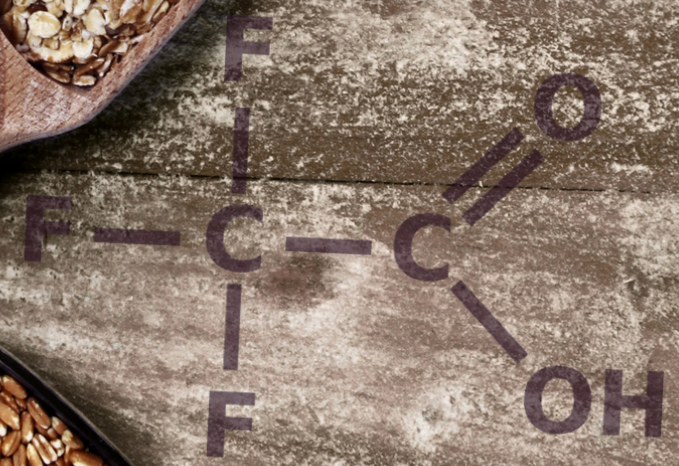
GLOBAL 2000

AK Oberösterreich

The Forever Chemical in our Daily Bread

The worrying rise of TFA in cereal products



FOREWORD

The rise of trifluoroacetic acid (TFA) levels in our water, plants and blood over the past decades is unprecedented.[1] Never have we seen a synthetic, non-degradable substance accumulate globally in water and vegetation at this magnitude. When TFA enters the water cycle, it can flow wherever the water flows, be it from the the rain and into our groundwater, through our water treatment plants and into tap water, through degrading pesticides in soil and into our plants. Ultimately, all these points of exposure lead to an increase in the TFA circulating in the blood of the human and animal population, where it passes through all our organs before it leaves and re-enters us at an increasingly greater concentration.

There are earlier claims in the scientific community that TFA is not a concern because it does not bioaccumulate and is not toxic. However, these conclusions do not match with current data. As TFA in our daily diet accumulates with increasing industrial emissions, so too does TFA in our blood accumulate, with no possibility for biodegradation. The earlier claims were of TFA not being toxic were based on short-term exposure tests, with few toxicity tests measuring life-long exposure to vulnerable populations. Now indications of TFA toxicity are emerging. The Dutch have recommended an exposure limit of 0.32 micrograms per kilogram bodyweight per day[2], which is being adopted in more regions; the Germans have submitted a dossier for harmonized classification that TFA can harm embryo-foetal development[3].

The study presented here presents new data on TFA in cereals. These results are shocking, yet do not come as a surprise. They are shocking because the TFA concentrations exceed the Dutch exposure limit. But this is not a surprise, as it is consistent with the increase of TFA observed in water, juices, beer and wine.

The results here also are helping to complete a puzzle. Research on TFA exposure is only emerging. The scientific community still does not know how much TFA we get from different sources, be it from our drinking water, vegetables, grains or animal-based products. The current evidence is leaning towards fruits, vegetables and grains as being the main source. For instance, a recent study of TFA in beer at a median concentration of 6.1 µg/L (maximum 51 µg/L), where the main source of the TFA was not the water used for brewing, but the wheat and barley used[4].

There are little farmers can do on their own to reduce TFA in their produce, nor we in our diets. As long as emissions of TFA precursors increase, so too will the concentration in future harvests, and future generations. The only real solution to avoid the global threat of TFA accumulation is to curtail the synthetic substances that lead to TFA accumulation.

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1 Arp, H. P. H., Gredelj, A., Glüge, J., Scheringer, M., & Cousins, I. T. (2024). The global threat from the irreversible accumulation of trifluoroacetic acid (TFA). Environmental Science & Technology, 58(45), 19925-19935.
2 RIVM. RIVM-VSP Advies 14434A02 – Drinkwaterrichtwaarde Voor Trifluorazijnzuur ; 2023; pp 1– 47. https://www.rivm.nl/documenten/bijlage-bij-rivm-brief-aan-ilt-indicatieve-drinkwaterrichtwaarde-trifluorazijnzuur-tfa
3 https://www.umweltbundesamt.de/presse/pressemitteilungen/trifluoressigsaeure-tfa-bewertung-fuer-einstufung
4 Scheurer, M., & Nödler, K. (2021). Ultrashort-chain perfluoroalkyl substance trifluoroacetate (TFA) in beer and tea–An unintended aqueous extraction. Food Chemistry, 351, 129304.

BRIEF SUMMARY

48 cereal products purchased in Austria (including bread, pasta, breakfast cereals, cornflakes, and flour sourced equally from organic and conventional farming) were analysed for the per- and polyfluoroalkyl substance (PFAS) **trifluoroacetic acid (TFA)**. TFA is an extremely stable end product of the degradation of PFAS pesticides used in agriculture, and of fluorinated gases (F-gases) from refrigeration technology. This 'forever chemical' exhibits reprotoxic properties, does not degrade in nature, and accumulates in the global water cycle and living organisms. The concentrations of TFA measured in the cereal products are unexpectedly high and already exceed health-relevant guideline values.

Key Findings:

- All 48 analysed cereal products contained TFA. Concentrations measured ranged from **13 µg/kg** (organically grown rye) to **420 µg/kg** (conventional butter biscuits). This is two to three orders of magnitude higher than the already considerable current TFA levels found in rainwater, groundwater, and drinking water.

- Organic cereal products also showed significant TFA concentrations (median: 47 µg/kg), even when produced on land that had never been treated with pesticides. This underlines TFA's wide distribution and high mobility in the environment. For conventional products, the median concentration was 3.5 times higher (median: 165 µg/kg).

- Comparison with the only official study on TFA in cereal grain to date (2016/2017, commissioned by the European Commission) shows a threefold increase in the contamination levels of cereal products in less than a decade.

Similar steep increases in TFA concentrations have already been observed in various other environmental media and plant-based products, most recently in wine, prompting leading environmental scientists to identify TFA as a "planetary boundary threat".

The health risks of TFA have so far been insufficiently researched. For decades, TFA was portrayed by the PFAS industry as relatively harmless to both the environment and human health. However, with the recognition of its reprotoxic properties, regulatory authorities have begun to take a different view. Recent risk assessments from the Netherlands and Belgium estimate the tolerable daily intake of TFA for humans to be significantly lower than what previous evaluations have suggested. **Based on these newer assessments, the TFA concentrations found in cereals already exceed the tolerable daily dose for children by a factor of four**. Meanwhile, the exposure levels continue to rise. This calls for swift and decisive action to curb TFA emissions and their associated risks.

GLOBAL 2000, PAN Europe and the Upper Austrian Chamber of Labour (Arbeiterkammer Oberösterreich), therefore, call on the responsible political decision-makers at both national and European levels to take immediate action to protect human health and the environment by:

- Banning PFAS pesticides as the primary source of TFA contamination in rural areas.
- Phasing out TFA precursors, such as F-gases, through the planned EU-wide PFAS ban.
- Introducing and monitoring effective health-based guidelines and limit values for TFA in food and water.

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1. BACKGROUND

Trifluoroacetic acid (TFA) is the smallest molecule in the chemical group of PFAS (per- and polyfluorinated alkyl substances), which are also known as "forever chemicals" due to their extreme longevity. TFA enters the environment primarily through the degradation of larger PFAS. The most important precursor substances are fluorinated hydrocarbons ("F-gases") from refrigeration technology and PFAS pesticides from agriculture.

The industry's decades-long portrayal of TFA as a toxicologically inconspicuous chemical has now been refuted. On 26 May 2025, the European Chemicals Agency ECHA published a proposal to classify TFA as *toxic for reproduction, very persistent and very mobile*[1]. A generic limit value of **0.1 micrograms per litre (µg/l)** applies to such pollutants in both groundwater and drinking water - a value that is already exceeded many times over in almost all water samples.

1.1 Ubiquitous distribution of TFA in the environment

TFA is not only extremely persistent but also highly mobile and very soluble in water. Investigations by GLOBAL 2000 and the Upper Austrian Chamber of Labour, and in some cases also official investigations, have so far found TFA in all sampled rivers[2], in domestic wells[3], in all samples of groundwater and tap water,[4] and in more than half of the mineral waters[5]. In 2019, the Austrian Federal Environment Agency found contamination levels of up to 30 µg/l in groundwater bodies, with an average value of around 1 µg/l[6]. In the more agriculturally utilised federal states of Styria, Burgenland, Upper and Lower Austria, the contamination levels in groundwater and drinking water were significantly higher than in Carinthia, Salzburg, Tyrol, Vorarlberg and Vienna.

And since TFA has spread ubiquitously in water and all life consists of water, TFA is also found in human blood serum and in plants - and therefore also in our food. A study of European wines carried out by GLOBAL 2000 together with PAN Europe in April 2025[7] found an unexpectedly high average TFA concentration of just under 150 µg/l in 18 Austrian wines analysed from the 2021 to 2024 vintages, with peak values of over 300 µg/l. Organic wines were also significantly contaminated. At the same time, the analysis of ten vintage wines dating from 2015 back to 1974 showed that TFA levels in the environment have only increased significantly since the late 1980s - an increase that has accelerated rapidly in the last 10 to 15 years. Even wines from areas that have never been farmed other than organically showed remarkably high TFA contamination, albeit significantly lower than in conventional wines, as studies at the University of Freiburg in Germany have shown.[7]

So how does this contamination come about? Background contamination in rainwater alone cannot explain the high TFA concentrations of over 300 µg/l already found in some conventional wines. At the same time, the detection of considerable TFA levels in some organic wines cannot be explained by pesticide applications, especially as organic wines are produced without chemically synthesised pesticides.

The solution to the puzzle lies in the chemical properties of TFA and PFAS pesticides. These persistent substances accumulate in the soil and are widely dispersed in the environment through drift, wind and

1 BfR, May 2025: Trifluoressigsäure (TFA): *Bewertung für Einstufung in neue Gefahrenklassen vorgelegt*
2 PAN Europe, GLOBAL 2000, May 2024: TFA in Water - Dirty PFAS Legacy under the Radar
3 Arbeiterkammer Oberösterreich, April 2025: *AK-Brunnenwassertest: Weniger Nitrat, aber Ewigkeitschemikalien* (German language)
4 PAN Europe, GLOBAL 2000, Juni 2024: TFA - The Forever Chemical in the Water we drink
5 GLOBAL 2000, Februar 2025: Reinheit unter Druck: TFA-Belastung im österreichischen Mineralwasser (German language)
6 GLOBAL 2000, Jänner 2025: Wer schützt unser Trinkwasser? (German language)
7 OTS, 23.04.2025: GLOBAL 2000-Studie: Alarmierender Anstieg der Ewigkeits-Chemikalie TFA im Wein (German language)

water erosion. A recently published study by German authorities measuring levels of PFAS in arable, grassland and forest soils detected TFA in all samples.

1.2 Enrichment in soils and plants

A study from North Rhine-Westphalia, published in February 2024[8], found TFA in every soil sample from forest, grassland and arable land. TFA concentrations in arable soils, detected between **0.2** and **4.5 µg/kg**, thus showed a similar range to groundwater. Strikingly, TFA was detectable at higher concentrations than any other PFAS analysed. However, due to its very high water solubility, TFA becomes concentrated in soil water rather than being evenly distributed in soil. Soil water refers to the water that fills the space between the soil particles (soil pores) and is available for extraction by plants via the roots. In a typical sandy loam soil with a water content of 10 %, the soil water would have a TFA concentration between **2** and **45 µg/kg** due to this concentration effect.

The already highly concentrated soil water undergoes a second concentration step in plants and plant-based products such as wine. This is because plants generally absorb many times more water than they convert into biomass, and transpire water via the leaf surface. Pollutants such as TFA therefore accumulate in plants at much higher concentrations than in the already pre-concentrated soil water. This effect is particularly pronounced for highly water-soluble substances such as TFA, as these are present in solution and can therefore be efficiently absorbed by the plants.

Another factor that may explain particularly high TFA levels, independent of direct pesticide application, is the presence of **oxidisable precursors of TFA**. These include PFAS pesticides in particular. This was demonstrated in some of the arable soils investigated in the study from North Rhine-Westphalia. If these precursors are taken up by the plant, the plant's pronounced metabolism can massively accelerate the release of TFA.

To summarise, the fact that PFAS pesticides are the main source of TFA emissions in rural areas, combined with the extreme persistence of both PFAS pesticides and TFA, their ability to spread in the environment through drift, water and wind erosion, and the concentration effects described above, may explain the unexpectedly high TFA loads found in agricultural products. These correlations also provide a conclusive explanation, supported by measurement data, for the fact that even products that have never been directly treated with PFAS pesticides can exhibit considerable TFA contamination.

1.3 Planetary boundaries under threat

The TFA contamination found in soils and in plant products such as wine, shows that contamination with TFA is not only a drinking water problem, but could also have a significant impact on food production and ultimately on the entire flora and fauna.

Back in October 2024, a group of leading international environmental scientists led by environmental chemist Hans Peter Arp published a comprehensive analysis[9], which confirms this assessment and makes it clear that TFA has long since penetrated global ecological systems far beyond water bodies. TFA has been detected not only in rainwater, oceans, lakes, rivers and groundwater, but also in soils, tree leaves, crop plants, plant-based foods and even in human blood.

8 Landesamt für Natur, Umwelt und Verbraucherschutz Nordrhein-Westfalen (LANUV NRW), Februar 2024: Hintergrundgehalte und -werte von PFAS in Böden ländlicher Gebiete in Nordrhein-Westfalen

9 Arp, HP. et al.: The Global Threat from the Irreversible Accumulation of Trifluoroacetic Acid, Environ. Sci. Technol. 2024, 58, 45, 19925-19935

Due to its widespread distribution, extreme persistence and continuously rising emissions, TFA fulfils all three criteria for being a planetary boundary threat according to Johan Rockström, Linn Persson and colleagues[10] :

- It accumulates to an extent that disrupts central processes of the earth system
- Its effects are or can become global.
- The consequences are difficult or impossible to reverse.

As long as TFA continues to be released from industrial, agricultural and municipal sources, environmental concentrations will continue to rise. As it cannot be broken down in nature, TFA will remain in the global water cycle and the biosphere for the foreseeable future. The long-term ecological and health impacts of this cannot be foreseen at present.

2 RESEARCH QUESTION AND ANALYTICAL APPROACH

Following the detection of high and steeply increasing TFA concentrations in wine, we are investigating for the first time an agricultural product that forms an elementary and staple part of our diet: cereals and cereal products made from wheat, rye, spelt, einkorn, oats and maize.

We analysed both processed products – including baked goods such as bread and biscuits, pasta such as noodles and spaghetti, and breakfast products such as oatmeal and cornflakes – as well as the raw materials themselves in the form of unground grains (e.g. spelt rice), flours, semolina, and bran.

In order to test whether the absence of synthetic chemical pesticides leads to a noticeable reduction in TFA contamination, 24 conventional and 24 organic products were analysed and compared with each other.

2.1 Selection of products

The conventional products were purchased in the four major Austrian supermarket chains. The selection was random, with well-known, established brands or supermarket brands being favoured in the purchasing decision.

Where possible, the organic products were purchased directly from the farm. Preference was given to farms that have been farming organically for 25 years or more. It was asked whether the origin of the respective grain products (grains, flours, baked goods and pasta) could be traced back to the field, whether the land was not directly affected by pesticide drift from neighbouring conventionally farmed land, and whether it had not been conventionally farmed for at least 25 years. Products that most met these requirements were prioritised in the selection of samples for analysis. Care was also taken to ensure that grain products from all Austrian federal states - with the exception of Vienna - were represented in the study.

In the case of some of the samples analysed, traceability back to the field was not ensured or not possible, particularly for organic cereal products purchased in supermarkets or health food stores, such as popcorn, cornflakes, or biscuits.

The products were sent to the Institut Dr. Wagner analytical laboratory, where they were analysed for their TFA content. An overview and description of all 48 cereal products - including the analysis results (without naming the brand names) - is available via this link and can be downloaded.

10 Rockström, J., Steffen, W., Noone, K., Persson, Å., et.al. 2009. A safe operating space for humanity. Nature 461: 472-475

2.2 Method of analysis

All analyses were carried out by the internationally accredited testing laboratory Institut Dr. Wagner, accredited according to EN ISO/IEC 17025), an Austrian laboratory specialising in the analysis of plant and animal foods. TFA levels were analysed according to the rapid method for the analysis of highly polar pesticides in food by extraction with acidified methanol and LC-MS/MS measurement - Part I: Food of plant origin (QuPPe-PO method), version 12.3, which was developed by the EU reference laboratory for pesticides requiring single residue methods (EURL-SRM), CVUA Stuttgart.

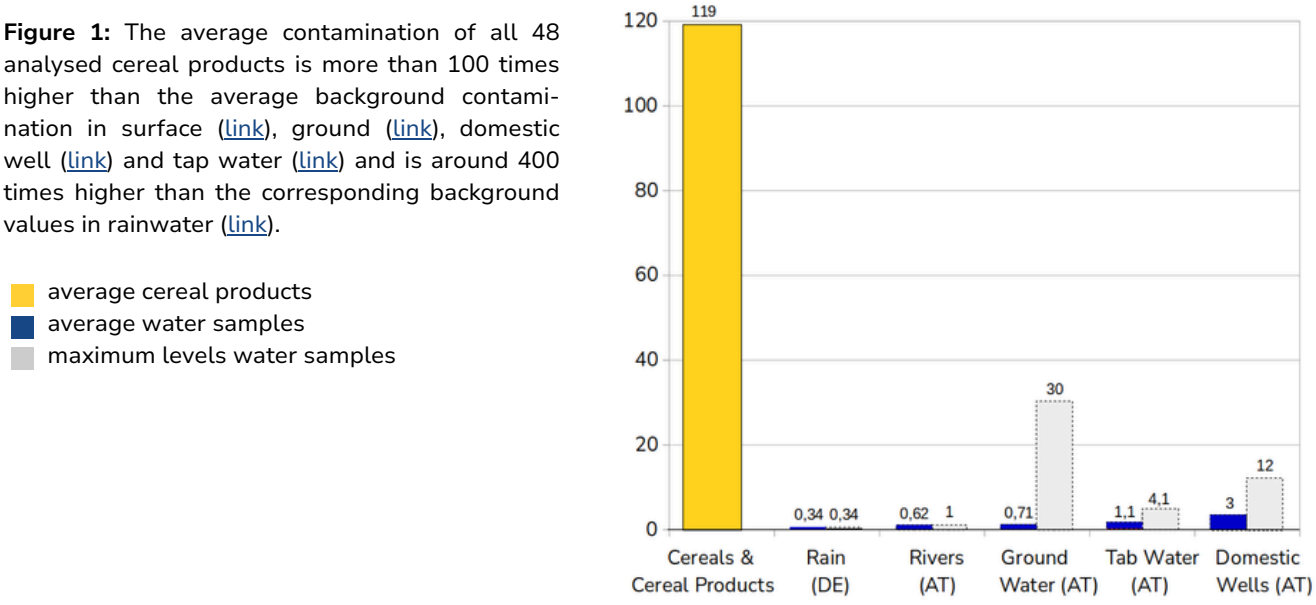
3. RESULTS

The forever chemical TFA was detected in high concentrations in all 48 cereal products analysed (24 organic and 24 conventional).

The range of TFA detections extends from **13 µg/kg** TFA (detected in organic rye) to **420 µg/kg** (in whole-meal biscuits from conventional production). The average contamination across all 48 products was **119 µg/kg**.

A comparison with the average background levels of TFA in rainwater, surface water, groundwater or tap water (see Figure 1) suggests two conclusions: The high TFA levels in bread and bakery products, which exceed those in water by several orders of magnitude, indicate a pronounced accumulation of TFA in the cereal plant, as previously observed in wine. At the same time, the known background levels in rainwater or irrigation water alone cannot explain the extent of the contamination of cereals (or wine). There must therefore be other sources from which the plants absorb and accumulate TFA.

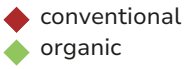
Figure 1: The average contamination of all 48 analysed cereal products is more than 100 times higher than the average background contamination in surface (link), ground (link), domestic well (link) and tap water (link) and is around 400 times higher than the corresponding background values in rainwater (link).

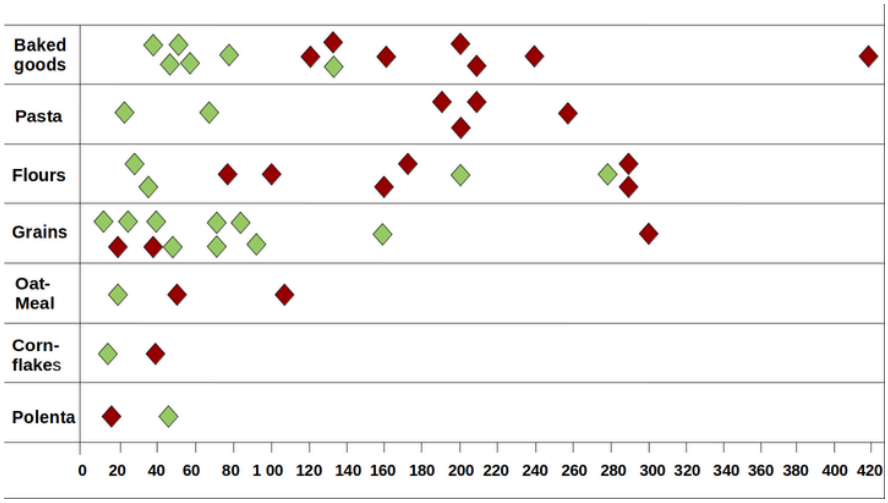


3.1 Conventional products more heavily contaminated

Conventional products were on average 2-3 times more contaminated with the forever chemical than products from organic farming. Figure 2 provides an overview of the measured TFA levels of all analysed cereal products sorted by product group. Organically grown products are shown in **green** and conventionally grown products in **brown**.

Fig. 2: While most organic products - with the exception of a few outliers - show TFA levels below 100 µg/kg, the majority of conventional products have significantly higher TFA levels, with a peak value of 420 µg/kg

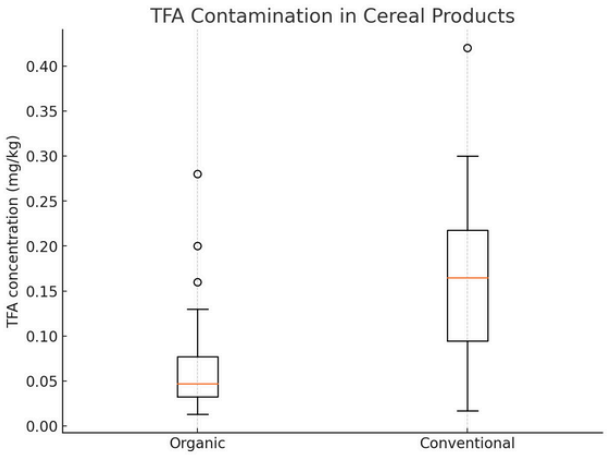




The Mann-Whitney U test[11] was used to test the statistical significance of the measured differences between organic and conventional products. This confirmed a significant difference (**p-value ≈ 0.0007**) in the measured TFA concentrations, meaning that the difference is highly significant (see Fig. 3).

Figure 3 & Table 1: The box plot (on the right) illustrates the difference in TFA contamination levels between the two groups. This difference is statistically significant, with a p-value ≈ 0.0007.

	Median [µg/kg]	Average [µg/kg]	Range [µg/kg]
organuc	47	71	13–280
conventional	165	167	17–420



As can be seen in Figure 4, the measured differences are most evident in dough and baked goods. The TFA concentration in conventional bread and biscuits was around three times higher than that in organically produced baked goods. For pasta, the difference was fivefold.

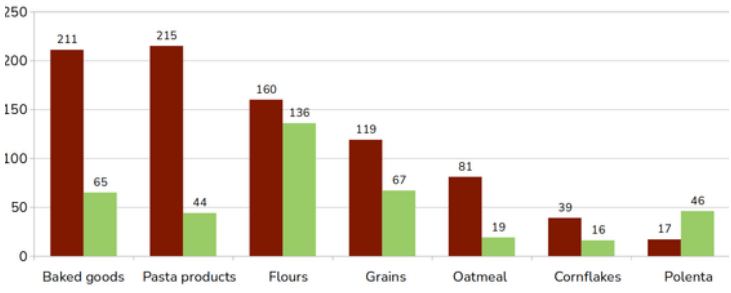


Figure 4: The differences in TFA concentrations [µg/kg] between organic and conventional cereal products are most evident in pasta (noodles) and baked goods (bread and biscuits).

11 The Mann-Whitney U test is a non-parametric test that tests the significance of the difference between two independent groups in the case of non-normally distributed data. It was chosen here because the TFA data in the organic group were not normally distributed.

A detailed overview of all analysed cereal products, sorted by cultivation type and origin, is available for download **via this link**. The brand names are not included, as we do not consider their publication to provide sufficient benefit to consumers due to the limited market coverage of the samples analysed.

3.2 TFA exposure tripled since 2016

In Austria and other EU countries, the contamination of food with TFA has not yet been recorded as part of food monitoring. To our knowledge, the only analysis of cereal products for TFA carried out in the EU to date took place in 2016 and was conducted by the *EU reference laboratory for pesticides requiring the individual residue methods* located at the CVUA Stuttgart[12]. The individual results of this study have not been published. However, some important key data from this investigation were disclosed in a final report[13]:

- A total of 38 samples of cereals and cereal products were analysed, of which 16 were from conventional and 22 from organic production.
- For conventional products, in 2016 the median[14] TFA concentration was 48 µg/kg, with the highest level measured being 280 µg/kg.
- For organic products, the median was below the (then) analytical limit of quantification (LOQ) of 40 µg/kg TFA, but above the limit of detection (LOD) of 20 µg/l.[15]
- At that time, 31% of conventional and 73% of organic products had TFA levels below the limit of quantification (LOQ).

Our current investigations, which cover a comparable sample size but were carried out nine years apart, paint a similar picture when looking at the relative differences between conventional and organic cereal products. In absolute figures, however, the contamination of cereals with TFA appears to have tripled since 2016, as the comparison of the available key data in the following table shows:

Table 2: The comparison of median contamination levels from 2017 and 2025 shows a steep increase in TFA contamination in cereal products.

CEREALS & CEREAL PRODUCTS	*EU-Reference Laboratory* (2017)		*GLOBAL 2000* (2025)	
	conventional (n=16)	organic (n=22)	conventional (n=24)	organic (n=24)
Median [µg/kg TFA]	48	< BG*	165	47
Maximum [µg/kg TFA]	280	83	420	280
Share < LOQ* [% of samples]	31	73	17	37
Share > 100 µg/kg [% of samles]	n.a.**	n.a.**	71	17

* LOQ = Limit of Quantification in 2017[15] = 40 µg/kg
** n.a. = „not available"

An increase in TFA contamination by a factor of 2 to 3 within just nine years was also observed in the recent study by GLOBAL 2000, conducted in collaboration with PAN Europe, which analysed 39 commercially available European wines.

12 For this investigation, the EU Reference Laboratory had to develop a specific analytical method. This method was also applied in our current study (see Section 2.2).
13 EU-SRLM, 2017: Residues of DFA and TFA in Samples of Plant Origin
14 The median is the value that divides an ordered data series into two halves, so that 50% of the values are below and 50% above it. It is often used as a measure of the average position of a distribution.
15 The limit of quantification (LOQ) for the cereal analyses conducted at Institut Dr. Wagner was 10 µg/kg.

In this wine study, a **median value** of **110 µg/l** and a peak contamination level of **320 µg/l** were identified. In 2017, the EU Reference Laboratory found a **median value** of "only" **50 µg/l** and a peak value of **120 µg/l** in 27 European wines.

The sharp increase in TFA contamination in wine was further confirmed by two independent studies on TFA contamination in vintage wines. These studies were conducted by GLOBAL 2000 in 2025, with comparable investigations previously carried out at the University of Freiburg (Germany). Both showed a 2- to 3-fold increase in TFA contamination within the past decade[16].

3.3 Health-based guidance values exceeded

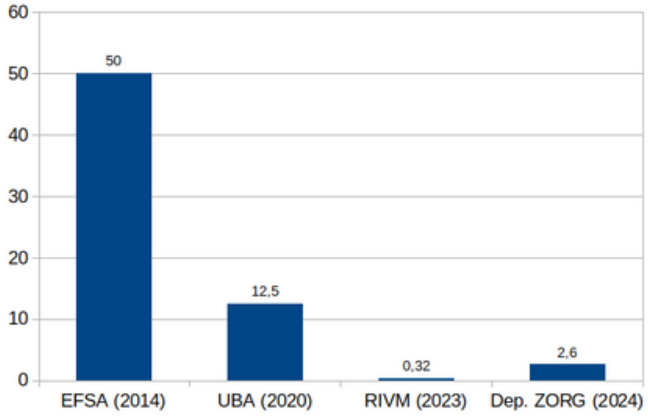
As cereal products are a fundamental part of the human diet, the question arises as to whether this widespread TFA contamination poses health risks. However, there is (still) no consensus in the EU as to which TDI (Tolerable Daily Intake)[17] should be used to answer this question. Although the EFSA proposed a tentative value for the acceptable daily intake for the first time in 2014, an EU-wide harmonised TDI is still missing. In the meantime, some Member States have independently derived health-based guideline values for acceptable or tolerable daily exposure to TFA and for monitoring TFA levels in drinking water.

As can be seen from Figure 5, the TDI values set to date range from 50 µg/kg bw/d[18] (this is the tentative EFSA value from 2014 mentioned above), to 18 µg/kg bw/d[19] (Germany, UBA 2020), to 2.6 µg/kg bw/d[20] (Flanders, Departement ZORG, 2024) und **0.32** µg/kg bw/d (Holland, RIVM 2023, Wallonia, 2024[21]). While the two older TDIs from EFSA (2014) and Germany (2020) did not take into account the obvious lack of data on TFA or the existing knowledge on the toxicity of structurally related PFAS, the more recent assessments by the Flemish and Dutch authorities take these aspects into account.

Figure 5: Different health-based guidance values for TFA in the EU

The key question of how much TFA a person can consume daily without posing a health risk has so far been answered very differently by various health authorities.

The range of existing health-based guidance values highlights current uncertainties in risk assessment. It reflects, in particular, the varying extent to which shortcomings in the toxicological data for TFA, the specific properties of TFA as a PFAS chemical, the available knowledge on the hazards of structurally related PFAS, and the current state of scientific knowledge have been taken into account.



16 PAN Europe & GLOBAL 2000: Message from the bottle – The rapid rise of TFA contamination across the EU: (April, 2025). Please note: The results of the study by Prof. Michael Müller from the University of Freiburg were presented on 19 March 2025 during an information session at the European Parliament by Hans Peter Arp, with the consent of the study's author.
17 The TDI (Tolerable Daily Intake) describes the amount of a substance that can be consumed daily over a lifetime without adverse health effects. In the toxicological evaluation of environmental contaminants such as PFAS, the term TDI is used, while in other areas (e.g., pesticides, food additives), ADI (Acceptable Daily Intake) is often used synonymously for the same concept. TFA falls into both of these categories. TDI or ADI values are usually expressed in milligrams or micrograms per kilogram body weight per day.
18 EFSA 2014: Reasoned opinion on the setting of MRLs for saflufenacil in various crops, considering the risk related to the metabolite trifluoroacetic acid (TFA), page 10
19 UBA 2020: Trifluoressigsäure (TFA) – Gewässerschutz im Spannungsfeld von toxikologischem Leitwert, Trinkwasserhygiene und Eintragsminimierung (2020). link
20 ZORG: In-depth analysis of the selection process for the health-based guideline value for trifluoroacetic acid (TFA) in drinking water (2024); in Dutch
21 This value is derived by applying the relative potency factor (RPF) of 0.002 for TFA as proposed by the RIVM and using as a basis the EFSA-assessed maximum tolerable daily intake of PFOA of 0.63 ng/kg bw/day. In this model, the tolerable daily intake of TFA is thus 500 times higher than that of PFOA (under the assumption that no other PFAS are present).

For the assessment of a potential health risk posed by the measured average TFA contamination in conventional cereal products (167 µg/kg), two exemplary consumer groups are considered: **adults** (including adolescents) and **children** (including young children).

According to German consumption data[22], children between the ages of 6 months (non-breastfed) and 6 years consume an average of 7.7 grams of wheat, barley, oats, and rye per kilogram of body weight per day. For adolescents and adults (14–80 years), the figure is 3.1 grams. The resulting daily TFA intake from these cereals is:

- **0.52 µg/kg BW/d** for adults
- **1.29 µg/kg BW/d** for children

When comparing these daily intake amounts with the four currently available toxicological reference values for the tolerable daily intake (TDI), the picture shown in Table 3 emerges:

Table 3: Assessment of a potential health risk: Based on the risk assessment applying relative potency factors (RPF) – an approach used by RIVM to derive the indicative drinking water guideline value for TFA of 2.2 µg/l – both adults and children exceed the tolerable daily intake through average cereal consumption.

TDI [µg/kg BW/d]	**TDI-Coverage**	
	Adults (14-80 years)	**Children** (6 month - 6 years)
50 (EFSA 2014)	1 %	3 %
18 (UBA 2020)	3 %	7 %
2.6 (Dep. Zorg 2024)	20 %	50 %
0,32 (RIVM 2023/24)	**163 %**	**403 %**

*For the calculation of TDI utilisation by children and adults, the consumption data used by the German Federal Institute for Risk Assessment (BfR) for long-term consumption of cereals were used.

While the use of the older reference values (EFSA 2014, UBA 2020) gives the all-clear in terms of health risk, the newer reference values paint a different picture: adults exceed the "Dutch-Walloon"[23] TDI (RIVM 2023) by a factor of 1.6, and children by a factor of 4.

Even the comparatively less cautious Flemish risk assessment (Dep. ZORG 2024) already indicates a 50% coverage of the tolerable daily intake in children, and that from cereal consumption alone. Additional TFA intake from fruit and vegetables, animal products, or drinking water has not yet been considered.

22 BfR (2023): Stellungnahme Nr. 041/2023 des BfR vom 25.09.2023 (page 6 / 66; in German)
23 In the Walloon region of Belgium, an indicative drinking water guideline value for TFA based on the RIVM risk assessment has been applied since autumn 2024, following the Recommendation of a Scientific Advisory Board.

4. SUMMARY AND CONCLUSIONS

The present study of 48 cereal products from conventional and organic farming – including baked goods, pasta, breakfast products, flours, and whole grains – tested for the "forever chemical" TFA, which is suspected of impairing human reproduction, revealed three key findings:

- **High TFA contamination in all cereal products**: The measured TFA concentrations, with a mean value of 119 µg/kg and a maximum value of 420 µg/kg, were two to three orders of magnitude higher than the average background TFA levels in rainwater, surface water, groundwater, and tap water. This indicates a significant accumulation of TFA in plant-based foods, which cannot be explained by rainwater or irrigation water alone.

- **Higher contamination in conventional products**: On average, conventional cereal products exhibited TFA contamination levels two to three times higher than those from organic farming. This difference is statistically significant and was particularly evident in pasta and baked goods.

- **Steep increase in TFA contamination**: A comparison with the key data from the only EU-wide survey of cereal products conducted in 2016 (commissioned by the European Commission) shows a roughly 3.5-fold increase in the median TFA contamination in conventional samples. An upward trend was also indicated in the organic samples, although this cannot be precisely quantified due to the analytical detection limits of earlier studies.

Comparable results were recently observed in studies of European wines, conducted independently by GLOBAL 2000 together with PAN Europe, as well as by Prof. Michael Müller at the Department of Pharmaceutical and Medicinal Chemistry, University of Freiburg.

TFA levels of 100 µg/kg or more in cereal or wine – sometimes even in organic products – cannot be explained by current background levels in rainwater (approx. 0.4 µg/l) alone. Rather, they suggest widespread contamination of agricultural soils. In fact, the extreme persistence of the "forever chemical" and its exceptional mobility provide the perfect conditions for its spread in the environment, through water erosion, wind erosion, and pesticide drift.

Soil investigations by the State Office for Nature, Environment and Consumer Protection of North Rhine-Westphalia (LANUV)[24] in 2023 showed that arable soils likely contain around 1 µg of TFA per kilogram of soil on average, with some areas reaching up to 4 µg/kg. Due to its very high water solubility, TFA concentrates in the aqueous part of the soil, the so-called soil solution, where its concentration at a soil moisture content of 10% reaches approximately 10 to 40 µg/l. This is about 25 to 100 times higher than the TFA concentration in rainwater.

Plants absorb this soil solution through their roots and transpire large amounts of water during growth. The dissolved TFA remains in the plant and accumulates, as the plant cannot break it down. Therefore, agricultural products that have not been treated with PFAS pesticides themselves may still exhibit high TFA contamination levels.

Not least, the LANUV studies also provide evidence for the presence of TFA precursor substances in the soil, from which large amounts of TFA are released upon oxidation – these are likely PFAS pesticides. Their degradation under the oxidative conditions present in plants represents another potential source of TFA accumulation in plant products.

24 Landesamt für Natur, Umwelt und Verbraucherschutz Nordrhein-Westfalen (LANUV NRW), Februar 2024: Hintergrundgehalte und -werte von PFAS in Böden ländlicher Gebiete in Nordrhein-Westfalen

The data on the health risks and effects of TFA remain highly fragmented to this day. There is a lack of both basic regulatory studies, as are standard for pesticides (e.g., on carcinogenicity, endocrine-disrupting effects, or neurotoxicity), and foundational academic research or epidemiological studies, especially on immunotoxicity. This is primarily because the PFAS industry succeeded over decades in portraying TFA as harmless, thereby diverting regulatory and scientific attention away from this forever chemical.[25]

It was only after the teratogenic properties of TFA and its negative effects on sperm quality came to light during the EU chemical registration process under REACH that the substance began to attract increased attention from European authorities. As a result, ECHA and EFSA are currently working on EU-wide harmonised hazard and risk assessments. Some member states, such as the Netherlands (2023) and Belgium (2024), have already conducted their own risk assessments. Their estimates of a health-based tolerable or acceptable daily intake ("Tolerable Daily Intake"=TDI) are significantly more cautious – and therefore lower – than older evaluations.

These new values take into account current scientific findings and, for the first time, also consider the unique nature of TFA as a PFAS compound. In contrast to the older reference values from EFSA (2014) and Germany (2020), which indicate little to no risk, the current assessment from the Netherlands (also applied in the Walloon region of Belgium) presents a clearly critical picture: adults already exceed the tolerable daily intake (TDI) by a factor of 1.6 with average cereal consumption, and young children by a factor of four.

In the Flemish part of Belgium, a higher TDI was set than in the Walloon region. However, even this higher value is already half-exhausted by young children through cereal consumption alone, not accounting for additional potential sources of TFA such as drinking water, fruit, vegetables, or animal products. This should be a cause for concern.

Detailed modelling by the German Environment Agency (UBA) to identify the sources of TFA contamination has identified PFAS pesticides as the main source, accounting for around three-quarters of TFA contamination in rural areas. The remaining 25% is mainly due to atmospheric degradation of F-gases deposited by rainfall, and around 3% each from wastewater treatment plants and manure.

In Austria, the situation is similar: in years with heavy rainfall, around 11 tonnes of TFA are deposited on agricultural land (approx. 2.5 million ha) via rain. In contrast, approximately 110 tonnes of PFAS pesticides are applied. These release about 40 tonnes of TFA into the environment over their lifecycle – four times (!) the amount from rain deposition.

In light of the TFA levels in grain, which are already approaching and exceeding toxicological guideline values, and considering their steep increase over time, urgent measures are needed to curb further contamination of our vital resources with this forever chemical. Attempts to obstruct or delay these necessary actions are highly irresponsible and unjustifiable in view of the increasingly evident risks to human health and the environment.

25 Goorden Thomas (2023); The Dark PFAS Hypothesis - Strategies of deception

PAN Europe, GLOBAL 2000 and the Upper Austrian Chamber of Labour, therefore, jointly and urgently appeal to decision-makers in the European Commission and at the federal level to the Austrian Ministers for Agriculture and Environment, and for Health and Social Affairs, Norbert Totschnig and Korinna Schumann:

- **Remove all pesticides containing PFAS active substances from the market**, as required by EU Regulation 1107/2009 on pesticides;

- **Advocate for rapid implementation of the planned EU-wide PFAS group ban**, which also includes F-gases from refrigeration technology (and other TFA precursor substances);

- **Ensure the establishment of health-based guidelines and statutory limit values** that, in accordance with the current state of science, provide a high level of protection for consumers;

- **Monitor compliance with these limit values!**

Only determined and coordinated action can prevent the invisible forever chemical TFA from becoming an unacceptable and lasting burden on people and the environment!

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