

Size characterization and quantification of E171 titanium dioxide particles in food sauces by spICP-MS

M. Menta^{1*}, M. Klein¹, F. Auger², F. Ait-Ben-Ahmad³, A. Papin³, H. Biaudet³ and F. Séby¹

¹Ultra Trace Analyses Aquitaine (UT2A/ADERA), Technopôle Hélioparc Pau-Pyrénées, 2 avenue du Président Angot, 64053 PAU cedex 9, France.

²Service Commun des Laboratoires (SCL), 3 Avenue Dr Albert Schweitzer, 33600 Pessac, France.

³Institut National de l'Environnement industriel et des RISques (INERIS), Parc Technologique ALATA BP2, 60550 Verneuil-en-Halatte, France

In the food industry, titanium dioxide (E171) is used as a coloring agent, opacifier or flavor carrier in foodstuffs or as a clarifying agent in drinks. In some common foods, a fraction (5 to 50 %) of this additive has been found with a size lower than 100 nm (1). This fraction, able to cross physiological barriers and then to be accumulated in systemic organs, may cause problems with the digestive system. Thus, EFSA has concluded this additive cannot be considered safe (2). As the toxicological effects depend mainly on the size and concentration of TiO₂ particles, the determination of these parameters is crucial to assess the level of dietary exposure and establish appropriate risk management procedures. This study also highlighted the lack of harmonization between techniques for TiO₂ nanoparticles (NPs) characterization as well as the need to develop sample preparation procedures. During the last decade, ICP-MS used in single particle mode (spICP-MS) was strongly developed and appears today as one of the most promising techniques for routine quality control of inorganic NPs in foods. Moreover, the high sensitivity and selectivity of spICP-MS allow to face the analytical challenges of food matrices.

This work was focused on the optimization of sample preparation procedures allowing a quantitative extraction of TiO₂ NPs from food sauces. Different extraction reagents (water, surfactants, acids, TMAH, enzymes) were studied and the potential of the spICP-MS technique was evaluated for the size characterization and quantification of NPs. The method was optimized using a white sauce and its corresponding E171 additive. The highest extracted amount of TiO₂ particles was obtained using TMAH with similar TiO₂ particle size distributions in the two samples showing no matrix effects during analysis. After validation, the method was applied to several sauces from the European market. Concentration values in the (0.6 – 6) g(TiO₂)/kg range were obtained for the E171 labelled sauces with median diameters in the range 206 – 280 nm and a percentage of TiO₂ NPs (< 100 nm) between 2 and 12 %. No titanium was detected in sauces purchased in the French market which complies with current regulations.

Keywords: TiO₂ nanoparticles, food, spICP-MS, method validation

* E-mail: mathieu.menta@univ-pau.fr

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