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Plasma Metabolomic Responses after consumption of Fermented Brewer's Spent Grain in Individuals with Metabolic Impairments

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Abstract

Brewers' Spent Grain (BSG), a food by-product from beer manufacturing rich in dietary fibre and protein, has potential as a sustainable functional plant-based ingredient [1]. Fermentation with *Rhizopus oligosporus* can improve nutritional quality of BSG by increasing crude protein, free amino acids and soluble fibre content, which may confer metabolic benefits after consuming fermented BSG (FBSG)-containing foods regularly [2, 3]. However, metabolic responses after regular consumption of FBSG, particularly in individuals with metabolic impairments at elevated cardiometabolic risk, remain unclear. This study aimed to evaluate metabolomic responses following regular consumption of BSG and FBSG fortified biscuits in a randomised, parallel clinical study.

29 individuals with metabolic impairment, meeting at least 2 of 5 NCEP-ATP III criteria for metabolic syndrome, were randomised to BSG (n=9), FBSG (n=10) or Control (CON, n = 10) groups and consumed 90 g/day of biscuit for 12 weeks. In the BSG and FBSG biscuits, 30% wheat flour was substituted with BSG or FBSG powder respectively. Fasting blood samples were collected pre- and post-intervention, and untargeted plasma metabolomics was analysed using LC-QTOF-MS in positive and negative electrospray ionisation modes. Treatment–time interaction effects were assessed using ANOVA–simultaneous component analysis (ASCA), followed by Tukey post-hoc testing on pre-post fold changes. Metabolic features with significant between-intervention differences were grouped into putative cardiometabolic pathways, and pathway-level median changes summarised.

ASCA identified global systemic metabolic changes characterised by opposing directional temporal responses across interventions, with 112 metabolic features exhibiting significant interaction effects. Of these, 17 metabolites showed statistically significant between-intervention differences, clustering within pathways related to amino acid metabolism, fatty acid oxidation, lipid-related metabolism and diet-derived metabolite processing. Pathway-level median changes were consistently greatest in the FBSG group compared to CON and BSG across all pathway classes.

Fermentation of BSG elicited more pronounced and widespread metabolic responses compared to BSG and CON following regular consumption, primarily in pathways related to amino acid turnover and lipid oxidation. As dysregulation of these pathways is common in individuals with metabolic impairments, these findings suggest that regular consumption of FBSG containing foods may provide metabolic benefits to this population.

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References

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