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EDITORIAL

Modulation of Gut Microbiota by Maillard Reaction Products in Intestinal Inflammation: Are We What We Eat?

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Although "We are what we eat" is a popular phrase implying that eating certain foods affects one's health, the phrase is currently gaining scientific credence due to the discovery of the linkage between diet, the intestinal microbiome, and many diseases. Disease entities not only limited to the gastrointestinal (GI) tract are described as microbiota-dependent. As an example, inflammatory bowel disease (IBD) possesses an established etiopathogenesis which comprises the genetic susceptibility and environmental factors associated with changes in the intestinal microbiota. The increasing incidence of IBD correlates with overall global industrialization, which in turn correlates with the "Western pattern diet" [1].

In this issue of *Digestive Diseases and Sciences*, Jahdali et al. [2] seek to correlate the exposure to N^{ε}-carboxymethyl lysine (CML), an advanced Maillard reaction product (MRP), and the intestinal microbiota in mice in common colitis experimental models. MRPs are compounds that follow the reaction between amino acids and reducing sugars during the heating or frying of food, lending an appealing crunchy texture and pleasing aroma and taste to many dishes. It is still debatable if MRPs have positive or negative impact on health and in particular in IBD subjects. Most likely they act as a double-edged sword, some of them being antioxidants while others promote carcinogenesis [3]. Jahdali et al. reported the ability of CML to modulate the intestinal microbiota in mouse models of IBD, reporting modest effects in 2,4,6-trinitrobenzenesulfonic acid (TNBS)-treated mice and more prominent effects in dextran sodium sulfate-treated (DSS) mice, where CML maintained a "healthy" microbiological profile in the group while preventing weight loss. Remarkably, these effects did not correlate with the attenuation of colitis in both studied models, but actually slightly increased, though nonstatistically, the damage scores. Different though nonstatistically different macroscopic damage scores between the control and CML groups are also notable. Furthermore, CML had no effect on the myeloperoxidase (MPO) activity in the colitis groups, suggesting that injury was mediated by neutrophil-independent mechanisms. CML induces endoplasmic reticulum stress injuring cells via different pathways that could partly explain this phenomenon [4]. Moreover, the study revealed that weight change inversely correlated with food intake by mice, consistent with metabolic changes associated with chronic consumption of CML, supported by an in vitro study [5] in which CML impaired basal glucose uptake while enhancing lipid accumulation in adipocytes.

Although the study helps elucidate how an MRP product influences the gut microbiota in inflamed and healthy mice, it has some weaknesses, which mostly can be attributed to the methodology employed in the studies on the microbiota, which due to the hundreds of variables measured and complex statistics employed is associated with standard errors of nearly the same magnitude as the means, typical of in vivo microbiota studies, complicating the reporting inter-individual variations. Furthermore, the authors studied a somewhat small daily dose of CML; higher doses might have been associated with a more robust effect. Moreover, even if CML is a good representative of MRP family, it is difficult to extrapolate these data to the whole MRP family due to sparse available data.

Similar studies are of great importance due to trend toward formulating an easily manageable adjuvant

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therapy—the diet. Full elucidation of the specific products that need to be added to the diet in order to facilitate intestinal healing would open new therapeutic possibilities. For instance, helpful dietary components could lower the doses of drugs needed for therapy, reducing interactions and undesired adverse events. Yet, modulation of the microbiota during a clinical trial does not necessarily translate to day-to-day experience. Nevertheless, the importance of such studies can inform the development of IBD therapies tailored for the individual patient. The trend to shift the focus from novel drugs to diet is gaining traction, with obvious benefits for patients and healthcare costs. As for now, it is still too early to tell whether or not MRP product adversely effect IBD pathogenesis. One thing is for sure a healthy, balanced diet is what can be proposed patients with IBD for now.

Compliance with ethical standards

Conflict of interest The author has no conflict of interest to disclose.

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