RELATIONSHIP BETWEEN OAT CONSUMPTION, GUT MICROBIOTA MODULATION, AND SHORT-CHAIN FATTY ACID SYNTHESIS: AN INTEGRATIVE REVIEW

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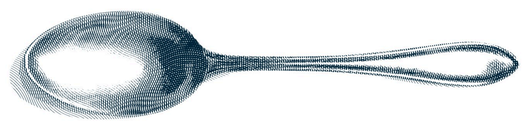


ABSTRACT

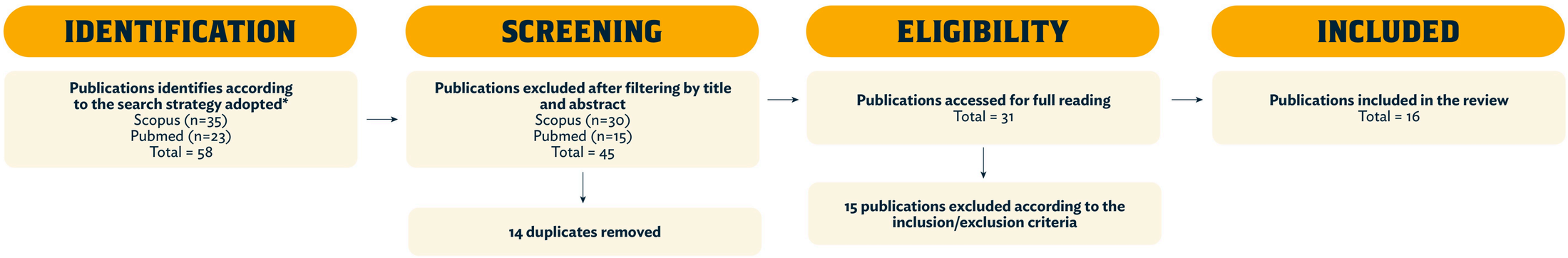
The gut microbiota includes those microorganisms that colonize the intestine and mainly ferment fibers from the host's diet. A healthy microbiota has a positive effect on digestion and plays a role in disease prevention while dysregulation has been related with various diseases. A healthy diet, rich in fiber, can beneficially modulate the gut microbiota. The International Food Information Council (IFIC) defines the term "functional foods" as foods or food components that provide a health benefit beyond basic nutrition [63]. Oats are considered functional foods as are a source of both soluble and insoluble fiber with prebiotic potential. This review summarizes the findings from studies on the relationship between oat consumption, the gut microbiota, and its metabolites.

INTRODUCTION

Oats (*Avena sativa L.*) contain soluble (betaglucan) and insoluble fibers (lignin and cellulose) [1]. Oats can be considered a functional food with prebiotic potential due to their fiber, lipid, and phenolic compounds content [2]. **The gut microbiota** is involved in several body functions, including nutrient digestion, metabolism, and fermentation [23–25]. The gut microbiota supports barrier function, improves intestinal permeability, and promotes mucous layer integrity [23]. Some situations can impair gut microbiota and generate dysbiosis that is associated with disease states, including inflammatory bowel disease (IBD), obesity, diabetes, allergies, and immune diseases [27,28]. Additionally, factors such as age, genetics, exercise, antibiotics, smoking, diet influence gut microbiota [28].

METHODOLOGY

The methodological approach utilized in this work was based on Kutcher and Le Baron's guide on completing an integrative review [45].



The criteria for inclusion were the selection of original articles (clinical trials, in vitro, and in vivo trials) from 2012 to 2023 downloaded from Scopus and PubMed. Terms identified comprised three cores: the food matrix "oat," the main interest "microbiota," and the metabolites that represent an important relationship between oats and the gut microbiota, "SCFA—short-chain fatty acids". From the advanced search 58 studies were identified, including 35 from Scopus and 23 from PubMed. After screening, 45 articles were identified and duplicates were removed, leaving 31 publications for full text review. During full-text review, 15 publications were excluded because they were either reviews, non-specific to oats, or the study was in a diseased population. Following full text review, 16 publications were included in the review and included in vivo studies using animals, in vitro studies and clinical studies in humans.

RESULTS

OATS AS FUNCTIONAL FOOD

The nutritional composition of oats includes carbohydrates, soluble fiber, proteins, lipids (such as unsaturated fatty acids), vitamins, minerals, and phenolic compounds. The main functional ingredients of oats are betaglucan and proteins (higher compared to other cereals and with a broader presence of essential amino acids) [67]. Other bioactive compounds include Vitamin E, flavonoids, phenolics, phytosterols, and avenanthramides with antioxidant capacity [68, 69].

ANTICHOLESTEROLEMIC AND HYPOGLYCEMIC PROPERTIES

There is robust evidence that oats consumption or oat-containing foods lowers total cholesterol and low-density lipoprotein (LDL) in healthy adults who are overweight or obese, as well as individuals with Type 2 diabetes [73–75]. A dose response meta-analysis concluded that 3 g of betaglucan per day was able to effectively reduce total cholesterol by increasing viscosity in the intestine, limiting bile acid reabsorption in the terminal ileum and increasing excretion, increased viscosity may also contribute to the reduction of blood glucose [76, 82]. The viscous nature of the bolus slows transit and makes it difficult for digestive enzymes to access carbohydrate molecules and limits the access of monosaccharides to the luminal surface to be absorbed [53, 83].

PREBIOTIC POTENTIAL OF OATS

Oats derived prebiotic fibers are fermented by the gut microbiota and selectively favor the growth of beneficial microorganisms [87,88]. Specific prebiotic benefits include promoting the integrity of the intestinal mucosal barrier, improving nutrient digestion and absorption, increasing immunity, reducing pH and production of SCFAs, as well as inhibiting pathogenic microorganisms [43].

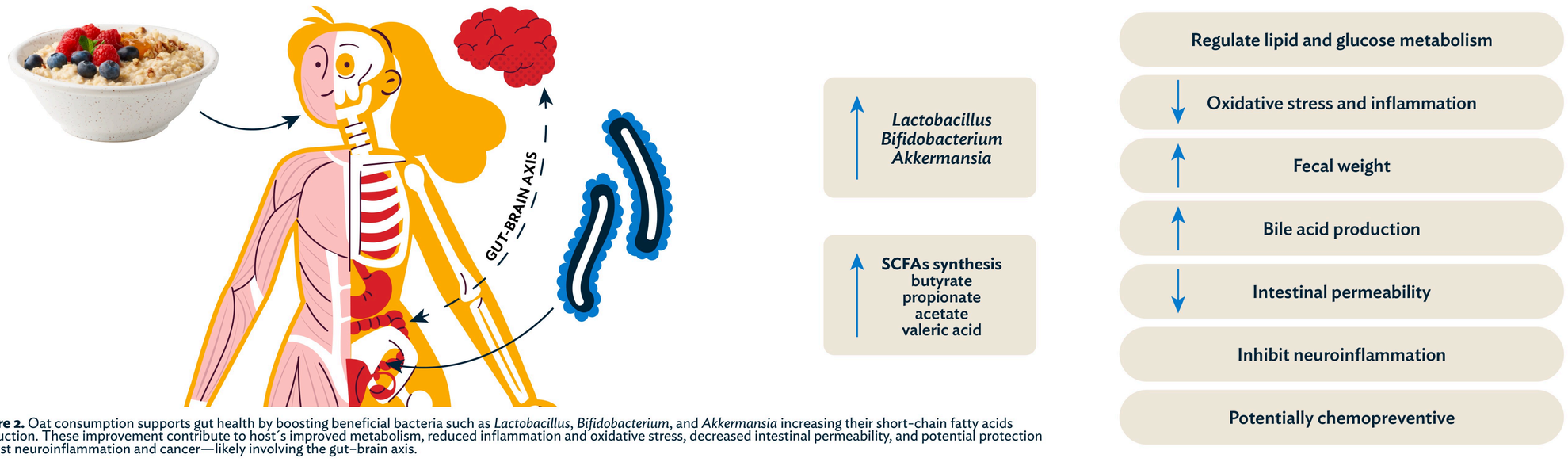


Figure 2. Oat consumption supports gut health by boosting beneficial bacteria such as *Lactobacillus*, *Bifidobacterium*, and *Akkermansia* increasing their short-chain fatty acids production. These improvement contribute to host´s improved metabolism, reduced inflammation and oxidative stress, decreased intestinal permeability, and potential protection against neuroinflammation and cancer—likely involving the gut–brain axis.

SHORT-CHAIN FATTY ACIDS (SCFAS)

The gut microbiome has an expansive metabolic capacity resulting in the production of many different metabolites. SCFAs are the most prevalent and well-researched metabolites produced during bacterial fermentation. A decrease in the abundance of SCFA-producing bacteria has been associated with chronic conditions, such as diabetes, inflammatory bowel disease, and atherosclerosis [96]. Acetate, propionate, butyrate, isobutyrate are the main SCFAs produced from dietary fibers in the human colon [23]. Most acetate and propionate are absorbed into circulation, while butyrate is the primary energy source for intestinal epithelial cells [96-102]. In addition to its energy source capacity, butyrate also suppresses cancer cell expansion and has been considered as a therapeutic target for the treatment of Type 2 diabetes [96, 106].

CONCLUSIONS

Current evidence suggests that **oats** can beneficially alter the composition of the gut microbiota and promote the synthesis of SCFAs. However, most of the research has been conducted in animals and *in vitro* making it difficult to extrapolate results to human models. Future human clinical trials are needed to demonstrate the impact of oats on the human gut microbiota.

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