

After the ban : How to control titanium dioxide in food?

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Titanium dioxide (TiO₂) is applied in food as a white pigment and listed as food additive E 171. EFSA's opinion [1] states that it is not certain that its use in food is safe because it may be genotoxic. Hence, the European Commission no longer allows E 171 [2]. Consequently, authorities need analytical methods to control the absence of E 171. Because most Ti occurs in food as TiO₂, screening can be realized by analyzing the total Ti content as a measure (proxy) for TiO₂. This study examined whether the concentrations of total Ti are (much) larger in food products containing E 171 than in products without E 171. The rationale behind this is that the refractive properties of E 171 are only useful at relatively high amounts, requiring the addition of E 171.

Challenges related to the measurement of Ti by ICP-OES in food are mainly related to sample preparation: TiO₂ is practically insoluble and requires a mixture of concentrated hydrofluoric, sulfuric, and/or other acids for dissolution. However, the typically applied hydrofluoric acid solution is an ultrahazardous chemical that should be avoided for safety reasons. Hence, a digestion method using microwave digestion at 220°C in a mixture of nitric acid and sulphuric acid was optimized and evaluated for the analysis of total Ti in a variety of food samples collected before and after the ban of E 171.

The measured concentrations of total Ti ranged from < 2 mg/kg to 13305 mg/kg, and from < 2 mg/kg to 26 mg/kg for foods known to contain E 171, and without added E 171, respectively. Cocoa products contained the highest natural Ti levels up to 25.5 mg/kg. When comparing four identical food items (brand, name, package) before and after the ban, the difference in total Ti concentration ranged up to 3 orders of magnitudes. Titanium concentrations above 50 mg/kg were only detected in food containing E 171. In the next phase, these analytical results will be compared with Ti concentrations measured by other analytical techniques (e.g. Raman, XRF).

These results guide competent authorities in setting cut-off values when screening food products for the presence of the banned E 171 and give insights on the methods which are fit for purpose for such control.

Keywords: Titanium dioxide, E 171, ICP-OES

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References

[1] EFSA Panel on Food Additives and Flavourings (FAF) *et al.*, "Safety assessment of titanium dioxide (E171) as a food additive," *EFSA J.*, vol. 19, no. 5, 2021.

[2] European Commission, *Commission Regulation (EU) 2022/63 of 14 January 2022 amending Annexes II and III to Regulation (EC) No 1333/2008 of the European Parliament and of the Council as regards the food additive titanium dioxide (E 171) (Text with EEA relevance)*, vol. 011. 2022. Accessed: Jan. 26, 2023.