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Effects of Plant-Derived Prebiotics on Hepatic Steatosis and Gut Metabolomics in Animal Models: A Systematic Review

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ADMINISTRATIVE INFORMATION

Support - None.

Review Stage at time of this submission - Formal screening of search results against eligibility criteria.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 15 December 2025 and was last updated on 15 December 2025.

INTRODUCTION

Review question / Objective What are the effects of plant-derived prebiotics on hepatic steatosis and gut-related metabolomic profiles in animal models of fatty liver disease?

Rationale Non-alcoholic fatty liver disease (NAFLD) is a major metabolic disorder closely associated with gut microbiota dysbiosis and altered host metabolite profiles. Increasing experimental evidence suggests that plant-derived prebiotics can modulate gut microbiota composition and microbial-derived metabolites, thereby improving hepatic steatosis and related metabolic disturbances. However, existing animal studies are heterogeneous in terms of prebiotic sources, experimental models, and metabolic outcomes, and no comprehensive systematic review has specifically synthesized evidence on plant-derived prebiotics, gut metabolomics, and hepatic steatosis in animal models. Therefore, this systematic review aims to summarize and critically evaluate the effects of plant-derived prebiotics on hepatic steatosis and gut-related metabolic alterations in animal models.

Condition being studied Non-Alcoholic fatty liver disease (NAFLD)/metabolic associated fatty liver disease.

METHODS

Search strategy PubMed, Scopus, and Google Scholar will be searched using keywords related to prebiotics, plant-derived compounds, hepatic steatosis, NAFLD, gut microbiota, and metabolomics.

Participant or population Experimental animal models (rats or mice) with diet-induced hepatic steatosis or NAFLD.

Intervention Plant-derived prebiotics, including plant polysaccharides, inulin-type fibers, or plant extracts with prebiotic properties.

Comparator Standard diet, high-fat diet without intervention, placebo, or no treatment.

Study designs to be included Controlled experimental animal studies.

Eligibility criteria Inclusion criteria:
– Controlled experimental studies conducted in animal models.
– Studies using plant-derived prebiotics (e.g., inulin, fructooligosaccharides, polysaccharides, or plant extracts with prebiotic properties).
– Studies employing dietary or metabolic models of hepatic steatosis or NAFLD (e.g., high-fat diet, Western diet).
– Studies reporting outcomes related to hepatic steatosis, liver histology, hepatic lipid metabolism, gut microbiota, or metabolomic profiles (gut, serum, or liver).

Exclusion criteria:
– Human studies, in vitro studies, reviews, editorials, or conference abstracts.
– Studies using non-plant-derived prebiotics or probiotics without a separable prebiotic-only intervention.
– Studies focusing on drug-induced liver injury, toxicological models, or non-metabolic liver diseases.
– Studies without relevant liver or metabolomic outcomes.

Information sources Electronic database including Pubmed, Scopus, ans google scholar.

Main outcome(s) Hepatic steatosis outcome, including liver histopathology, hepatic lipid accumulation, liver biochemical marker.

Additional outcome(s) Gut microbiota composition and gut related metabolomic profile, including short chain fatty acids and other microbial-derived metabolites.

Data management All records retrieved from electronic databases were managed using reference management software and Rayyan for screening and study selection. Extracted data will be stored in spreadsheet files with predefined data extraction forms. Data will be securely stored on password-protected computers and backed up regularly. Only the review authors will have access to the extracted data.

Quality assessment / Risk of bias analysis Risk of bias will be assessed using SYRCLE's Risk of Bias tool for animal studies.

Strategy of data synthesis Risk of bias of included animal studies will be assessed independently by the reviewer using the SYRCLE's Risk of Bias tool for animal studies.

Subgroup analysis Subgroup analyses will be performed if sufficient data are available. Planned subgroup analyses include: (1) type of plant-derived prebiotic (e.g., inulin-type fructans, plant polysaccharides, oligosaccharides); (2) animal species and strain (e.g., mice vs rats); (3) disease model (high-fat diet–induced NAFLD vs NASH); and (4) type of metabolomic assessment (gut, serum, or hepatic metabolomics). Subgroup analyses will be descriptive due to expected heterogeneity among studies.

Sensitivity analysis Sensitivity analysis is not planned due to expected heterogeneity in animal models, interventions, and outcome measurements.

Language restriction English-Language publication only.

Country(ies) involved Indonesia - University of Riau.

Other relevant information This protocol follows Prisma-P recomendation for systematic review protocols.

Keywords Plant-derived prebiotic; hepatic steatosis: NAFLD; gut microbiota; gut metabolomic; experimental animal studies.

Dissemination plans Results will be disseminated via publication in a peer-reviewed journal and scientific conference presentation.

Contributions of each author
Author 1 - Mukhyarjon Mukhyarjon -protocol preparation -data analysis -manuscript production.
Email: mukhyarjon@lecturer.unri.ac.id
Author 2 - Saryono Saryono - reviewing of the manuscript. Proper editing.
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