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Fiber and gut microbiota: what happens when they reach the colon?

D.ssa D. Iodice[1]

1 Biologist, Italy

1. ABSTRACT

This publication examines why many dietary fibers bypass the small intestine and become available to microorganisms in the colon. It brings together data on fiber structure, fermentation, dosage, and individual differences. The central message is that the fate of a fiber depends on both its own characteristics and the individual's gut microbiota.The authors' summary describes fibers and prebiotics as complex carbohydrates that human enzymes are largely unable to break down in the small intestine. For this reason, they can reach the colon, where the gut microbiota—the collection of microorganisms present in the gut—can use them as an energy source. Fermentation can produce short-chain fatty acids, molecules including acetate, propionate, and butyrate. These data explain a biological transition: material not absorbed in the first part of the intestine is not necessarily inactive, as it can become a substrate for bacteria in the colon. However, the publication emphasizes that responses are not uniform. The length of sugar chains, branching, dosage, overall diet, and the presence of bacterial species capable of utilizing that specific fiber can alter the outcome. Furthermore, a distinction is made between results observed in the laboratory and those measured in humans. The review does not prove that every change in the microbiota produces a clinical benefit, nor does it identify a single fiber that is effective for everyone.

ONLINE ARTICLE

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MISSION

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Through articles, reviews, in-depth analyses and expert contributions, the Journal champions evidence-based medicine and science, fostering a correct interpretation of scientific data and countering misinformation. Every piece of content is developed with the aim of translating the complexity of research into understandable, useful and applicable information, while keeping intact the principles of accuracy, transparency and scientific independence.

Free from political, industrial and commercial influence, the journal stands as an authoritative and independent editorial space, dedicated to promoting scientific culture, professional development and the growth of health awareness among the public.

2. WHAT THIS RESEARCH ANALYZED

The 2017 study by Holscher analyzed the literature on the pathway of dietary fiber and prebiotics in the gastrointestinal tract. In simple terms, it considered what happens when complex plant components are not absorbed like common sugars and reach the colon. The scientific point is that many polysaccharides, i.e., very long sugar chains, cannot be completely broken down by human digestive enzymes.The publication therefore examines the transition from resistance to digestion to microbial fermentation. Fermentation refers to the use of a substance by microorganisms in the absence of oxygen. Possible products include acetate, propionate, and butyrate, which are called short-chain fatty acids. The review also considers properties such as chain length, branching, and dosage. However, it did not directly test a single fiber or treatment in a new group of people.

3. WHAT RESULTS EMERGE FROM THE STUDY

The main finding is that reaching the colon makes many fibers available to the gut microbiota, but it does not establish that all of them are utilized in the same way. The structure of the fiber can make it more or less accessible to specific bacteria. In scientific terms, microorganisms possess enzymes capable of breaking only certain chains and specific chemical bonds.The 2017 Holscher study also reports that the transformation of a fiber can involve multiple species: one may release smaller compounds, and another may use them. This exchange is called cross-feeding, which is the feeding interaction between microorganisms. The practical implication is that knowing whether a fiber is present in the diet is not enough to predict the outcome. The review does not prove that an increase in a specific bacterium, or in a metabolite in the stool, automatically equates to an improvement in health.

4. WHY THIS STUDY IS RELEVANT

This publication is relevant because it clarifies a common misconception: dietary fiber is not simply a part of food that passes through the body without consequences. A portion can reach the colon and become material usable by microbial communities. This helps explain why two types of fiber, despite belonging to the same general category, can behave differently.Furthermore, the 2017 Holscher study proposes a cautious interpretation of the results regarding the gut microbiota. Dosage and dietary context matter, as does the initial microbial composition. The work does not provide a personalized dietary prescription and does not establish a causal relationship between every microbial change and a clinical outcome. Instead, it offers a biological framework useful for interpreting subsequent experimental studies with greater precision.

5. STUDY LIMITATIONS AND WHAT IT DOES NOT DEMONSTRATE

As a narrative review, the 2017 Holscher study does not have its own control group, intervention duration, or original clinical results. It summarizes various studies with different fibers, dosages, experimental designs, and microbiota analysis methods. This heterogeneity prevents the derivation of a single quantitative effect.Furthermore, the concentrations measured in stool do not perfectly describe what occurs throughout the entire colon: some metabolites may be absorbed before elimination. The publication does not prove that every fiber increases short-chain fatty acids, that every person responds in the same way, or that the observed changes in bacteria prevent or cure diseases. Targeted, larger, and longer clinical trials are needed for such conclusions.

6. INDEPENDENT SUPPORTING EVIDENCE

An initial step in the proposed chain, from undigested fiber to the modification of specific bacteria, was observed in a randomized, double-blind, placebo-controlled crossover clinical trial. In 29 healthy adults, 5 or 7.5 grams per day of agave inulin for 21 days increased *Bifidobacterium* three- and four-fold compared to the control; *Desulfovibrio* also decreased by 40%. The work directly supports the idea that a fermentable fiber can modify the gut microbiota in humans, but it does not demonstrate a clinical benefit [1].A second randomized, placebo-controlled crossover study involved 34 healthy adults classified according to their habitual fiber intake. After three weeks of 16 grams per day of inulin-type fructans, *Bifidobacterium* increased in both the low and high intake groups; in the high intake group, *Faecalibacterium* also increased. This reinforces the

role of dietary context and indicates that the response is not identical for everyone [2].The relationship between fiber structure, bacterial community, and metabolites is also supported by a randomized study on 31 adults who were overweight or obese. Six weeks of corn bran arabinoxylan modified the microbial composition and increased fecal propionate; however, the result varied among participants. This is a direct confirmation of the fermentation mechanism, but it concerns an isolated fiber at high doses and a specific population [3].

7. CONFLICTING EVIDENCE

Evidence also shows that the effect is not consistent. In a crossover study on three prebiotics—inulin, galacto-oligosaccharides, and wheat dextrin—the short-chain fatty acid response depended primarily on the individual participant. At the population level, no significant associations with the overall composition of the gut microbiota emerged for the individual interventions. This does not disprove fermentation, but it reduces the possibility of predicting a uniform effect [4].Another double-blind, randomized trial assigned 75 healthy adults to resistant starch, polydextrose, both, or a placebo for 50 days. In the 58 participants with paired samples, no significant changes in the diversity or composition of the gut microbiota emerged; most of the measured metabolites did not change either. This result is relevant because it involves non-digestible fibers, but it may depend on the type of fiber, effective dose, statistical power, and baseline gut microbiota [5].

8. QUADRO COMPARATIVO E SINTESI DELLE EVIDENZE

The following studies show how the fate of fibers in the colon depends on the type of substrate, the study design, and the characteristics of the participants.

Quadro comparativo

Publication	Model and intervention	Main result	Relationship to the Holscher study
Holscher et al., 2015 [1]	Crossover RCT; 29 healthy adults; agave inulin for 21 days	Increase in Bifidobacterium and reduction in Desulfovibrio	Direct confirmation of microbial modification by a fermentable fiber
Healey et al., 2018 [2]	Crossover RCT; 34 healthy adults; inulin-type fructans for three weeks	Different responses based on habitual fiber intake	Direct confirmation of the role of baseline diet
Nguyen et al., 2020 [3]	Parallel RCT; 31 adults with overweight or obesity; arabinoxylan for six weeks	Microbial changes and individualized increase in propionate	Direct confirmation of structure and person dependency
Holmes et al., 2022 [4]	Crossover study; different prebiotics in the same group of adults	Short-chain fatty acid response depended primarily on the individual	Evidence of variability that limits generalization
Malcomson et al., 2024 [5]	Factorial RCT; 75 healthy adults; resistant starch and polydextrose for 50 days	No significant change in microbial composition	Discordant evidence dependent on fiber type and context

9. SINTESI EDITORIALE E CONCLUSIONI

EDITORIAL CONCLUSION

Holscher's 2017 review explains why many fibers do not complete their journey in the small intestine. Since human enzymes cannot fully break down numerous complex plant carbohydrates, a portion reaches the colon. Here, it can be utilized by the gut microbiota and transformed into metabolites, including short-chain fatty acids. The value of this publication lies in linking fiber structure, intake quantity, habitual diet, and initial microbial composition. Subsequent trials confirm that certain isolated fibers can modify bacteria or fecal metabolites. However, they also show highly variable responses between individuals and, in some cases, an absence of measurable changes. Therefore, while the passage of fibers to the colon is biologically well-documented, the subsequent effects cannot be predicted by the word "fiber" alone. The clinical significance of individual changes in the gut microbiota remains to be evaluated on a case-by-case basis with appropriate studies.

Aggiornato al 17/11/2026. Questo contenuto riflette una sintesi divulgativa delle evidenze scientifiche al momento della pubblicazione e non sostituisce il parere medico.

10. TRANSPARENCY AND SCIENTIFIC RESPONSIBILITY

Artificial Intelligence was used solely as a tool for editorial and documentary support. All content, interpretations, bibliographic citations and conclusions have been verified, reviewed and approved by the author, who assumes full scientific responsibility for them.

The manuscript was also subjected to independent peer review prior to publication.

To ensure the greatest transparency, the complete history of the article, including the dates of submission, revision, acceptance and publication, as well as information on the peer review process, is available on the dedicated Article History page.

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