Beneficial Effects of Selenium on the Human Gut Microbiome

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Introduction

- The benefits of dietary fiber on human health include reducing the risk for cardiovascular disease, diarrhea, diverticulitis, lowering serum cholesterol, and serving as a prebiotic for the bacteria of the human gut microbiome.1,2
- Currently, the average American consumes about 17 grams of dietary fiber daily, which is half of the recommended intake.3
- Data suggests that consuming adequate amounts of dietary fiber supports optimal growth of gut bacteria, and adding partially hydrogenated guar gum to one's diet can contribute to reduced risk of certain chronic diseases.
- The primary objective of this study was to observe the change in gut bacteria diversity in human-derived gut microorganisms samples combined with partially hydrogenated guar gum (PHGG) and selenium.
- The secondary objective of this study was to record gas production and short-chain fatty acid production of the gut bacteria in reference to other sources of fiber.

Methods

- Gut bacteria samples were collected from three volunteers who consumed an antibiotic-free Western diet. Samples were stored in anaerobic conditions and were homogenized immediately upon collection.
- Partially hydrogenated guar gum fiber was hydrated and incubated for 12 hours at 4°C Celsius.
- Gut bacteria sample was prepared with a reduction solution (2.52 g cysteine hydrochloride, 16 mL 1N NaOH, 2.56 g sodium sulfide nonanhydride, 380 mL DD H2O) at a 2:1.5 ratio.
- 2.5 ppm of selenium was added to S1, and 5 ppm of selenium was added to S2.
- 10 mL of bacterial inoculum was added to each of the serum bottles, 0.8 mL Oxyrase® added, flushed with CO2, sealed, and then immediately placed in the 37°C circulating water bath.
- Samples prepared in triplicate and analyzed at 0, 12 and 24 hours.
- pH and total gas volume were measured at 12 and 24 hours.
- 2-mL aliquots were sent for 16s miSEQ genomic sequencing.
- Gas measured by piercing the cap of the serum bottle with a syringe needle and measuring gas released from system.

Results

- Results for total gas production for different amounts of selenium compared to samples without selenium as well as the gas production from various types of fiber are illustrated below.
- Donors 4, 5, and 6 produced significantly lower amounts of gas at 12 and 24 hours (figures 5-7).
- At 24 hours, donors 1-3 had no significant difference in gas production between the PHGG control and the Selenium (figures 1-3).
- At 12 hours, there was significant variability in gas production among all 6 donors (figure 4).

Discussion

- Based on the results, the higher short-chain fatty acid production correlates with a greater expression of microorganisms including Bifidobacteria and Lactobacillus (data not shown).
- The results imply that the short-chain fatty acid production yield an acidic environment, which made optimal growing conditions for the microorganisms.3
- Limitations of the methodology include the lack of simulation of the human intestinal digestion and absorption processes. For example, the glass tubes that contained the fermentation reactions were not exposed to peristalsis or water reabsorption. Also, the variable aqueous environment could have different effects on the microorganism growth and the availability of nutrients.

Conclusions

- This study is the first human study in the effects of specific elements on bacterial growth the metabolic function in the gut microbiome.
- The study has shown a statistically significant correlation between the amount of selenium and the growth of bacteria in the human gut microbiome, but further research will be needed to identify the long-term effects that a diet high in selenium has on chronic disease and other health implications.
- The results contribute greatly to the understanding of the relationship between dietary fiber, the human gut microbiome.

References