast behavior, https://www.sciencedirect.com/science/article/abs/pii/S1742706105001303

[3] Schiffner U., 2021; Verwendung von Fluoriden zur Kariespräventio, https://pmc.ncbi.nlm.nih.gov/articles/PMC8241667/

[4] EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA), 2009; Scientific Opinion on the substantiation of health claims related to fluoride and maintenance of tooth mineralisation (ID 275, 276) and maintenance of bone (ID 371) pursuant to Article 13(1) of Regulation (EC) No 1924/2006; https://efsa.onlinelibrary.wiley.com/doi/10.2903/j.efsa.2009.1212

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According to Regulation (EC) 396/2005 a MRL of 400 mg/kg applies for fluoride in tea (*Camellia sinensis*). Based on THIE monitoring data, this MRL is not practicable for a considerable share of teas.

Due to the fact that the presence of fluoride in tea is of natural origin and not based on an active use as a pesticide, THIE requests an increase of the current MRL from 400 mg/kg to 1000 mg/kg. This corresponds to the p97 of the THIE monitoring data and is in line with experiences reported in scientific literature.

Monitoring data

THIE has collected monitoring data from its members from 2017 to 2024 to assess the current situation with regard to fluoride in tea (*Camellia sinensis*). The data mainly relates to raw materials, which have not necessarily come to market. Table 1 shows the statistical evaluation of black tea, green tea and all teas combined.

Table 1: Statistical evaluation of the monitoring data on fluoride (in mg/kg).

Food analysed	n	≥ 400	Median	p95	p97	Max
Black tea	105	36	264	895.6	968.7	1430
Green tea	53	25	395	856	959.9	1342
Sum of teas	158	61	302	879.4	982.1	1430

Based on this monitoring data, 34% of the black teas and 47% of the green teas and a total of 39% of all teas would not be compliant with the current MRL of 400 mg/kg. Kenyan tea in particular shows higher values than most other origins. This could be due to exogenous factors, such as the highly fluoride-rich rivers and the ideal pH value of the soils in the highlands of Kenya, which is discussed in the following sections.

Ruxton and Bond (2014) performed a study with 28 black teas, 10 decaffeinated teas and 11 speciality (white, green, single estate black) teas and analysed them for fluoride content. The proven values of this study are consistent with the results of the THIE monitoring data. The results for black tea range from 540-1700 mg/kg (mean = 1082 mg/kg), for decaffeinated black tea from 750-1800 mg/kg (mean = 1200 mg/kg) and for speciality teas from 25-1300 mg/kg (mean = 769 mg/kg).

Based on an average consumption model for people from the UK, one of the countries with the highest consumption behaviour in Europe, they concluded that the exposure from drinking tea does not pose a risk for health and, indeed, may provide benefits for dental health given EU approved health claims for fluoride. [5]

It must be emphasised in this context that a large proportion of teas in many other markets outside the EU has much higher fluoride levels, ranging up to ca. 9,000 mg/kg. Thus, the proposed fluoride MRL for tea of 1,000 mg/kg would still be restrictive in regard of tea qualities allowable in the EU in relation to overall available qualities the world market.

Sources for the presence of Fluoride in tea

Fluorine is a natural occurring chemical element, which, due to its highly electronegative properties, does not occur in free form but as fluoride. Fluorides are present in the environment in different minerals, mainly in fluorspar, cyolite and fluorapatite. [6] Owing to the universal presence of fluorides in earth's crust, all water contains fluorides in varying concentrations ranging from trace levels to several milligrams per litre. In surface fresh water such as rivers and lakes, fluoride concentrations are usually low, ranging from 0.01 to 0.3 mg/L. Exceptionally high levels can be found such that some lakes in Kenya have fluoride content >2000 mg/L. For Example, Lake Nakuru, which is situated in the rift valley in Kenya, has a fluoride concentration of 2800 mg/L and it is reported that this is the highest natural fluoride concentration in water.[7]

Fluoride gradually accumulates in plants over time and acts as a toxin in plant foliage, strongly inhibiting photosynthesis and disrupting other physiological processes. It moves according to the transpiration stream from roots or through stomata and accumulates in leaf margins.[8] Unlike other plants, the tea plant is a Fluoride hyperaccumulator, that is able to absorb an enormous amount of fluoride from soil and 98% of total accumulated fluoride by tea plants is present in tea leaves. [9]

Fluoride content in tea plants vary massively in different tea growing countries based on the local soil conditions. Even in a growing country itself, there can be clear trends

[5] Ruxton C. H. S. and Bond T. J., 2014; Fluoride content of UK retail tea: comparisons between tea bags and infusions, https://www.cambridge.org/core/services/aop-cambridge-core/content/view/1A0FC06F0D78B85DE0F26584F9EA3364/S0029665115000993a.pdf/fluoride-content-of-uk-retail-tea-comparisons-between-tea-bags-and-infusions.pdf

[6] K.W.M. Msonda, W.R.L Msamba, E. Fabiano, 2007; A study of fluoride groundwater occurrence in Nathenje, Lilongwe, Malawi, https://www.sciencedirect.com/science/article/abs/pii/S1474706507000988

[7] Murray, J. J., 1986; Appropriate use of fluorides for human health, https://iris.who.int/bitstream/handle/10665/39103/9241542039_(part1).pdf

[8] Jacobsen J.S., Weinstein L. H. McCune D.C., Hitchcock A. E., 1966; The accumulation of fluoride by plants, https://www.tandfonline.com/doi/abs/10.1080/00022470.1966.10468494

[9] D. Zhang et.al, 2023; Monitoring fluorine levels in tea leaves from major producing areas in China and the relative health risk, https://www.sciencedirect.com/science/article/abs/pii/S0889157523000790

in the fluoride concentration of the soil. For example, Lu et al. (2004) discovered a clear correlation between the fluoride concentration and the geographical location of the tea fields in China, with the more southerly the plant is located, the less fluoride was detected. [10] Factors like a low pH-Value (optimal at pH = 5.5) and a decreased Calcium concentration in the soil have a positive effect on the absorption of fluoride in the tea plant. [11] This may explain why teas originating from Kenya tend to have higher fluoride content, as indicated by THIE monitoring data. Tea originating from Kenya is grown in the highlands located within the west and east rift and on higher altitude of between 1500 m and 2700 m above sea level. [12] According to Kanyanjua et al. (2002), pH-values of about 5.5 are recorded in the areas of the tea gardens, which in turn strongly favours the natural accumulation of fluoride in the tea plant from the soil. [13]

Fluoride intake from tea

Fluoride is an important mineral for human health and plays an essential role in preventing tooth decay and the growth and strength of bones at a level of between 1.0 and 1.5 mg per day. This is also the reason why in some areas fluoride is added to community water systems to reduce dental decay. Based on the highly soluble form of fluoride in tea infusions, tea represents an effective fluoride supplement for human beings. Furthermore, the digestive tract can directly absorb soluble fluoride and the bioavailability of fluoride from tea is close to 100% which is similar to that from drinking water. [14]

The Dietary Reference Intakes (DRIs) set by the Institute of Medicine (IOM) recommends levels that have been shown to reduce tooth decay without causing marked fluorosis, which is a discoloration of the teeth. Like with other dietary essential substances like vitamins and other minerals, amounts consumed in excess of what is required by the body can have adverse health effects. An overconsumption can lead to a build-up in the teeth and bones and in rare cases to skeletal fluorosis. The Tolerable Upper Limit for fluoride is set at 10 mg/day noting that exposure to fluoride

[10] Lu Y., Guo W.F., Yang X. Q., 2004; Fluoride content in tea and its relationship with tea quality, https://pubs.acs.org/doi/abs/10.1021/jf0308354

[11] Ruan J., Ma L., Shi Y., Han W., 2004; The impact of pH and calcium on the uptake of fluoride by tea plants (*Camellia sinensis* L.), https://academic.oup.com/aob/article/93/1/97/221559?login=false

[12] Tea Board of Kenya, last visit: 07.24.2024; https://www.teaboard.or.ke/kenya-tea/history-of-kenyan-tea

[13] Kanyanjua S. M., Ireri L., Wambua S., Nandwa S. M., 2002; Acidic soils in Kenya: Constraints and remedial options, https://repository.seku.ac.ke/bitstream/handle/123456789/4313/Wambua_Acidic%20soils%20in%20Kenya....pdf?sequence=1

[14] Tokalioglu S., Kartal S., Sahin U., 2004; Determination of fluoride in various samples and some infusions using a fluoride selective electrode, https://journals.tubitak.gov.tr/chem/vol28/iss2/8/

at this level for 10 or more years carries only a small risk for individuals to develop skeletal fluorosis. [15]

Based on the average consumption data from EFSA's PRIMo model, French adults are the group with the highest consumption of tea at 0.1405 g/kg per body weight based on dried tea leaves.[16] Assuming an average adult weight of 70 kg, this results in an intake of 9.835 g of tea per day. A tea with a fluoride content at the level of the proposed MRL 1,000 mg/kg would provide a theoretical intake of 9,835 µg of fluoride. However, the scientific literature on the fluoride content in teas and tea infusions clearly shows that only a fraction of the fluoride content (ca. 60%) is transferred to the infusion at the mostly recommended brewing time of three minutes. [17,18,19] Of note, recommendations for brewing time are even lower for many teas in the market. Green teas are infused at only 80°C and for even shorter brewing times, which further reduces the transfer rate. Thus, at tea with 1,000 PPM of fluoride, at a dosage of 9.835 g/L would provide only approx. 5.9 mg of fluoride to a **very high consumer**. However, since fluoride levels vary from batch to batch, even a highly loyal consumer of a single high-fluoride tea origin would not consistently ingest this maximum possible amount of fluoride.

Consumption data

In its recent *Updated consumer risk assessment of fluoride in food and drinking water* …, EFSA bases its consumption scenario calculations on nutritional surveys conducted across various European countries. However, it should be noted that many of these surveys no longer accurately reflect current dietary habits. For example, the German nutrition surveys VELS for children and NVSII for adults have been published approx. 25 years ago. In the meantime, dietary habits have changed and more up-to-date surveys have become available.

[15] Institute of Medicine (US) Standing Committee on the Scientific Evaluation of Dietary Reference Intakes, 1997; Dietary Reference Intakes for Calcium, Phosphorous, Magnesium, Vitamin D, and Fluoride, https://www.ncbi.nlm.nih.gov/books/NBK109832/

[16] EFSA PRIMo Revision 3, last visit: 07.29.2024; EFSA_PRIMo_rev3.xlsm (live.com)

[17] Jayasingha H. et al., 2025; Fluoride in tea: accumulation, dietary exposure, and future strategies for risk mitigation in food safety; a scoping review, https://www.tandfonline.com/doi/abs/10.1080/10408398.2025.2516756

[18] Malyszek A. et al., 2025; Identification of Factors Influencing Fluoride Content in Tea Infusions: A Systematic Review, https://www.mdpi.com/2076-3417/15/11/5974

[19] Yang J. et al., 2024; Critical review of fluoride in tea plants (Camellia sinensis): absorption, transportation, tolerance mechanisms, and defluorination measures, https://www.maxapress.com/article/doi/10.48130/bpr-0024-0010?utm_source=TrendMD&utm_medium=cpc&utm_campaign=Beverage_Plant_Research__TrendMD_1

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