LIFE Science Hub
JOURNAL OF SCIENCE
EXPANDING KNOWLEDGE ABOUT NUTRITION AND HEALTH

ORIGINAL RESEARCH
Volume 1, Issue 4, November 2026

Distinction between soluble and insoluble fiber and digestive effects

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1. ABSTRACT

The review by Williams and colleagues examines why the traditional distinction between soluble and insoluble fiber is useful, yet incomplete. The authors explain that fermentability, viscosity, plant structure, and food processing all contribute to determining the path of fibers through the digestive system and their interaction with the gut microbiota.The authors' synthesis examines fibers from grains, legumes, fruits, and vegetables, with reference to both human and swine nutrition. The core message is simple: two fibers with the same solubility label can behave differently during digestion. Some retain water or increase the density of intestinal contents; others reach the colon and are transformed more rapidly by microorganisms; others remain poorly fermented. The authors link these differences to chemical composition, particle size, plant cell wall structure, and food processing technology. Fermentation products are also discussed, including short-chain fatty acids, which are molecules produced by gut bacteria when they utilize certain non-digestible carbohydrates. The review does not measure a single clinical effect nor compare people assigned to a treatment. Instead, it proposes an interpretive framework: to understand what a fiber does, it is necessary to describe multiple properties, not just determine whether or not it disperses in water.

ONLINE ARTICLE

ARTICLE INFORMATION

Published: November 8, 2026
Updated: November 8, 2026

DOI 10.5281/zenodo.24051722

KEYWORDS

perché fibra solubile e insolubile non bastano
classificazione funzionale delle fibre
proprietà fisiche delle fibre
fermentabilità delle fibre
viscosità delle fibre
matrice alimentare vegetale

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

Williams and colleagues conducted a narrative review of the literature, not a clinical trial. They compared the fibers present in various plant-based foods and discussed data obtained from humans, pigs, and fermentation models. The goal was to clarify what truly defines solubility—that is, a fiber's ability to disperse in water—and which characteristics are excluded from this definition.The authors primarily considered fermentability, meaning how much and how quickly colon microorganisms can utilize a fiber; viscosity, or the ability to thicken liquids; and the food matrix, the physical structure that holds food components together. The next step concerns what these differences might mean within the digestive tract.

3. WHAT RESULTS EMERGE FROM THE STUDY

The main finding is that "soluble" and "insoluble" are useful descriptive labels, but they do not explain biological behavior on their own. Simply put, a fiber that disperses well in water is not necessarily the one that is most fermented; likewise, a poorly soluble fiber is not necessarily inactive in the colon.The authors provide examples of insoluble fibers with rapid, slow, or minimal fermentation. They attribute these differences to composition, chemical bonds, accessibility to bacteria, particle size, and food processing. The review also highlights that fermentation products, including acetate, propionate, and butyrate, depend on the type of substrate and the microbiota present. This describes a plausible mechanism, but it does not allow for predicting the effect of every food or supplement in an individual.

4. WHY THIS STUDY IS RELEVANT

This work helps to avoid a common simplification: treating all fibers in the same category as equivalent. To interpret a food, it is not just about how many grams of fiber it contains or whether the label defines it as soluble. Physical form, processing, and whether the fiber is part of a plant cell wall or isolated can also matter.The relevance is therefore methodological. A more precise description allows for better hypotheses regarding digestive processes and for comparing studies that use different fibers. However, it does not prove that a particular classification directly improves health or is superior for every clinical goal.

5. STUDY LIMITATIONS AND WHAT IT DOES NOT DEMONSTRATE

As a narrative review, the study by Williams and colleagues does not have a single experimental protocol, its own study population, or a measured clinical effect. It brings together sources with very different models: foods, isolated fibers, incubations with microbiota, humans, and pigs. For this reason, it does not provide a single quantitative estimate nor does it establish a causal relationship between a fiber property and a health outcome.Furthermore, some of the evidence cited involves experimental or animal models. While these can clarify biological processes, they do not replace human studies. The proposal to move beyond a binary classification is conceptually sound; however, its practical utility depends on the quality with which each fiber is characterized and studied.

6. INDEPENDENT SUPPORTING EVIDENCE

A methodological publication by Poutanen and colleagues confirms the central step in the chain: physical properties, composition, structure, and matrix can modify the function of fiber. It is a review with recommendations for nutritional studies, not an experiment on participants. The authors indicate that solubility, viscosity, and fermentability must be measured and reported separately; the level of confirmation is direct on a methodological level, but it does not quantify a clinical benefit [1].The review by Stephen and colleagues argues that solubility also depends on the measurement method and does not always predict fermentation or physiological response. It therefore confirms the link between fiber properties and function in the colon. It is a synthesis of the literature, without new sample sizes; the limitation is the heterogeneity of the included sources [2].Bliss and colleagues add experimental data: in fermentations with human fecal microbiota, gum arabic, psyllium, and carboxymethylcellulose showed different extents of fermentation. The model involved samples from three healthy people and, in a second experiment, 52 people with fecal incontinence. It confirms that the specific substrate matters, but the model does not fully replicate the living human intestine [3].

7. CONFLICTING EVIDENCE

No directly conflicting evidence of sufficient relevance has been identified; this does not prove the absence of contrary results. However, studies are available showing how effects vary according to fiber type, dose, intestinal site, and the population studied.In 19 people with irritable bowel syndrome, Gunn and colleagues observed that inulin produced more gas than psyllium and that the combination of the two fibers reduced gas compared to inulin alone. This finding shows that specific characteristics remain clinically informative, but it concerns a specific intestinal condition and acute intake [4]. In 17 healthy adults, Alhasani and colleagues detected an early reduction in exhaled hydrogen with psyllium and inulin, with no average reduction over 24 hours. This scales back the idea that a single indicator can describe all fermentation; the small sample size and short observation period limit generalizability [5].

8. QUADRO COMPARATIVO E SINTESI DELLE EVIDENZE

The following publications compare or clarify the thesis that solubility, on its own, does not describe all the functions of fibers.

Quadro comparativo

Publication	Model and sample size	Main result	Relationship to the Williams study
Poutanen et al., 2018 [1]	Methodological review; no new population	Requires description of structure, rheology, fermentation, and matrix	Direct confirmation on a methodological level
Stephen et al., 2017 [2]	Literature review; no new population	Solubility does not always predict fermentation or physiological effects	Direct conceptual confirmation
Bliss et al., 2013 [3]	In vitro fecal fermentation; 3 healthy individuals and 52 participants in the second experiment	Three fiber sources showed different fermentation	Indirect experimental confirmation
Gunn et al., 2022 [4]	Crossover RCT; 19 people with irritable bowel syndrome	Inulin and psyllium had different effects on gas	Qualifies generalizability
Alhasani et al., 2025 [5]	Crossover RCT; 17 healthy adults	Effects on exhaled hydrogen varied over time and between individuals	Qualifies the interpretation of a single indicator

9. SINTESI EDITORIALE E CONCLUSIONI

EDITORIAL CONCLUSION

The review by Williams and colleagues clarifies that fibers do not constitute a biologically uniform group. The distinction between soluble and insoluble retains descriptive value, because it indicates how a fiber interacts with water, but it is not enough to predict what happens along the digestive tract. Fermentability, viscosity, chemical composition, accessibility to microorganisms, particle size, and food structure can modify the result. The independent publications considered reinforce, above all, this methodological principle: studies should better characterize the fiber used and the dietary context. However, the available evidence does not authorize us to deduce a single health effect for all fibers belonging to the same category. Even studies in humans show variable responses, influenced by the type of fiber, the dose, the observation time, and the population. The most rigorous message is therefore to evaluate fibers by their properties and context, not through a single label.

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.

11. RIFERIMENTI BIBLIOGRAFICI

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