

## EXPLORING CAROTENOID-INTESTINAL MICROBIOTA INTERPLAY: IN VITRO INSIGHTS INTO GASTROINTESTINAL INTERACTIONS AND HEALTH-ENRICHING EFFECTS

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**Objective:** This study aimed to explore the interactions between carotenoids and the intestinal microbiota (IM) during simulated gastrointestinal digestion and absorption. The focus was on understanding carotenoids' impact on bioavailability, absorption, microbial dynamics, and organic acid (OA) production. Additionally, the study assessed the antioxidant, antidiabetic, and antimutagenic properties of carotenoid solutions.

**Methods:** An *in vitro* simulation of gastrointestinal digestion (INFOGEST) and absorption was performed to explore carotenoid interactions. Three carotenoids (beta-carotene, lutein, lycopene), a pigment mixture, and the alga *Osmundea pinnatifida* were analysed. Human faecal samples were subjected to fermentation to assess the effects on IM dynamics and OA production.

**Results:** During simulated digestion, carotenoids (e.g., lutein, beta-carotene, lycopene, beta-cryptoxanthin) were identified, with compromised bioaccessibility as none were absorbed. The IM analysis revealed *Bacteroidota*, *Bacillota*, *Pseudomonadota*, and *Actinomycetota* as the main phyla present. Also, carotenoids increased the relative abundance (RA) of the *Lachnospiraceae* family (+77.8%) and decreased the RA of bacteria such as *Lactobacillus* (-1.27%), *Enterococcus* (-16.3%), *Streptococcus* (-8.80%), and *Bifidobacterium* (-18.3%), which was consistent with prior studies. Carotenoids stimulated OA production, in particular, succinic ( $\approx 6.4$  g/L), acetic ( $\approx 2.75$  g/L), butyric ( $\approx 0.47$  g/L) and propionic ( $\approx 2.78$  g/L) acids, reinforcing their positive role in intestinal health.

**Conclusions:** Despite compromised bioaccessibility, carotenoids exhibited positive interactions with IM. The results of microbial dynamics, OA production, and functional properties support carotenoids' potential to promote intestinal health and mitigate oxidative and diabetic risks. The observed antimutagenic effects further underscore the potential health benefits of carotenoids.