Review of: "Regular Consumption of Lacto-fermented Vegetables has Greater Effects on the Gut Metabolome Compared with the Microbiome"

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The authors presented an interesting study investigating an under-researched aspect of diet modification with lacto-fermented vegetables for potential health benefits. While there is general recognition of this ancient tradition found in all cultures, details about mechanisms and effects of these foods on the human gut microbiome are sparse (1, 2).

Similar to the findings reported from the American Gut Project (3), in this study a substantial increase of LFV consumption to a daily amount of four servings (4 ounces) had only minor effects on the taxonomic composition or diversity of the microbiome comparing consumers and non-consumers. Authors are aware of generalisability concerns where in this small cohort (n=47) only some participants showed differences of abundances of certain taxa such as *Leuconostoc mesenteroides* and *Rhodotorula mucilaginosa.* Microbiome diversity as an indicator of health is increasingly being questioned: some studies found that healthier individuals have a greater diversity of taxa and functional pathways while others reported the opposite (4, 5). Intervention studies reported improvements of symptoms without increases of diversity or greater diversity in the unhealthy group compared to healthy controls (6, 7). This reiterates the necessity of the debate about diversity as a biomarker for health, let alone the issue that we are still yet to define a healthy microbiome (8).

Here, a shift from discussing a 'core of healthy species' to a 'core of functions' common to all human beings has changed our understanding of the influence of the microbiome. Guse et al. reported in this regard a significantly greater metabolomic diversity post intervention, particularly a potential increase of butyrate producers and a general increase of short-chain fatty acid production. SCFAs have been identified as beneficial to human health with their broad ranging effects as energy sources for enterocytes or signalling molecules for a wide range of physiological processes well beyond the intestinal tract (9). At the same time, we are alerted that some 95% of SCFAs are absorbed and amounts measured in faecal samples do not adequately represent production rates (10). Furthermore, there is no generally recognised level of adequate amounts of SCFAs. The reported increase of SCFA levels as a result of increased LFV consumption is nevertheless an intriguing fact requiring further investigation. The authors mentioned that it is not clear if the consumption of LFV itself caused the increase in SCFA levels or if it supported the existing population of producers to increase their production. One way or another it appears that an increased intake has the health benefit of increased SCFA levels for the individual. In addition, SCFAs are metabolites of fibre fermentation and higher levels found in the LFV group poses an intriguing question given that there were no differences in fibre intake between the groups. Authors hint that the lack of lactic acid consumed with the fermented vegetables may indicate its metabolization to butyrate. Elucidating the mechanisms behind the higher abundances of valeric, butyric, and acetic acids in the LFV group would indeed be of great interest.

Potential health benefits from LFV consumption faces the well-known challenges of correlating metabolomic data with dietary data from self-administered questionnaires. Reporting bias and accuracy of study participants is one issue, the limitations of the assessment tool are another. More fundamental issues plague nutritional epidemiology where millions of possible combinations of food items and their ingredients seriously hamper classifications of a healthy food or diet. This had been hotly debated in the field for many years and is unlikely to be resolved anytime soon (11, 12). LFV consumption, its effect on the microbiome and potential health benefits could be assessed in much greater detail in controlled feeding studies, as the authors suggest. Their finding in the present study of a higher metabolite pool and higher abundances of SCFAs in the consumer group is encouraging for further research in this area.

1. Marco ML, Sanders ME, Ganzle M, Arrieta MC, Cotter PD, De Vuyst L, et al. The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on fermented foods. Nat Rev Gastroenterol Hepatol. 2021;18(3):196-208.

2. Castellone V, Bancalari E, Rubert J, Gatti M, Neviani E, Bottari B. Eating Fermented: Health Benefits of LAB-Fermented Foods. Foods. 2021;10(11).

3. Taylor BC, Lejzerowicz F, Poirel M, Shaffer JP, Jiang L, Aksenov A, et al. Consumption of Fermented Foods Is Associated with Systematic Differences in the Gut Microbiome and Metabolome. mSystems. 2020;5(2).

4. Khalif IL, Quigley EM, Konovitch EA, Maximova ID. Alterations in the colonic flora and intestinal permeability and evidence of immune activation in chronic constipation. Dig Liver Dis. 2005;37(11):838-49.

5. Chen O, Sudakaran S, Blonquist T, Mah E, Durkee S, Bellamine A. Effect of arabinogalactan on the gut microbiome: A randomized, double-blind, placebo-controlled, crossover trial in healthy adults. Nutrition. 2021;90:111273.

6. Vandeputte D, Falony G, Vieira-Silva S, Tito RY, Joossens M, Raes J. Stool consistency is strongly associated with gut microbiota richness and composition, enterotypes and bacterial growth rates. Gut. 2016;65(1):57-62.

7. Asnicar F, Leeming ER, Dimidi E, Mazidi M, Franks PW, Al Khatib H, et al. Blue poo: impact of gut transit time on the gut microbiome using a novel marker. Gut. 2021;70(9):1665-74.

8. Shanahan F, Ghosh TS, O'Toole PW. The healthy microbiome-what is the definition of a healthy gut microbiome? Gastroenterol. 2021;160(2):483-94.

9. Gershon MD, Margolis KG. The gut, its microbiome, and the brain: connections and communications. J Clin Invest. 2021;131(18).

10. Sakata T. Pitfalls in short-chain fatty acid research: A methodological review. Anim Sci J. 2019;90(1):3-13.

11. Ioannidis JPA. Unreformed nutritional epidemiology: a lamp post in the dark forest. Eur J Epidemiol. 2019;34(4):327-31.

12. Archer E, Marlow ML, Lavie CJ. Controversy and debate: Memory-Based Methods Paper 1: the fatal flaws of food frequency questionnaires and other memory-based dietary assessment methods. J Clin Epidemiol. 2018;104:113-24.