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Titanium dioxide is a white metal oxide, which is commonly used as a pigment in coatings of candies and chewing-gum. Food-grade TiO_2, referred to as E171 in Europe and INS171 in North America, includes a nano-sized fraction, representing up to 44% of the particles. Due to concerns about TiO_2 nanoparticles (NPs) as potentially hazardous, at least by inhalation, the toxicity of ingested TiO_2 NPs are currently under investigation. However, the impact of confectionary titania have yet to be determined.

We used a defined gut bacterial community, MET-1 (microbial ecosystem therapeutic-1), as a model human intestinal community. The anaerobic consortium containing 33 bacterial species was batch cultured (n=30) for 48 h at 37°C in a starch-based medium. Food-grade TiO_2 from several suppliers were used to amend the cultures at two realistic concentrations (based on a single unit of gum; 100-250 ppm). In addition, purchased TiO_2 NPs (25 nm; P25) were used. The impact of the additives was assessed with physiological, biochemical and molecular assays. Gas production was monitored using gas chromatography, and fatty acid methyl ester (FAME) analysis used the MIDI Sherlock Microbial Identification System protocol. DNA analysis included polymerase chain reaction denaturing gradient gel electrophoresis (PCR-DGGE) and 16S ribosomal RNA gene fragment 454-pyrosequencing.

Our results showed that TiO_2 particles had no impact on gas production nor on fatty acid composition. Only a food grade sample (n°1) induced a small variation in culture gas composition, when tested at 250 ppm ($p<.05$) and this, as well as P25 particle controls, resulted in a limited shift in the saturated fatty acid composition (12:00 and 14:00, $p<.05$). PCR-DGGE profiles and phylogenetic distributions obtained from 454 pyrotag 16S rRNA gene sequencing confirmed a modest impact on the bacterial community (food grade n°1 and P25), with a significant decrease in sequences corresponding to the dominant *Bacteroides ovatus* (-10%) in favor of *Clostridium. cocleatum* (+10%; $p<0.05$).

Despite these minor shifts in the relative abundance of two members of the model gut consortium, taken together, we believe that food grade titania and TiO_2 NPs particles do not have a major impact on the human gut microbiota when tested at realistic concentrations.

References

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