In Controlled Rat Study Long-Term Cola Intake Weakens Immune Cell Counts

Researchers evaluated the effects of long-term replacement of drinking water with either sugar-sweetened or sugar-free cola on gut microbiota, immune status, and organ function in rats.

Study

The study included 24 Sprague-Dawley rats (male and female, aged 6–8 weeks) randomly assigned to three groups (n = 8 per group): Water, Sugary Cola, and Diet Cola. Each group received purified water, sugar-sweetened cola, or diet cola as their sole fluid source for eight weeks, representing full replacement rather than partial supplementation. All animals had free access to standard laboratory chow and were housed under controlled temperature conditions.

Body weight, body length, and body mass index were measured. Thymus and spleen indices were calculated as organ weight relative to body weight. After the intervention, blood samples were collected under anesthesia. A five-classification blood analyzer measured hematological parameters, including white blood cell count.

Serum biochemical markers, including total protein, albumin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), blood urea nitrogen (BUN), creatinine, triglycerides, total cholesterol, high-density lipoprotein, and low-density lipoprotein, were analyzed using an automatic biochemical analyzer.

Gut microbiota composition was assessed through 16S ribosomal ribonucleic acid (rRNA) gene sequencing of the V3–V4 region using the Illumina NovaSeq 6000 platform. Amplicon sequence variants were generated via the Divisive Amplicon Denoising Algorithm 2 (DADA2) within Quantitative Insights into Microbial Ecology 2 (QIIME 2). Diversity analyses, Linear Discriminant Analysis Effect Size (LEfSe), and correlation analyses were performed.

Findings

After eight weeks of exclusive cola intake, no significant differences were observed in body weight, body length, body mass index, blood glucose, or lipid profiles across groups. Superficially, the animals appeared metabolically stable.

However, both cola groups exhibited significantly reduced white blood cell counts, indicating leukopenia and suggesting altered immune cell profiles. The sugar-sweetened cola group demonstrated a reduced thymus index and increased spleen size, indicating thymic atrophy and splenomegaly. These findings may reflect immune regulatory changes, although inflammatory markers were not directly measured.

The sugar-free cola group did not show a statistically significant reduction in thymus index compared with controls, but did display elevated ALT and AST levels, suggesting liver stress relative to the sugar-sweetened group.

The sugar-sweetened cola group showed significantly increased BUN levels, indicating renal burden, while creatinine levels remained unchanged. Both cola groups exhibited decreased serum total protein levels, suggesting systemic physiological strain. These findings indicate that potential health risks may extend beyond sugar content alone.

Gut microbiota analysis revealed substantial dysbiosis in both cola groups. Operational taxonomic unit clustering showed that the sugar-sweetened cola group had markedly more unique units compared with water controls, indicating pronounced microbial perturbation. Alpha diversity indices, including the Abundance-based Coverage Estimator (ACE), Chao1, Shannon, and Simpson indices, were significantly higher in the cola groups, particularly in the sugar-sweetened group.

At the phylum level, both cola groups showed decreased relative abundances of Firmicutes and Proteobacteria, and increased abundances of Bacteroidota and Desulfobacterota. The Firmicutes/Bacteroidota ratio declined significantly.

At the genus level, sugar-sweetened cola markedly reduced beneficial taxa, including unclassified Lachnospiraceae, Lachnospiraceae NK4A136 group, Ligilactobacillus, Lactobacillus, and Quinella. Sugar-free cola produced milder reductions.

LEfSe analysis identified 25 discriminative taxa in the sugar-sweetened group, indicating extensive restructuring of the microbiota. Co-abundance network analysis revealed complex microbial interactions centered around Lactobacillus and Romboutsia.

Conclusion

Replacing water with either sugar-sweetened or sugar-free cola for eight weeks resulted in significant changes in immune-related indices, gut microbiota composition, and organ-associated biochemical markers in rats, even in the absence of body weight or glucose alterations.

Sugar-sweetened cola exerted stronger renal and immune-related effects, while sugar-free cola showed greater liver enzyme elevations. These findings suggest that diet beverages are not physiologically neutral in this animal model and highlight a potential role for gut microbiota in mediating systemic responses.

From a public health perspective, regular cola consumption, regardless of sugar content, may influence immune and organ function. However, extrapolation to humans should be approached cautiously due to species differences and the controlled experimental conditions of the study.

Source:

https://www.news-medical.net/news/20260225/Long-term-cola-intake-weakens-immune-cell-counts-in-controlled-rat-study.aspxs