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Are dietary emulsifiers making us fat?

"Any chemical can be toxic if you eat, drink, or absorb too much of it" Paracelsus

To the Editor:

While our ancestors had to find, kill and consume food directly to meet dietary needs, over time procedures were developed to conserve food and increase its nutritional value and palatability. For example, fermentation, pickling and curing emerged as valuable preservation methods, first by allowing for stockpiling for future use but also by adding nutritional value to the food. Nowadays preserving food and improving its sensory quality has evolved from the addition of vinegar, salt or sugar to the use of modern food additives. Food additives are used to increase shelf life and/or enhance food flavor and modify its texture. Emulsifiers are among the most widely used food additives and are regularly consumed in developed countries. Emulsifiers are commonly used to prevent fat dispersion in aqueous solutions. They may also serve as aerating agents, starch complexing agents and/or crystallization inhibitors and are therefore present in numerous foods, such as ice cream, drinks, dressing etc. [1]. In a recent study, Chassaing and collaborators pulled the alarm on the safety of regular emulsifier consumption for human health [2].

Natural emulsifiers include casein and lecithin, which are found in milk and egg yolk and are readily used for cooking purposes. P80 (polysorbate-80 or E433) and CMC (carboxymethylcellulose or E466) are non-natural emulsifiers and can be found as additives in food but are also regularly used as inactive ingredients in cosmetics, and pharmaceutical products. Their use as food additives is controlled and regulated by specific regulatory agencies, such as the EFSA (European Food Safety Authority) or the FDA (Food and Drug Administration). P80 and CMC have been evaluated for toxicity and are generally recognized as safe and used in various foods up to 1% and 2% for P80 and CMC respectively [3–5].

Most emulsifiers are broken down during digestion limiting their potential detergent effect [6]. Nonetheless previous research has associated the consumption of emulsifiers' to gastrointestinal (GI) diseases. Interestingly, emulsifiers share structural domains with pro-inflammatory mycobacterial lipids [3] and their use has been linked to an increase in GI inflammation and bacterial translocation. Incidence of Crohn's disease has been hypothesized to be associated with emulsifiers' consumption [6]. This is particularly relevant in the context of obesity, which is on the rise worldwide and has been characterized as a low-grade inflammatory condition. Obesity-associated inflammation is believed to originate from the GI tract [7–11]. Changes in gut microbiota composition and alteration in GI permeability have been linked to obesity while preventing GI inflammation and maintaining the integrity of the epithelial barrier is associated with resistance to metabolic diseases [12–15].

This has led Gewirtz's group to investigate a potential association between emulsifier consumption and the occurrence of metabolic disorders. The author's findings [2] demonstrate that CMC and P80, administered via drinking water (1% w/v or v/v respectively) or mixed with the food (1% supplementation) significantly altered the gut microbiota composition (Fig. 1). Emulsifiers' consumption reduced the overall microbial diversity and raised the microbiota pro-inflammatory properties, notably via an increase in flagellin and lipolysaccharide release. Furthermore, this emulsifier-induced dysbiosis enhanced the microbiota capacity to infiltrate the dense mucus barrier that lines the intestinal wall, which normally isolates bacteria from the host allowing translocation of pro-inflammatory bacterial products to the circulation and promoting systemic inflammation. Such changes in bacteria composition triggered chronic colitis in *Il10*$^{-/-}$ and *Tlr5*$^{-/-}$ mice that are genetically prone to this disorder due to an abnormal immune system. In wild-type animals, P80 and CMC consumption induced low-grade inflammation, increased food consumption and adiposity and triggered insulin resistance [2].

Interestingly, P80 and CMC effects were eliminated in germ-free mice [2]. Conversely, the transplantation of microbiota from emulsifier-treated mice to germ-free animals was sufficient to transfer some parameters of low-grade inflammation and metabolic syndrome. Changes in microbiota composition were not only necessary but sufficient in mediating the adverse effects of emulsifier consumption. Microbial dysbiosis was sufficient in promoting chronic colitis, intestinal inflammation, hyperphagia, weight gain and hyperglycemia, pointing towards a central role for the microbiota in chronic GI inflammation and metabolic syndrome [2]. Additionally, lower doses of emulsifiers than the ones currently approved for human consumption were able to induce metabolic disorders (from 0.1 to 0.5%). This study meticulously scrutinizes potential important confounding factors such as

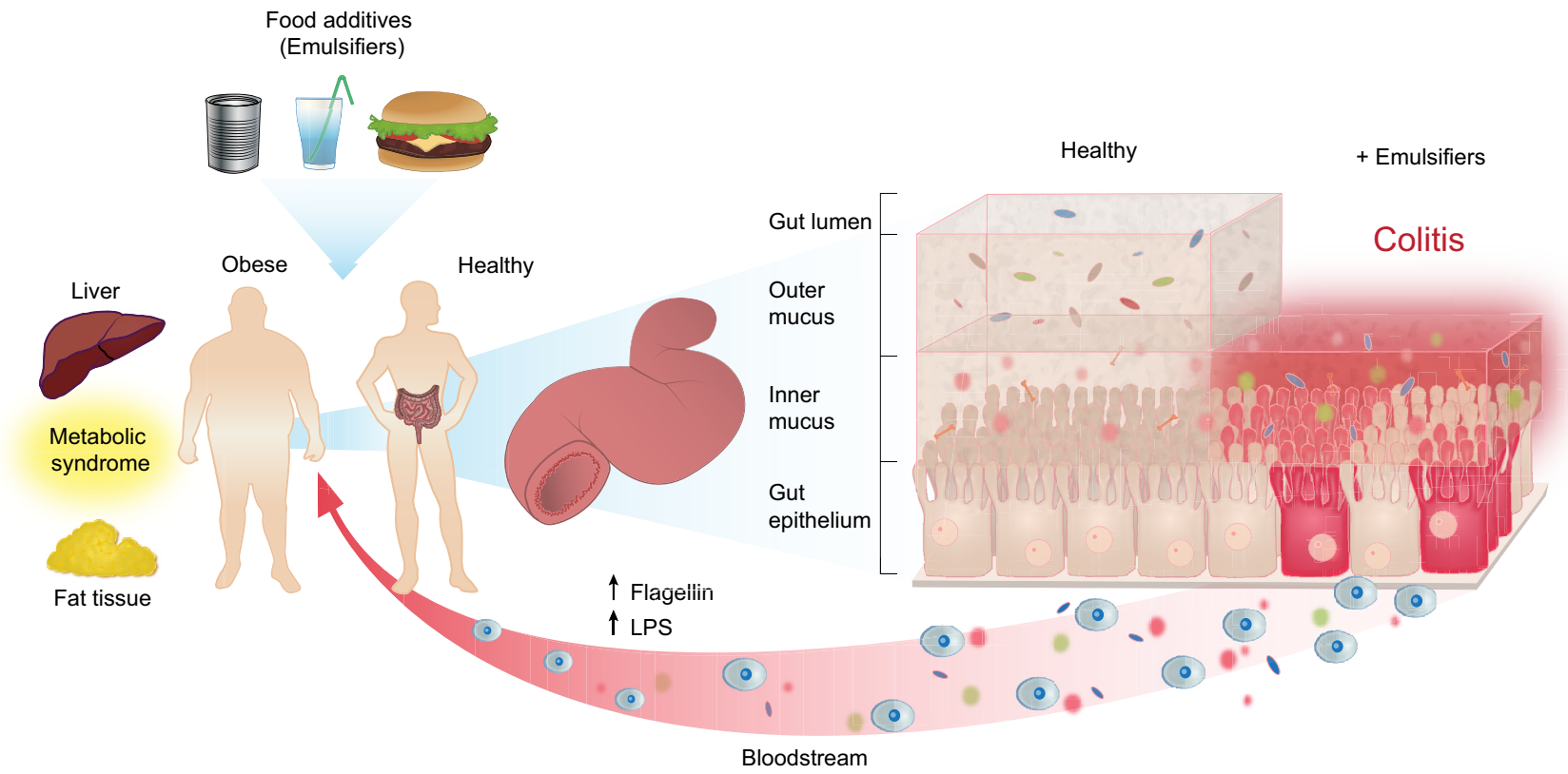

Fig. 1. P80 and CMC disrupt mucus-bacterial interactions and promote diseases associated with gut inflammation and metabolic syndrome. Healthy mucosa is protected from potentially harmful bacteria by an impenetrable viscous mucus barrier. Chronic exposure to dietary emulsifiers (like CMC or P80) results in a microbiota dysbiosis associated with enhanced mucolytic activity leading to erosion of the protective function of the mucus. Increased bacterial adherence with a more pro-inflammatory profile and compromised GI lining induce intestinal inflammation allowing for translocation of pro-inflammatory factors to the circulation, such as lipolysaccharide (LPS) and flagellin. (This figure appears in colour on the web.)