Press release – 7th October 2020

# Nanoparticles of titanium dioxide: E171 crosses the placental barrier

**What is titanium dioxide? It is an important food additive widely used throughout the world for its opacifying and colouring properties (white pigment). Better known in Europe as E171, the sale of food products containing this additive has been suspended in France since January 1st, 2020, for precautionary reasons[1]. Studies[2] by INRAE scientists in 2017 had provided the scientific proof necessary to underpin this limited measure, introduced for a period of one year potentially renewable. Working in collaboration with the Laboratoire national de métrologie et d'éssais (LNE), the Groupe de Physique des Matériaux (CNRS/INSA Rouen/Université de Rouen-Normandie), Toulouse University Hospital, Picardie-Jules Verne University and the National Veterinary School in Toulouse, the same scientists continued their work in humans and now supplied proof that the titanium dioxide nanoparticles present in E171 can cross the placenta and reach the foetal environment. Their results, published on October 7th in *Particle and Fibre Toxicology,* alert on the importance of evaluating the risk of exposure of pregnant women to these nanoparticles.**

Previous studies of the same scientists[2] had raised the alarm concerning the risks linked to E171 consumption, showing its passage into the bloodstream from the gut in the form of nanoparticles[2,3], then accumulating in organs such as the liver or spleen[4]. After chronic exposure, the risks of initiating and promoting the early stages of colorectal carcinogenesis, and modifications to the immune response, were observed[2]. In response to these results obtained in rats (and despite them not being directly transposable to humans), the French authorities decided on a one-year suspension of the sale of food products containing E171, with effect from 1st of January 2020.

Other scientific studies had demonstrated this phenomenon in animals: non food-grade titanium dioxide nanoparticles crossed the placenta and amongst other effects, disturbed foetal development. But the issue of the transplacental passage of these nanoparticles had never been addressed in pregnant women. So what happens in the event of exposure to E171? Might the human foetus also be exposed to nanoparticles of dietary origin? To answer these questions, the same INRAE scientists, working with LNE, CNRS (Groupe de Physique des Matériaux), Toulouse University Hospital, the Picardie-Jules Verne University and the National Veterinary School in Toulouse, focused on the diffusion of E171 in the placenta.

## The E171 additive crosses the placenta

The scientists collected 22 placentas from volunteer mothers and assayed the total titanium levels accumulated in this organ during pregnancy. These assays, coupled with microscopic and chemical analyses, demonstrated an accumulation of titanium dioxide in the placenta, mainly in the form of nanoparticles. The mothers had therefore been exposed to this substance during their pregnancies. In parallel, in order to determine whether their diet might be a source of contamination, the scientists perfused the placentas with E171 on the maternal side. They assayed the titanium on the foetal side of the placenta, and observed whether they would find any particles. The results were clear: titanium dioxide nanoparticles from E171 passed from the maternal compartment to the foetal side.

## Newborns are exposed *in utero* to titanium dioxide

The scientists also focused on newborns exposure to titanium dioxide during their *in utero* development. To achieve this, they used the same tests they had performed on placentas but this time on meconium samples, as these first stools from a neonate offer an excellent indicator of his or her exposure to chemical substances during pregnancy. Once again, the results were clear: titanium dioxide nanoparticles were found in meconium, indicating that foetuses were exposed to this substance via the mothers' blood.

These new data on human organs and tissues demonstrate for the first time prenatal exposure in humans to titanium dioxide nanoparticles. In addition to food, these particles may arise from other sources (see inset). Thanks to the isolated human placenta model perfused with E171, the scientists demonstrate that food-grade titanium dioxide consumed during pregnancy pass into the placenta in the form of nanoparticles and can contaminate the foetus. These human data could be used by food safety agencies to evaluate the risk of exposure to E171 in pregnant mothers. They now need to be supplemented with studies conducted according to OECD and EFSA guidelines in order to clarify potential effects on development and thus guide the authorities in their decisions concerning the presence of nanoparticles in this widely used additive.

Titanium dioxide ($TiO_2$) is used in cosmetics, paints and construction materials, but it is also employed in the agrifood industry where it is a very common additive (known as E171 in Europe). E171 is employed for its whitening and opacifying properties in confectionery, chocolate products, biscuits and chewing-gums, sauces and ice creams. Although its use in foodstuffs was suspended in France as from 1st January 2020 for a period of one year because of insufficient scientific proof concerning its safety, it is still being used in toothpaste, sunscreen, cosmetic creams and powders and pharmaceutical products. However, E171 is not considered as a "nanomaterial" according to a recommendation from the European Commission, when it is not more than 50% composed of nanoparticles. However, the regulatory definitions applicable to food products, such as cosmetic products, do not provide for a threshold.

[1] Application of the French Law of 30 October 2018 on the balance of trade relations in the agricultural and food sector and healthy, sustainable, and accessible food for all (Egalim Law). This measure applies to food products sold in France, for a period of one year, potentially renewable. This precautionary principle does not apply to non-food products.

https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000038410047?r=v1pKGxVbGN

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[4] The spleen plays a role in immunity and the renewal of blood cells.

## Reference

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