Two isomers of ginger root extracts modify composition and function of gut microbiota in rats treated with neuropathic pain

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ABSTRACT

- Emerging evidence suggests that gut microbiota plays a key role during the development of chronic pain, such as neuropathic pain (NP). This study aimed to evaluate the effects of two ginger root extract isomers (gingerols and shogaols) on the composition and function of gut microbiota in animals with NP.
- Sixteen male Sprague-Dawley rats were randomly assigned to 4 groups: untreated sham group, untreated spinal nerve ligation (SNL) group as the control group for treatment, SNL+gingerols-enriched ginger (GEG) extract group, and SNL+shogaols-enriched ginger (SEG) extract group. Animals in GEG and SEG groups were fed their respective diets for 30 days starting on the day of SNL surgery. On day 30, fecal samples were collected for microbiota composition and functional analyses. 16S rRNA gene sequencing was conducted from fecal samples, and microbiome data analysis was performed with QIIME2 and PICRUSt2. Data were analyzed using non-parametric Kruskal–Wallis test to compare GEG and SEG with untreated SNL group.
- Based on the results of alpha-diversity analyses, neither GEG nor SEG treatment affected the evenness of microbiome. Gingerols or shogaols supplementation into the diet reduced the richness of the gut microbiome in NP, compared to the untreated SNL group. Relative to the SNL group, the GEG group had an increase in the relative abundance of the genus *Faecalitalea*, while the SEG group had an increase in the relative abundance of the genus *Aerococcus* and species *Bacteroides massiliensis*. In comparison to the untreated SNL group, both GEG and SEG groups showed a decrease in the relative abundance of the family Muribaculaceae and the genus Rikenellaceae RC9 gut group. Functional profiling results revealed that relative to the untreated SNL group, both GEG and SEG supplementation increased the proportion of biosynthetic pathways related to energy metabolism (i.e., pentose phosphate pathway and sugar degradation) and peptidoglycan biosynthesis. Furthermore, GEG and SEG differentially modified amino acid-related metabolic pathways, i.e., tyrosine degradation, tryptophan biosynthesis, arginine, and ornithine biosynthesis.
- GEG and SEG exhibited differential effects on the microbiome composition and function, suggesting a prebiotic potential for dietary ginger root intake in the management of NP.

INTRODUCTION & METHODS

- Neuropathic pain is caused by damage (injury, lesion) to the peripheral or central nervous system. It affects 7–10% of the general population.
- Several phytochemicals are effective in alleviating neuropathic pain. Ginger root extract isomers (i.e., gingerols and shogaols) were suggested to relieve neuropathic pain.
- The gut microbiota may play a role in neuropathic pain, but the exact mechanism is not yet known.
- This study aimed to investigate the effect of gingerols and shogaols on the gut microbiota of rats with spinal nerve ligation injury (neuropathic pain model).
- Neuropathic pain was induced in animals by spinal nerve ligation (SNL). Then, animals were treated with either GEG and SEG for 30 days. Finally, fecal samples were collected and 16S rRNA gene was sequenced to analyze the alterations in the gut microbiota.
- Gut microbiome composition and diversity were analyzed using QIIME2, while PICRUSt2 was used to investigate the functional profile changes.

RESULTS

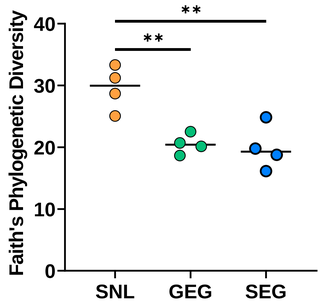

Figure 1. Gingerols and shogaols reduce the richness of the gut microbiome.

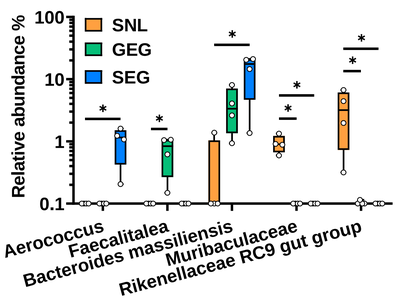

Figure 2. Gingerols and shogaols shift the gut microbiome composition.

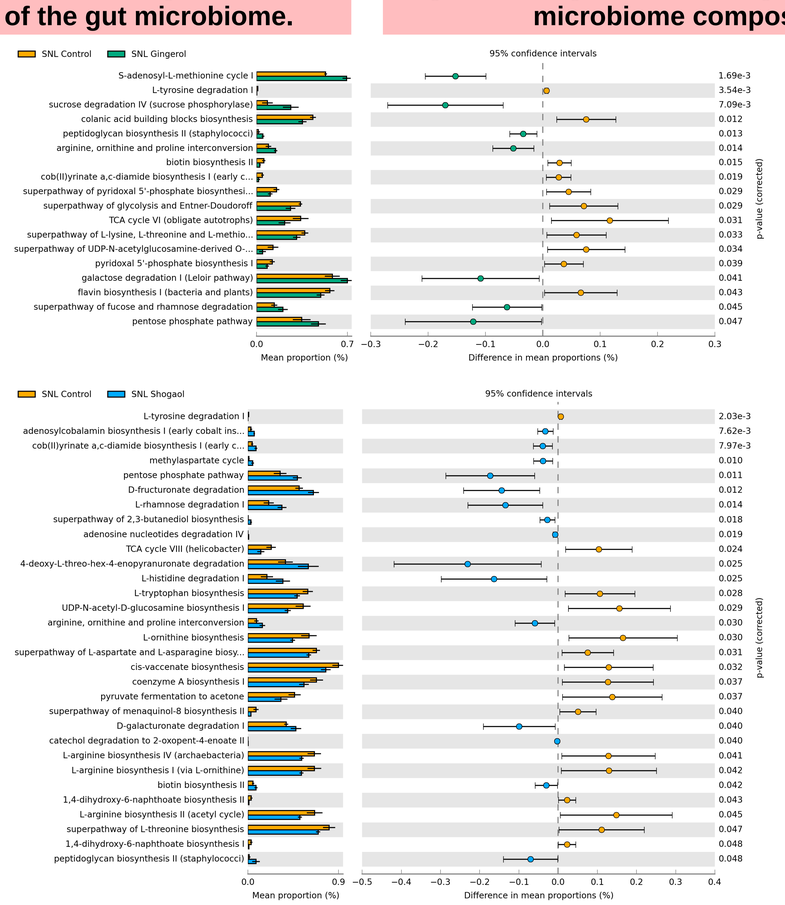

Figure 3. Gingerols and shogaols alter the functional profile of the gut microbiota.

CONCLUSIONS

- GEG and SEG exhibited differential effects on the microbiome composition and function, suggesting a prebiotic potential for dietary ginger root intake in the management of NP. Most notably GEG and SEG increased the abundance of *Bacteroides massiliensis.*