The effects of ginger root extract on gut microbiota-derived metabolites in animals with neuropathic pain

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Introduction

Recent studies indicate gut microbiota as a key modulator of peripheral and central sensitization pathways of chronic pain through gut microbiota-derived mediators (GMDM). These pathways include the activation of microglia and infiltration of immune cells. Thus, dietary intervention with changes in GMDM may represent a new therapeutic strategy for chronic pain. Ginger (Zingiber officinale Roscoe), an analgesic and anti-inflammatory agent, poses great potential. This study evaluates the effects of ginger root extract (GRE) on GMDM in neuropathic pain models.

Methods

Animal Treatments

- Sixteen male rats were divided into four groups and the study period was 30 days
- Sham group: received sham surgery and fed AIN-93G diet
- SNL group: received spinal nerve ligation (SNL) and fed AIN-93G diet
- SNL+GEG group: received SNL and fed gingerol-enriched ginger (0.75%) in AIN-93G diet
- SNL+SEG group: received SNL and fed shogaols-enriched ginger (0.75%) in AIN-93 diet

Sample Collection/Data analysis

- Fecal samples were collected using metabolic cages.
- Metabolites from 50mg homogenized fecal samples were extracted and centrifuged.
- Aqueous phase was process for untargeted metabolomics analysis using LC-MS/MS.
- Principal Component Analysis (PCA) was performed to assess the different profiles of the metabolites.
- Data were analyzed using compound discover software (3.1) to identify and quantify metabolites.

Key Pathways Analyzed

- Anaerobic aromatic compound degradation (AACD)
- Aromatic amino acid biosynthesis (AAAB)
- Branched chain amino acid biosynthesis (BCAAB)

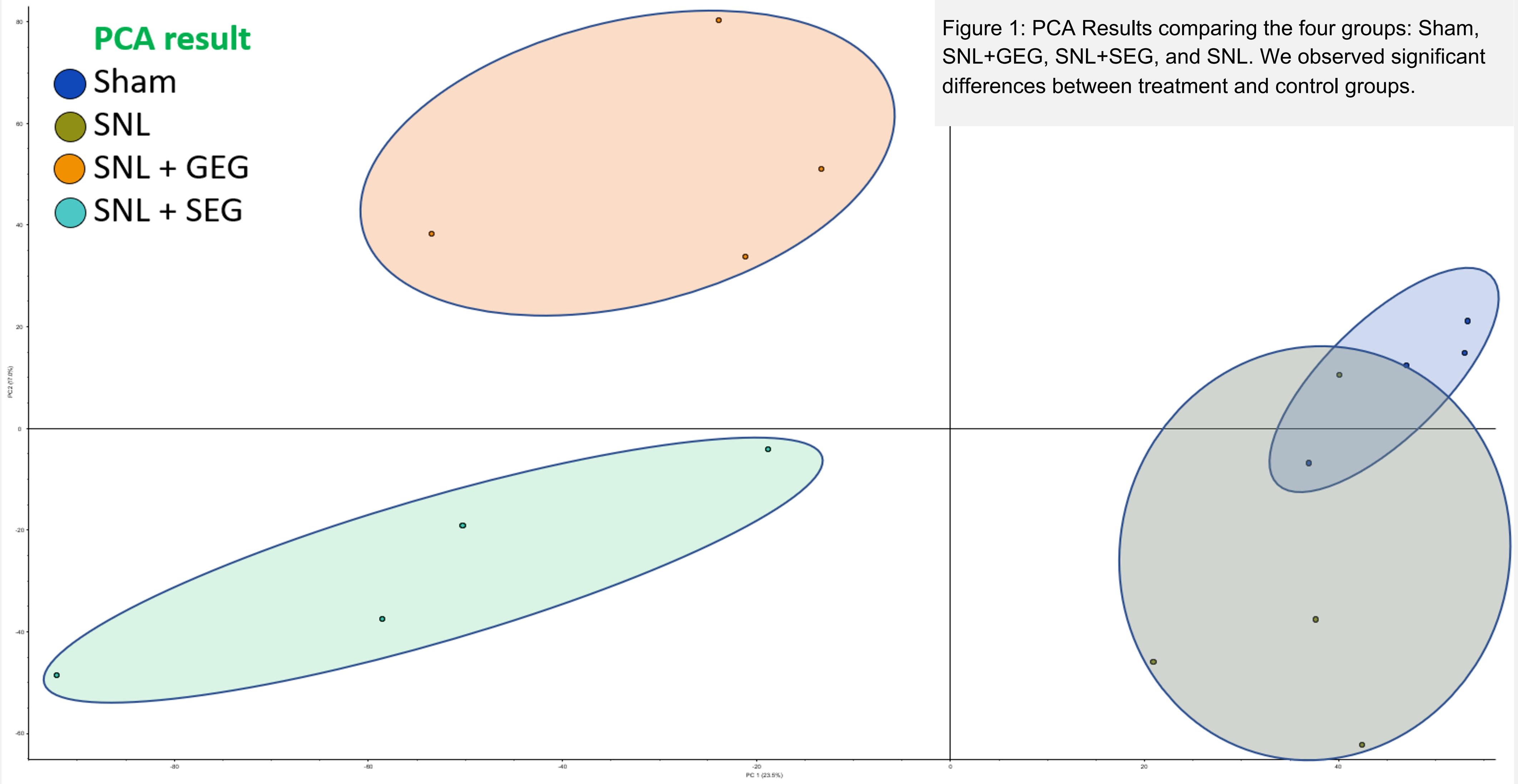

Figure 1: PCA Results comparing the four groups: Sham, SNL+GEG, SNL+SEG, and SNL. We observed significant differences between treatment and control groups.

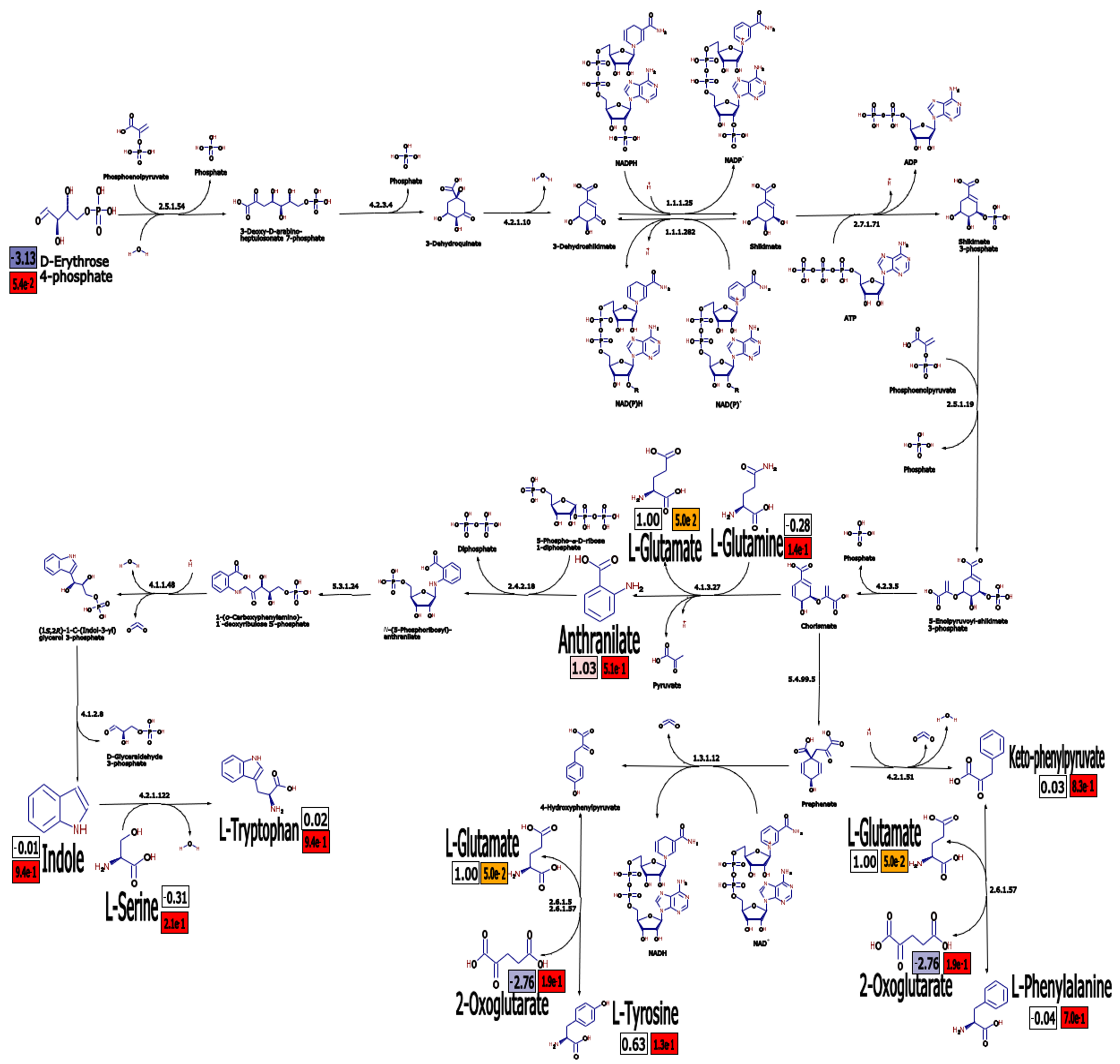

Figure 2: Aromatic Amino Acid Biosynthesis Superpathway. Highlighted are compounds that demonstrated fold changes between the SNL+GEG and SNL groups. Beside these are the P-values for each differences observed.

Results and Discussion

No statistically significant differences were observed in these 3 pathways between the sham and the SNL control groups (p>0.05). PCA of four groups demonstrates less variance and good reproducibility between the 4 cohorts while also demonstrating significant differences between treated groups and the sham/control groups (Figure 1). Significant differences were observed between the ginger-supplemented groups (SNL+GEG and SNL+SEG) and the SNL control for fecal metabolites in the AAAB pathway (L-Tryptophan, L-Tyrosine, L-Phenylalanine) (Figure 2) and the BCAAB pathways (2-Oxoglutarate, 4-Methyl-2-oxopentanoate, L-Glutamate, L-Valine) (Figure 3). Further analysis of fecal functional data is ongoing. These significant differences due to ginger supplementation may be beneficial signs for neuropathic pain relief.

Acknowledgement

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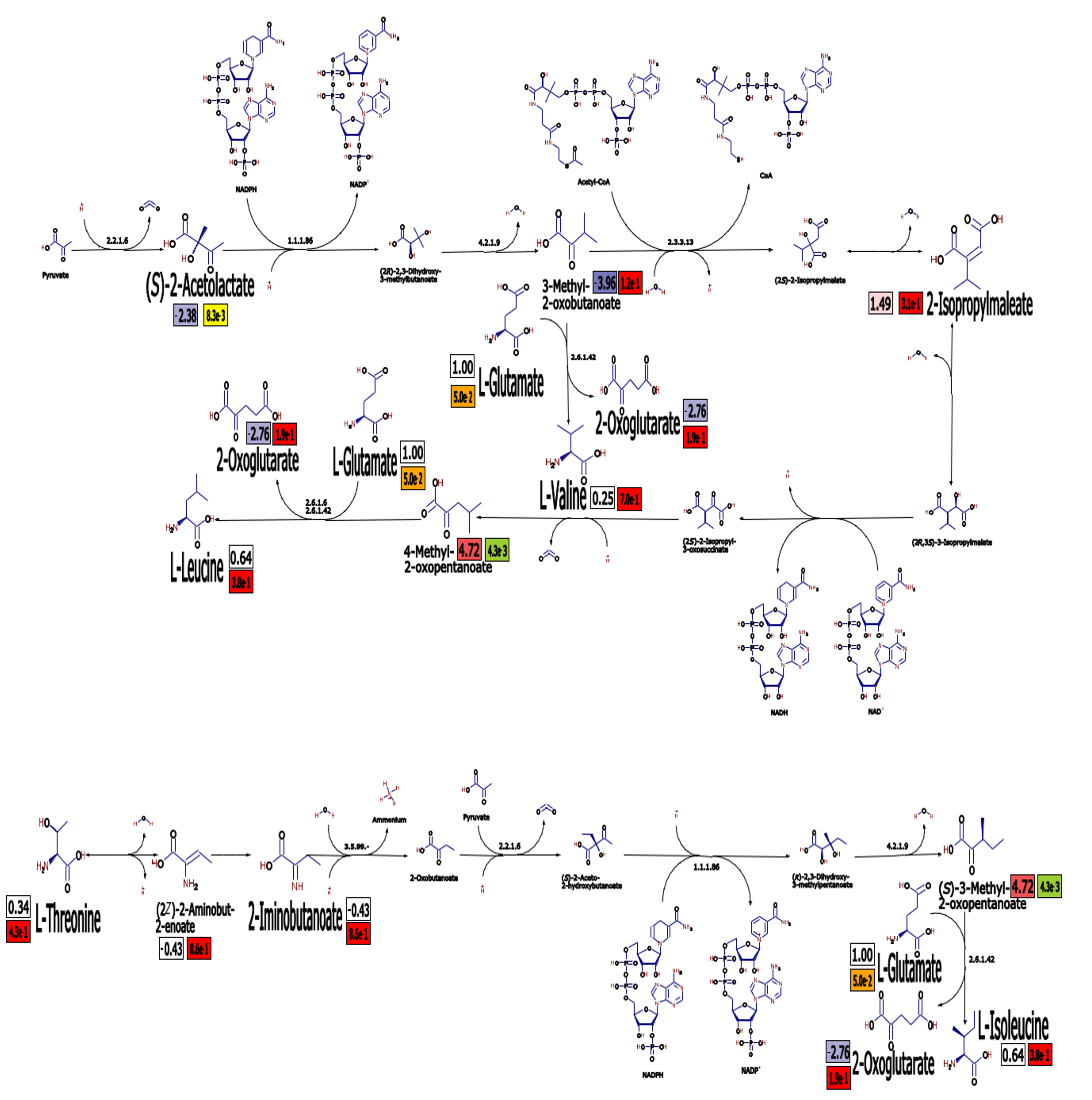

Figure 3: Branched Chain Amino Acid Biosynthesis Superpathway. Highlighted are compounds with fold changes between SNL+GEG and SNL. Beside these are the P-values for each differences observed.