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REVIEW ARTICLE ON CRUDE FIBER

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Abstract

Crude fiber represents the indigestible fraction of plant-derived foods that remains after sequential acid and alkali digestion and mainly consists of cellulose and lignin. Although traditionally used as a nutritional parameter in food and animal feed analysis, crude fiber estimation provides only a partial representation of total dietary fiber. This review article aims to summarize the definition, physiological significance, health benefits, limitations, disease-modulating effects, dietary requirements, food sources, and analytical methods related to crude fiber. Crude fiber plays an important role in maintaining digestive health by increasing stool bulk, improving bowel motility, and preventing constipation. It also contributes to weight management, glycemic control in diabetes, reduction of cardiovascular risk through cholesterol regulation, and lowering the risk of certain cancers by diluting intestinal carcinogens and reducing transit time. However, the conventional crude fiber method underestimates total dietary fiber as it excludes soluble fiber components such as pectins and gums and may lead to nutrient loss during harsh chemical extraction. The review also discusses daily fiber intake recommendations across age groups, commonly consumed fiber-rich plant sources, and analytical techniques, including the traditional Weende method and modern enzymatic-gravimetric methods. Overall, while crude fiber analysis remains relevant for animal nutrition and basic food evaluation, modern dietary fiber assessment methods provide a more comprehensive and accurate understanding of fiber's role in human health.

Keywords: Crude fiber; Dietary fiber; Cellulose; Lignin; Digestive health; Constipation prevention; Glycemic control; Cardiovascular health; Cancer prevention; Weende method; Enzymatic-gravimetric analysis.

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Introduction

Dietary components play a vital role in maintaining human health, preventing chronic diseases, and supporting normal physiological functions [1,2]. Among these components, dietary fiber has gained considerable attention due to its significant effects on gastrointestinal health, metabolic regulation, and disease prevention [3,4,5]. Crude fiber represents one of the earliest analytical measures of dietary fiber and has long been used in food composition analysis and animal nutrition studies. Although it does not fully represent total dietary fiber, crudefiber remains an important parameter for evaluating the indigestible portion of plant-based foods. This review article aims to provide a comprehensive overview of crude fiber, including its definition, advantages and disadvantages, physiological effects on various diseases, recommended daily intake, common dietary sources, and methods used for its estimation. By highlighting both traditional and modern perspectives, this review emphasizes the continuing importance of crude fiber in nutrition science and public health [6].

Definition

Crude fiber the indigestible portion of plant material that remains after food undergoes sequential treatment with dilute acid and alkali. It primarily consists of cellulose and lignin, with small amounts of hemicellulose and other plant component.

Advantages of crude fiber

Digestive Health: Adds bulk, promotes bowel movement, prevents constipation, and supports gut bacteria.

Weight Management: Low in calories, promotes fullness, aiding appetite control.

Blood Sugar & Heart Health: Slows glucose absorption, helping regulate blood sugar and potentially lowering heart disease risk.

Animal Feed: A standardized metric (Weende method) for formulating roughage in animal diets, important for gut motility.

Disadvantages of crude fiber

Incomplete Fiber: Only measures cellulose and lignin (insoluble), missing soluble fibers (pectins, gums) and other components.

Inaccurate Representation: Doesn't reflect true fiber content in modern foods, often underestimating total dietary fiber.

Nutrient Loss: The harsh acid/alkali extraction removes beneficial compounds.

Outdated: Modern analysis (like Van Soest) provides more detailed, accurate fiber profiling for human nutrition [7].

Effects of Crude Fiber on the Diseases

C0nstipation

Fiber, more than any other dietary component, affects human large bowel function, causing an increase in stool output, dilution of colonic contents, a faster rate of passage through the gut and changes in the colonic metabolism of minerals, nitrogen and bile acids. (Fiber here refers to 'dietary fiber', which comprises plant cell wall polysaccharides and lignin, and not to 'crude fiber'.) It is thought that these changes are brought about by fiber passing through the gut undigested and holding water within its cellular structure. Although the amount of water taken up in vitro varies for different types of fiber, this does not correlate in the expected way with the effects these materials have on colonic function. This is because fiber is extract [8].

Diabetes

The past few decades, the incidence of diabetes, especially type 2 diabetes, is the highest, accounting for 90% of all diseases. It has grown very rapidly, and the number of patients with diabetes has continued to increase globally. It was 151 million in 2000 and 285 million in 2010. The global prevalence of diabetes is expected to be 7.8% by 2030 [66]. The increase in the number of diabetic patients also increases the global economic burden. These issues make it urgent for us to prevent and treat type 2 diabetes as soon as possible. Studies have found that DF has an important role in the prevention and treatment of diabetes.

Cancer

The mechanism of DF to prevent cancer is mainly reflected in the following aspects. DF has WHC and SWC, which can increase stool volume, accelerate defecation time, and reduce the concentration of carcinogens in the intestine. Dahl et al. Reported that DF can reduce the risk of colorectal cancer because the increased fecal bulk and decreased transit time, thereby reducing the carcinogens concentration of colorectal epithelium. DF can reduce the concentration of circulating hormones and increase excretion. The prevention mechanism of ovarian cancer and breast cancer is mainly to inhibit the secretion of hormones and reduce the bioavailability of hormones. Ho et al. studies showed that DF in fruits and vegetables prevents female breast [9].

Effect on Cardiovascular System

High fiber protects against hyperlipidemia and ischemic heart disease. Low intake of this dietary component is related to other risk factors of heart disease in susceptible genotypes such as obesity and diabetes. Gums and pectic substance have hypocholesterolemia and hypotriglyceridemic effects. This action of dietary fiber is very important in the treatment of atherosclerosis, coronary heart disease, and hypercholesterolemia andhyperlipidemia. Diets rich in fiber alter biliary lipid and bile salt metabolism making bile less saturated with cholesterol. Such bile would be less likely to precipitate its cholesterol and form gallstones [10].

Daily Amount in Take of Crude Fibre

- Fiber intake for children increases with age, often following an "age plus 5 grams" guideline for a rough estimate, or specific amounts by age group.
- Ages 1–3 years: 14 grams per day.
- Ages 4–8 years: 16.8 g for girls, 19.6 g for boys.
- Ages 9–13 years: 22.4 g for girls, 25.2 g for boys.
- Ages 14–18 years: 25.2 g for girls, 30.8 g for boys.

Adults

Fiber recommendations for adults are higher and differ between men and women due to differences in average caloric intake.

Age Group	Women (grams/day)	Men (grams/day)
19–50 years	25 g	38 g
51+ years	21 g	30g [11]

Methods for estimation of crude fiber

The Weende Method (Classic Crude Fiber)

This traditional gravimetric method, developed in the19th century, relies on sequential chemical digestion.

Principle: Removes fats (using ether), then boils with 1.25% H_2SO_4 (removes sugars, starch), then with 1.25% NaOH (removes protein, some hemicellulose/lignin), leaving the crude fiber residue.

Process:

Defatting: Extract sample with petroleum ether.

Acid Digestion: Boil residue with 1.25% H_2SO_4 for 30 mins.

Alkali Digestion: Boil residue with 1.25% NaOH for 30 mins.

Filtration & Washing: Filter, wash with water, alcohol, ether.

Drying & Weighing: Dry to constant weight (W1).

Ashing: Ignite in a muffle furnace (525°C) and reweigh (W2).
Calculation: Crude Fiber (%) = [(W1 - W2) / Sample Weight] * 100.
Limitations: Doesn't measure total fiber (lignin, cellulose, hemicellulose not fully, Used mostly in animal feed [12].

Modern Dietary Fiber Methods (More Accurate)

These methods provide a better estimate of total dietary fiber (TDF) by differentiating soluble (SDF) and insoluble (IDF) fiber.
Enzymatic-Gravimetric (AOAC Methods): Uses enzymes (amylase, protease) to mimic digestion, then precipitates and weighs the fiber residue.
Enzymatic-Chemical (Englyst, Uppsala): Similar to above but involves specific hydrolysis and measurement of sugars released from fiber fractions.

Table 01: Plants having the Fiber Content

SI.NO	NAME OF THE PLANT	SCIENTIFIC NAME	FIBRE CONTENT(GM)
1	Green pea	Pisum sativum	5.1
2	Carrot	Daucus carota	2.8
3	Cauli flower	Brassica oleracea	2.5
4	Sweet potato	Ipomoea batatas	4.0
5	Bean	Phaseolus vulgaris	9.0
6	Sweet corn	Zea mays	4.0
7	Tomato	Solanum lycopersicum	1.0
8	Cucumber	Cucumis sativus	1.1
9	Cabbage	Brassica oleracea	1.8
10	Pumpkin	Cucurbita spp	2.8
11	Radish	Raphanus sativus	0.9
12	Potato	Solanum tuberosum	2.4
13	Chick peas	Cicer arietinum	6.3
14	Bottle guard	Lagenaria siceraria	0.6
15	Bell pepper	Capsicum annuum	2.3
16	Spinach	Spinacia oleracea	2.8
17	Mushroom	Agaricus bisporus	1.2
18	Celery	Apium graveolens	1.5
19	Broccoli	Brassica oleracea	3.2
20	Eggplant	Solanum melongena	2.3

Conclusion

Crude fiber, though an early and limited measure of dietary fiber, remains a valuable parameter in nutritional evaluation, particularly for assessing the indigestible components of plant-based foods and animal feed formulation. While it does not fully represent total dietary fiber, crude fiber contributes significantly to digestive health, metabolic regulation, and disease prevention, including constipation, diabetes, cardiovascular disorders, and certain cancers. Traditional estimation methods such as the Weende method continue to be relevant, especially in animal nutrition, while modern analytical techniques offer improved accuracy for human dietary assessment. Understanding crude fiber alongside total dietary fiber enhances nutritional planning and supports public health strategies aimed at promoting balanced diets and disease prevention.

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Not applicable

Author Contributions

All authors are contributed equally

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