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Editorial

Sugary t(h)reats: our gut microbiome and diet

Festivities are just behind us, and, after indulging in the delicious, traditional puddings and pies that enriched our Christmas table, the will to follow a good, healthy diet represents one of the most classic New Year's resolutions.

The importance of a balanced diet should never be underestimated, as our alimentary regime has a profound effect on our general wellbeing and the risk of developing diabetes, obesity, and cardiometabolic diseases. Following of good diet practices from childhood should be encouraged and promoted, as it is one of the best ways to prevent a burden of diseases and huge health-care costs for the future.

Nevertheless, attention to children diet practices appears not to be a priority for the Trump administration, who recently codified a substantial relaxation of the federal nutritional standards for the lunches served at school: according to the Agriculture Department, those requirements were too demanding [1]. The new guidelines were announced in Washington on Dec 6, 2018, and will be effective from Feb 11, 2019 [2,3]. Implying that schools cannot afford to serve food that is both nutritious and appealing, they are now allowing more refined sugars and more fat in chocolate and other flavoured milks.

This change is a jump backwards compared with the original efforts the US Congress made with the Healthy, Hunger-Free Kids Act of 2010, and the justification provided by the Agriculture Secretary Sonny Perdue—that children are not eating the healthy options provided, and therefore the food is being wasted—is not supported. The nutritional standards threshold should never be lowered, given that increasing consumption of refined carbohydrates influences the risk of diabetes and obesity. However, these risks are not being taken into sufficient account. The chef Jamie Oliver's campaigns against the UK government, which started in 2005 with the Feed me Better campaign, aimed to protect kids from junk food, but have been too often neglected. The UK Childhood Obesity Strategy, which was presented on June 25, 2018 [4] could hopefully induce a change of direction, although the latest data from the National Child Measurement Programme (NCMP) for 2017/18 remain concerning [5].

The gut microbiome, which is being more and more recognised as an essential component of human health and disease, is heavily affected by diet, and covers a fundamental role in the context of diet-related pathologies. Studies undertaken in humanised mice show that switching from a low-fat, plant polysaccharide-rich diet to a high-fat and high-sugar diet typical of Western cultures can shift the structure of the microbiota within a single day, changing both gene expression and the representation of metabolic pathways in the microbiome [6]. Humanised mice fed a Western diet showed increased adiposity, and this trait is transmissible via microbiota transplantation [6].

This influence of dietary components on gut microbiome composition relies on the fact that they serve as nutrients to specific subsets of microbes, thereby favouring their selective expansion. However, Groisman and colleagues [7] described a new, striking mechanism identified in a mouse model. They discovered that dietary fructose and glucose, which are prevalent in the Western diet, specifically silence a protein that is necessary for gut colonisation, but not for utilisation of these sugars, by the human gut commensal *Bacteroides thetaiotaomicron*. These preclinical findings highlight how dietary sugars that reach the microbiota in the intestine not only supply nutrients to the microbiome, but can also regulate gut colonisation by beneficial microbes by modulating protein expression.

But this is not the only recent discovery giving a red flag to the Western diet: Knights and colleagues [8] reported a great example of how diet, ethnicity, and geographical environment can shape microbiome structure and function. They showed how migration from a non-Western country to the USA is associated with immediate loss of gut microbiome diversity and function. US-associated strains displace the original ones, and these effects increase with duration of US residence and are compounded in obese individuals and second-generation immigrants.

While several factors, such as cultural norms and genetics [9], in addition to diet have to be considered, this finding is concerning, because Western urban populations, which typically eat processed food and use antibiotics, have a far less diverse gut microbiome than do those from non-Western countries. The awareness that microbiome biodiversity is under threat led microbiologists at the Massachusetts Institute of Technology, Cambridge (USA), to create the Global Microbiome Conservancy (GMC) in 2016. With the aim of rescuing and preserving the microbes, they are creating a biobank by asking people worldwide for faecal samples. Considering that these microbes come from the human body, it is legally difficult to establish who owns the samples and any scientific advance made using them [10], but GMC founders believe that preservation of strains that coevolved with humans and that are currently disappearing could pave the way for the development of new treatments.

The connection between gut microbiome health and human health is getting stronger and stronger, which is not surprising given that the microbiome is such an important component of our body (thinking only in terms of quantity, it largely outnumbers our own cells!). New approaches are arising to exploit the microbiome to treat diseases, based on the assumption of drugging the microbiome to promote the host health. These methods are still in their infancy, and have a lot of difficulties to overcome, but could become a common therapy.

However, it is important to underline that a lot of the evidence obtained so far arises from studies undertaken in preclinical animal models. Much still has to be done before extrapolating the findings to humans, and further research in this direction is warranted.

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Nevertheless, the profound consequences that bad alimentary habits can exert should never be underestimated, as they could represent a huge threat to human global health.

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