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LETTER

On the role of gut bacteria and infant diet in the development of autoimmunity for type 1 diabetes. Reply to Hänninen ALM and Toivonen RK [letter]

Austin G. Davis-Richardson[1] · **Eric W. Triplett**[1]

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To the Editor: We agree wholeheartedly with Hänninen and Toivonen [1] that we must move beyond taxonomic associations of bacteria with type 1 diabetes. However, a strong bacterial taxonomic association with disease, such as with *Bacteroides dorei* and type 1 diabetes autoimmunity in Turku, Finland [2], can provide a considerable number of clues about how the functions of this bacterium can lead to disease. When a bacterial species is known at the genus and species levels and associated with disease, this allows us to make many predictions about how this organism may be dominating a particular environment. In the case of *B. dorei* and type 1 diabetes in Finland, this has gone further, with the publication of three full genomes of this species from stool samples obtained in Turku. This work led to the model described in our recent review [3]. The model was intended to serve as a platform to test the ideas presented, as well as to add new concepts. That is, if *B. dorei* is associated with type 1 diabetes autoimmunity, what are the factors that contribute to its dominance in the gut microbiome of unhealthy children? As stated in the review, a number of papers have shown that diet can affect *Bacteroides* populations in the human gut.

The authors propose the addition to fibre to our model for the dietary control of *Bacteroides* gut populations [1]. This is based on their recent study in the NOD mouse [4], the idea being that fibre in the diet may be an important component leading to type 1 diabetes and that this may be conferred by an increase in the *Bacteroides* population in the NOD mouse. It is not clear whether this work in mice is translatable to the human condition. The authors propose that a fibre-containing berry cocktail given to Finnish children at 4 months of age may be the trigger that precedes the increase in *B. dorei* at about 7.5 months of age. Solid food is introduced to Finnish babies at 4–6 months of age [5, 6], so it is hard to identify the particular dietary components that contribute to a high *B. dorei* population, but we agree that soluble fibre is one candidate.

As stated previously [2], it has been known for many years that *Bacteroides* likely plays an important role in the digestion of complex carbohydrates in the human gut [7]. Nevertheless, there are precious few papers on the role of dietary fibre on *Bacteroides* populations in the human gut. A recent paper by Lamichhane et al [8] reported a strong positive correlation between soluble fibre intake and the level of *Bacteroides* in the human gut. Still other papers point to gluten as a contributor to a high relative proportion of *Bacteroides* species [9], while others suggest that high protein and animal fat is an important contributor [10]. It would not be surprising that all of these dietary factors play a role. However, it is clear that the source of *B. dorei* in Turku, Finland, will never be resolved by studies in the NOD mouse, and a careful epidemiological analysis of the source of this bacterium in that city is warranted.

✉ Eric W. Triplett
ewt@ufl.edu

[1] Microbiology and Cell Science Department, Institute of Food and Agricultural Sciences, 1355 Museum Road, PO Box 110700, Gainesville, FL 32611-0700, USA

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