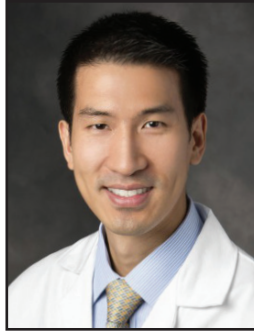


Carol Rees Parrish, M.S., R.D., Series Editor

# Low Residue vs. Low Fiber Diets in Inflammatory Bowel Disease: Evidence to Support vs. Habit?



Neha D. Shah



Berkeley N. Limketkai

**Inflammatory bowel disease (IBD) involves chronic inflammation of the gastrointestinal tract. Patients with IBD may experience gastrointestinal distress through abdominal pain, cramping, diarrhea, and hematochezia. Despite lack of evidence to support the practice, IBD patients are often instructed to limit fiber or residue during active flares to reduce gastrointestinal distress. The same advice is common when intestinal strictures are identified or suspected, to reduce the risk of obstruction. Low residue and low fiber diets are often recommended interchangeably, although they comprise two distinct diets. This review discusses the similarities and differences between “residue” and “fiber” and presents the studies that have evaluated the use of low residue and low fiber diets in IBD.**

## INTRODUCTION

Inflammatory bowel disease (IBD) encompasses two primary disorders: Crohn’s disease (CD) and ulcerative colitis (UC). It is characterized by chronic inflammation of the gastrointestinal tract.<sup>1</sup> Common clinical manifestations of IBD include abdominal pain, cramping, diarrhea and hematochezia. CD patients, in particular, may also experience intestinal strictures with obstructive symptoms, abscesses, and fistulizing disease.

Dietary recommendations for IBD patients have been highly variable, largely due to the dearth of research data available to guide clinical practice. Nonetheless, IBD patients are often instructed to limit their consumption of fiber or residue during an active flare in order to help minimize gastrointestinal distress, particularly when intestinal strictures are suspected. Recommendations for a “low residue” or “low fiber” diet are often used interchangeably and incorrectly as synonymous terms; although there are similarities between the low residue and low fiber diets, they are indeed distinct diets with different theoretical effects on digestion.

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Neha D. Shah, MPH, RD, CNSC Berkeley N. Limketkai, MD Digestive Health Center, Stanford Health Care Division of Gastroenterology & Hepatology Stanford University School of Medicine, Palo Alto, CA

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The purpose of this review is to clarify what constitutes “residue” and “fiber”, discuss their physiologic effects on digestion and present the studies that have investigated the use of low residue and low fiber diets in IBD.

## RESIDUE vs. FIBER

### What is Residue?

Historically, the term “residue” has denoted the by-products of the digestive process that were eventually defecated in stool. This definition covers the gamut of partially or completely undigested food particles, ash, gastrointestinal secretions, intestinal epithelial sloughing, and bacterial waste. In early canine studies, the appearance of stools after food consumption was generically called “residue”.<sup>2</sup> In other discussions, residue was described as “crude fiber”: a component of foods not digestible by pancreatic and intestinal

enzymes in humans and therefore not available for intestinal absorption.<sup>3</sup> Crude fiber, also called “roughage” or “bulk”, is primarily comprised of cellulose, hemicellulose and lignin. Finally, residue has also been designated as any food that increased stool output, including meats, fats and dairy products, even if the foods underwent enzymatic digestion or had low amounts of crude fiber.

The actual composition of a high or low “residue” diet has been a topic of investigation for over a century, yet it continues to have no clear definition. In early canine studies, the rate of passage of foods was thought to correlate with digestion of foods and appearance of residue. In an early study from 1884, Müller found that meat fed to dogs produced stool similar to that defecated during fasting.<sup>4</sup> Later in 1905, Heile published that up to 98% of lean meat and 100% of rice were absorbed.<sup>5</sup> By contrast, milk increased bulk and accelerated the passage of stool. In 1928, Hosoi et al. systematically

**Table 1. Residue vs. Fiber**

What is Residue?
<ul style="list-style-type: none"> <li>• There is no consensus for the definition of residue</li> <li>• There are various descriptions of residue:                             <ul style="list-style-type: none"> <li>○ In early canine studies, the appearance of stool was termed as residue</li> <li>○ Non-digestible crude fiber (cellulose, hemicellulose and lignin) was also referred to as residue</li> <li>○ Residue was also referred to as any food that increased stool output, including meats and dairy products, regardless whether the foods underwent enzymatic digestion or had minimal amounts of crude fiber</li> </ul> </li> </ul>
What is Fiber?
<ul style="list-style-type: none"> <li>• The Institute of Medicine (IOM) proposed new definitions for fiber in 2001 to standardize what constitutes fiber, which includes “dietary fiber”, “added fiber” and “total fiber”:                             <ul style="list-style-type: none"> <li>○ “Dietary fiber” is defined as “non-digestible carbohydrates and lignin that are intrinsic and intact in plants”</li> <li>○ “Added fiber” is defined as the “isolated, non-digestible carbohydrates that have beneficial physiological effects in humans”</li> <li>○ “Total fiber” is considered the sum of both dietary and added fiber</li> </ul> </li> <li>• Fiber is not considered to be foods of animal origin</li> </ul>

**Table 2. Physicochemical Properties of Fiber**

Properties	Description
Solubility	Refers to the ability of the fiber to dissolve in water
Fermentability	Refers to the ability of colonic bacteria to digest fiber, producing short chain fatty acids (SCFAs) as a by-product
Viscosity	Refers to the ability of the fiber to hold water, thicken and resist flow

evaluated intake of various foods and then measured stool output in dogs with ileal fistulas.<sup>2</sup> Proteins (e.g., lean meats, hardboiled egg) and some carbohydrates (e.g., rice, bread) were found to have a slow rate of passage through the intestines. Foods with little or no cellulose did not produce residue even 8 hours after consumption. On the other hand, fruits (e.g., canned pineapple, skinless apple, banana and prunes) had an increased rate of passage, with residues appearing within an hour of consumption. Whole milk and Swiss cheese significantly increased residue within 15-30 minutes after consumption, an effect assumed to stem from lactose malabsorption. Gelatin, broth, hardboiled eggs, lean meat, liver, rice, farina and cottage cheese produced the least amount of residue, whereas fruits, baked potatoes, bread, lard, butter and whole milk produced the largest residue. The authors concluded that “the best basis for a low residue diet is lean meat ... rice, hard boiled eggs, sugars (except lactose), and probably small amounts of fruit juices, tea and coffee” and that “less material will be carried into the colon if the diet is kept fairly dry.”

**What is Fiber?**

In an early definition, fiber was considered to be the non-digestible plant-based components of cell walls that are not found in foods of animal origin.<sup>6</sup> Subsequent definitions were broadened to include associated plant-based substances, such as gums, mucilages, pectin and phytates. Other definitions specified methods of extraction of fiber from foods. In 2001, the Institute of Medicine (IOM) proposed new definitions for “dietary fiber” and “added fiber” to standardize the definition. Similar to an earlier description of crude fiber, “dietary fiber” is defined as “non-digestible carbohydrates and lignin that are intrinsic and intact in plants” and

“added fiber” is defined as the “isolated, non-digestible carbohydrates that have beneficial physiological effects in humans.” Thus, the “total fiber” is then considered the sum of both dietary and added fiber ([http://www.nal.usda.gov/fnic/DRI/DRI\\_Proposed\\_Definition\\_Fiber/proposed\\_definition\\_fiber\\_full\\_report.pdf](http://www.nal.usda.gov/fnic/DRI/DRI_Proposed_Definition_Fiber/proposed_definition_fiber_full_report.pdf)). See Table 1 for the definitions of what constitutes residue and fiber.

The physiologic effects of fiber vary based on its chemical composition and properties, with solubility, or the ability to dissolve in water, being the most salient property. As such, fiber has often been classified as “soluble fiber” or “insoluble fiber” with respect to its role in health, particularly in the management of gastrointestinal disorders, cardiovascular disease, diabetes, and obesity. The IOM recommends phasing out these terms and instead favors classifying fiber by its fermentability and viscosity, since these properties better outline the physiological benefits of fiber on gastric and small bowel function. Fermentability refers to the ability of colonic bacteria to digest the fiber, while viscosity concerns the ability of the fiber to hold water, thicken stool, and resist flow.<sup>6</sup> See Table 2 for definitions of the physiochemical properties of fiber.

The fibers traditionally considered to be soluble are generally fermentable and viscous; they include guar gum, pectin, some hemicelluloses, fructo-oligosaccharides and inulin. Once fermented by colonic bacteria, they contribute to the production of short chain fatty acids (SCFAs) — such as acetate, butyrate, and propionate — that are used as fuel by colonocytes.<sup>7</sup> The SCFAs, especially butyrate, stimulate growth of beneficial nonpathogenic intestinal bacteria, which are thought to play an anti-inflammatory role, enhance immune function, and optimize intestinal barriers to pathogenic bacteria. Additionally, the increase in intestinal bacteria through fermentation contributes

**Table 3. Types and Food Sources of Fiber**

	Types	Food Sources (*partial list)
Fermentable/Viscous (soluble)	-glucans, guar gum, some hemicelluloses, mucilages, pectin	Banana, fruits, some legumes, oats
Fermentable/Non-Viscous (soluble)	Acacia gum, inulin, partially hydrolyzed guar gum (PHGG), oligofructose (OF), fructo-oligosaccharides (FOS), galacto-oligosaccharides (GOS)	Artichoke, asparagus, chicory root, garlic, onion, rye, soybeans, wheat
Non-Fermentable/Non-Viscous (insoluble)	Cellulose, some hemicelluloses, lignin	Brown rice, celery, flax, fruit and vegetable skins, nuts, quinoa, rye, seeds, some legumes, vegetables, wheat bran, whole grains

to bulk in stools. The insoluble fibers, including cellulose and lignin, provide “roughage” and are generally considered to be non-fermentable and non-viscous. By increasing bulk and frequency of stool, they promote passage of stool through the intestinal tract and ease defecation.<sup>8</sup> The food sources of fermentable fibers include bananas, potato, brown rice, and oats, whereas good sources of non-fermentable fibers include bran, nuts, seeds, whole wheat and skins of fruits and vegetables.<sup>9</sup> See Table 3 for a review of fiber types and food sources of each.

To complicate matters, most foods have a mix of various fibers. Although the fiber content of foods is easily found on food labels listed as “dietary fiber,” unfortunately, there is no requirement that manufacturers classify the fiber further.

## RESIDUE AND FIBER DIET STUDIES IN IBD

### The Low Residue Diet

The low residue diet has traditionally been used to reduce fecal volume in a number of situations: to treat diarrhea, keep wounds free from stool, promote wound healing in patients with decubitus ulcers or those who have undergone rectal surgeries. As there is no consensus on the composition of residue, studies that evaluated the low residue diet have used various definitions of residue and degree of food restrictions.

We speculate that the low residue diets in these studies would limit intake of crude fiber, meats and dairy.

There are limited studies on the use of the low residue diet in IBD. A two-year prospective Italian trial compared long-term effects of a low residue diet, which the authors defined as the elimination of whole grains, legumes and all fruits and vegetables (except for bananas and skinless potatoes). Many clinicians would call this a “low fiber” diet and a regular diet in 71 adult patients with active CD.<sup>10</sup> Eighty-five patients were identified for possible participation and all patients, except for five recently diagnosed patients, had already been prescribed a low residue diet. After eliminating 4 patients due to radiologic strictures and another 10 patients due to lack of willingness to adhere to the low residue diet, the remaining 71 patients were randomized to either continue following the low residue diet or transition to an unrestricted Italian diet. The consumption of dairy was allowed as tolerated in both groups. There were no differences in outcomes between the two groups when evaluating rates of flares, intestinal obstructions, need for a hospital admission and/or need for surgery. The addition of fiber into the “regular” Italian diet was tolerated well overall. The study authors concluded that patients should be encouraged to eat an unrestricted diet as tolerated.

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### The Low Fiber Diet

In contrast to the low residue diet, the low fiber diet only restricts fiber; however, to our knowledge there appears to be no consensus of what defines a low fiber diet. Review of various patient education handouts on the low fiber diet, reveals a trend to limit the type of fiber that is traditionally viewed as insoluble. Although there are limited studies to support this practice, the low fiber diet is often recommended to those who have, or who are suspected to have, intestinal strictures to reduce risk of obstruction. Some clinicians may favor and instruct patients to follow the diet if small bowel bacterial overgrowth has arisen from the intestinal strictures. There are very limited studies to support

the restriction of fiber during an IBD flare. Quite the contrary; the inclusion of fiber has generally been of greater interest to researchers and has been suggested to play a role in treatment as well as maintenance of remission—in both CD and UC, mainly via the anti-inflammatory properties of SCFAs. Nonetheless, the bulk of evidence remains inconclusive in supporting fiber as a treatment or as maintenance therapy in IBD. See Table 4 for a comparison of the restrictions between the two diets

### Crohn's Disease

The use of fiber in CD has produced inconsistent outcomes. In an early four-year prospective study, 32 adult patients with active CD, including those with intestinal strictures, were treated with a fiber rich

**Table 4. Comparison of Restrictions in the Low Fiber to Low Residue Diets (partial list)**

Food Group	Low Fiber Diet	Low Residue Diet
Meats, Poultry, Fish, Eggs	No restriction	Fibrous meats
Dairy	No restriction	Whole milk
Legumes, Nuts, Seeds	Beans, lentils, peas	Beans, lentils, peas
Grains	Brown or wild rice, quinoa, wheat bran, whole grains (e.g. whole wheat, rye)	Brown or wild rice, quinoa, wheat bran, whole grain (e.g. whole wheat, rye)
Fruits/Vegetables	Fruits that cannot be peeled, with seeds or with membranes (e.g. berries, figs, oranges), dried fruits, all raw vegetables, vegetable skins (e.g. potato skin), broccoli, brussel sprouts, cauliflower, corn, cabbage, celery, eggplant	All fruits and vegetables except for bananas and peeled potatoes
Beverages	Fruit and vegetable juices with pulp, prune juice	Fruit and vegetable juices with pulp, prune juice
Miscellaneous	Coconut, flax, nuts, seeds, popcorn	Butter, coconut, flax, nuts, seeds, popcorn

**Table 5. Summary**

- There is no consensus as to what comprises residue and with fiber in contrast to residue, there are definitions in place as well as there is data available on the types of fiber and content in foods.
- Although the low residue and low fiber diets are often used interchangeably, they are not the same and may impose unnecessary restrictions as a result.
- There is limited data available to support the use of the low residue or low fiber diets in symptomatic IBD. If restrictions are in place, dietary food tolerances should be evaluated and nutritional strategies should be provided to reintroduce foods as tolerated.
- Regarding intestinal strictures in IBD, there is also limited data to encourage or discourage the use of a low fiber diet.
- There is insufficient evidence to support fiber in treatment as well as maintenance of remission in IBD.
- No evidence was found to use a low residue diet in the setting of IBD; the authors suspect that when the diet is ordered, the vast majority of the time, what is desired is a low fiber restriction.

diet in addition to corticosteroids, azathioprine and sulfasalazine, as appropriate.<sup>11</sup> The participants were compared with historical controls who were matched by age, site of disease at diagnosis, previous resections and disease duration. The fiber rich treatment group was found to have fewer and shorter stays in the hospital. Only one patient in each group underwent bowel surgery for stricturing disease. The average intake of fiber was 33 g per day by the patients on the fiber rich diet, much more than the national average intake of 20 g per day. The study suggests that fiber restriction may not be necessary and that fiber may instead have a favorable impact on the prognosis of CD patients. In another two-year single blinded study, 352 adult patients with mildly active or inactive CD on sulfasalazine were randomized to either receive a low or a high fiber diet.<sup>12</sup> The weekly average for fiber consumption was 110 g (16 g/day) for the low fiber group and 195 g (28 g/day) for the high fiber group. There were no significant differences in intestinal surgeries, hospital admissions, or outpatient treatments between the two groups.

### ***Ulcerative Colitis***

Evidence for the use of fiber in UC also remains inconclusive. In an open label, multicenter randomized trial, 102 adult patients in UC remission were divided into three groups to receive 20 grams of *Plantago ovata* seeds (fermentable fiber), daily mesalamine or a combination of the seeds with the mesalamine.<sup>13</sup> Treatment failure was seen in 14 of 35 (40%) patients in the seeds group, 13 out of 37 (35%) in the mesalamine group and 9 out of 30 (30%) in the seeds and mesalamine group. An increase in fecal butyrate levels was found in the groups that were given the seeds. While the authors suggested that fiber may have comparable effectiveness as mesalamine, the sample size is too small to assert this conclusion.

### **CONCLUSION**

There is no consensus of what constitutes residue; in contrast, clear definitions of fiber exist, as does a wealth of data on various types of fiber and the fiber content of foods. However, the low residue and low

fiber diets are not synonymous, and due to lack of a clear definition of the former, these diets may impose different limitations on dietary choices. The low residue diet is more restrictive as in addition to restricting some fiber; it also limits meats and dairy. Low residue or low fiber diet prescriptions are common in clinical practice for symptomatic IBD patients, despite a lack of research on their efficacy. If these diets are utilized there should be careful follow up, and if symptomatic relief does not occur, then restrictions should be lifted. Regarding intestinal strictures, there is insufficient evidence to encourage or discourage the use of a low fiber diet in this patient population. However, some clinicians may argue a low fiber diet would be worth trying in patients who have developed small bowel bacterial overgrowth as a consequence from the intestinal strictures. See Table 5 for a summary of findings. ■

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