**Nutrition and the Microbiome: Probiotics and their effects on Microbiota**

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**Abstract**

Nutritional sciences and the study of the microbiome are closely related to one another through the study of probiotics. Probiotics are dietary living organisms that have the potential to directly alter the microbiota of the gut. This topic is important in order to conduct further research on how treat chronic diseases through the use of probiotics. Recently, a study was conducted that took samples of fecal metagenomes from participants from other countries to observe their enterotypes. Currently, after the development of the Human Microbiome Project, more studies have been published that researched the microbiota in individuals that are health and that are diseased. The use of probiotics for medicinal purposes is still a controversial subject both to the general public and within the nutritional sciences field. There are still some questions to be addressed as to the safety and effectiveness of probiotics as influencers of the microbiome.

**Introduction**

The microbiome is defined as “the ecological community of commensal, symbiotic, and pathogenic microorganism that literally share our body space and have been all but ignored as determinants of health and disease” (Lederberg and McCray, 2001). Microbiome is composed of two different categories: core and secondary microbiomes. The core microbiome is shared by the human population of bacteria that we are exposed to from birth to present time. The secondary microbiome is specific to each individual human. There are different factors that can alter the microbiome, such as diet, antibiotics, and presence of chronic disease. In the article, they described a recent discovery that showed that “obesity was associated with changes in the microbiota at the phylum level and alteration in the representation of bacterial genes and metabolic pathways” (Hermarajata, P., & Versalovic, 2013). This shows a direct correlation between how the secondary microbiome changes in a person with chronic disease. Probiotics could be used to alter the microbiome back to a homeostatic state to eliminate or better treat the disease. Another recent study was conducted that gathered fecal samples from populations around the world to analyze their enterotypes and they were identified as being “three dominant genera: *Bacteroides* (enterotype 1), *Prevotella* (enterotype 2) and *Ruminococcus* (enterotype 3)” (Hermarajata, P., & Versalovic, 2013). The discoveries of this research further reinforce the nutrition-microbiome synergistic relationship and how it relates to the pathophysiology of disease.

Probiotics, according to the Food and Agricultural Organization of the United Nations and the World Health Organization, are defined as “living microorganisms, which when administered in adequate amounts confer health benefits on the host” (Food and Agricultural Organization of the United Nations *et all*. 2006). Nutritionally, probiotics are more commonplace in food than is acknowledged on the nutrition facts panel. Yogurt is an example of a commonplace food that also contains a probiotic, without the need of excess dietary supplementation. The probiotics in yogurt function as to promote the “suppression of pathogens… stimulation of epithelial cell proliferation and differentiation and fortification of the intestinal barrier” (Thomas and Versalovic, 2010). While the use of dietary supplements of probiotics is still controversial, humans actually unknowingly ingest foods that already contain probiotics in their everyday life.

**Recent Progress**

In 2016, a study was conducted to examine the impact of a ketogenic diet on the gut microbiota of an experimental mouse that had an Autism Spectrum Disorder (Newell 2016). Symptoms of Autism Spectrum Disorder display as gastrointestinal dysfunction. The ketogenic diet, before it became a fad diet, was originally purposed as a treatment option for children with epilepsy. This study demonstrates “the first successful use of a dietary therapy as a treatment to pharmacologically resistant epilepsy…shown to improve the core symptoms of ASD” (Newell 2016). The overall purpose of using a mouse model on the ketogenic diet was to disrupt the normal flora of the gut microbiota in a way that would improve the symptoms of ASD. The cecal and fecal matter of the mice were examined to monitor the progress ketogenic diet on the bacteria. Successfully, the number of total host bacteria was decreased, showing the beginnings of a gut microbiota remodeling.

**Discussion**

According to the aforementioned studies, the microbiota and the diet are directly related and have an effect on an individual’s health. “Well-designed experiments in appropriate experimental models may yield insights into the biology and potential manipulation of the microbiome in the human host” (Hermarajata, P., & Versalovic, 2013). This is a foreshdowing to what could possibly lead to another project that is equally the magnitude of the Human Microbiome Project. These new experiments could also address any remaining questions the general public has about the microbiome and how our western diets affect the composition of our bodies. “New types of probiotics or medicinal compounds derived from the microbiome may be used as future strategies to promote health, prevent disease, and treat different disorders” (Hermarajata, P., & Versalovic, 2013). There is research left to be completed on probiotics and their safety and effectiveness that may reinforce the benefits illustrated in the previous experiments. In this article, the relationship between nutrition, microbiomes, and the pathophysiology of disease has been analyzed. These recent discoveries are just the beginning of an even greater medical breakthrough.

**References**

Hemarajata, P., & Versalovic, J. (2013). Effects of probiotics on gut microbiota: mechanisms of intestinal immunomodulation and neuromodulation. *Therapeutic advances in gastroenterology*, *6*(1), 39-51.

Food and Agriculture Organization of the United Nations, World Health Organization, Joint FAO/WHO Expert Consultation on Evaluation of Health and Nutritional Properties of Probiotics in Food Including Powder Milk with Live Lactic Acid Bacteria, and Joint FAO/WHO Working Group on Drafting Guidelines for the Evaluation of Probiotics in Food (2006) Probiotics in food: health and nutritional properties and guidelines for evaluation. In *Report of a Joint FAO/WHO Expert Consultation on Evaluation of Health and Nutritional Properties of Probiotics in Food Including Powder Milk with Live Lactic Acid Bacteria*, Cordoba, Argentina, 1–4 October 2001 [and] *Report of a Joint FAO/WHO Working Group on Drafting Guidelines for the Evaluation of Probiotics in Food*, London, ON, Canada, 30 April –1 May 2002 Rome: Food and Agriculture Organization of the United Nations, World Health Organization

Lederberg J., McCray A. (2001) ‘Ome sweet’ omics: a genealogical treasury of words. The Scientist 15: 8

Newell, C., Bomhof, M. R., Reimer, R. A., Hittel, D. S., Rho, J. M., & Shearer, J. (2016). Ketogenic diet modifies the gut microbiota in a murine model of autism spectrum disorder. *Molecular Autism,7*(1). doi:10.1186/s13229-016-0099-3

Thomas C., Versalovic J. (2010) Probiotics-host communication: modulation of signaling pathways in the intestine. Gut Microbes 1: 148–163