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## Ramya A

Student, Foods and Nutrition,  
Department of Home Science,  
Mother Teresa Women's  
University, Kodaikanal,  
Tamil Nadu, India

## Dhanushya P

Guest Lecturer, Foods and  
Nutrition, Department of Home  
Science, Mother Teresa Women's  
University, Kodaikanal, Tamil  
Nadu, India

## Review on advances in gluten free diet for celiac disease patient

### Ramya A and Dhanushya P

#### Abstract

For those with a hereditary predisposition, ingesting gluten can result in the whole body deteriorating into celiac disease. It mostly manifests as an autoimmune disease of the digestive tract, associated with a certain human leukocyte antigen genetic makeup and specific autoantibodies in the circulation. Persistent symptoms in celiac disease are associated with deteriorating physical functioning, a worse quality of life, and a higher risk of depression and anxiety. Consuming gluten can exacerbate clinical symptoms, worsen intestinal damage, and increase the risk of getting cancer in the future, including melanoma, small intestinal adenocarcinoma, esophageal cancer, and non-Hodgkin's lymphoma. Pseudocereals, cereals, legumes, fruits, vegetables, nuts, and dairy composite goods are just a few of the Gluten Free substitutes that people who have been interested in the creation of Gluten Free products have selected during the past few decades.

**Keywords:** Pseudocereals, celiac disease, gluten free diet, non-celiac gluten sensitivity

#### Introduction

Celiac disease is a condition that affects the entire body and is caused by consuming gluten in people who have a genetic predisposition. It mainly appears as an autoimmune disorder in the digestive system that is linked to certain autoantibodies in the bloodstream and a specific human leukocyte antigen genetic makeup (Calado *et al.*, 2022) [5]. Constipation, diarrhea, bloating in the abdomen, and discomfort in the abdomen are typical indications and symptoms of celiac disease. Extra intestinal symptoms like weariness, weight loss, dermatitis herpetiformis, iron insufficiency, and osteoporosis are also linked to celiac disease (Austin *et al.*, 2024) [4]. Gluten sensitivity (Non-Celiac Gluten Sensitivity, NCGS) is being reported more frequently around the world. Patients with wheat intolerance, gluten sensitivity, or celiac disease should follow a gluten-free diet (Demirkesen *et al.*, 2022) [6]. In order to manage Celiac Disease (CD), the Gluten-Free Diet (GFD) is still a complicated paradigm. It should be tight for a number of reasons in order to enhance results. Due to the prevalence of celiac disease and the clear understanding of its underlying pathophysiology, pharmacological development has shown interest in addressing the shortcomings of dietary treatment (Discepolo *et al.*, 2024) [7]. Adhering to a Gluten Free Diet (GFD) presents challenges and restrictions in the quality of life for Celiac Disease (CD) sufferers. As a result, daily non-adherence to a Gluten Free Diet (GFD) occurs, which hinders or delays the healing process for patients. According to studies conducted over the past three decades, 45-90% of Celiac Disease (CD) patients follow a Gluten Free Diet (GFD) (Wiser *et al.*, 2021).

#### Celiac Disease

Celiac Disease (CD), An autoimmune chronic illness that causes villous atrophy in the small intestine, resulting in symptoms include extraintestinal and intestinal, and is brought on by gluten consumption in those who are genetically susceptible (Ribeiro *et al.*, 2024) [17]. The immune-mediated disorder known as Celiac Disease (CD) is typified by Tissue Transglutaminase (TTG) autoantibodies, small intestine enteropathy, and systemic symptoms associated with immunological activation or malabsorption (Lebwohl *et al.*, 2021) [11].

#### Corresponding Author:

#### Ramya A

Student, Foods and Nutrition,  
Department of Home Science,  
Mother Teresa Women's  
University, Kodaikanal,  
Tamil Nadu, India

Elevated titers of celiac-specific autoantibodies, varying degrees of inflammatory enteropathy, Gastro Intestinal (GI) problems, and a wide range of extraintestinal complaints ranging in severity from non-existent to potentially fatal are the characteristic features of celiac disease (Guandalini *et al.*, 2022) [10]. In celiac disease, persistent symptoms are linked to worsening physical functioning, a lower quality of life, and an increased risk of anxiety and depression (Dochat *et al.*, 2024) [8]. Patients require professional care and direction to manage their disorder and associated social and nutritional issues, as well as to navigate their dietary and therapy options, particularly in the early years following diagnosis. The majority of individuals with Celiac Disease (CD) will require Follow-Up (FU) visits with physicians, dietitians, general practitioners, and primary or family practitioners (Mulder *et al.*, 2023) [14].

**Gluten Free Diet:** For those with Celiac Disease (CD), a

lifelong Gluten-Free Diet (GFD) is recommended. Gluten consumption can worsen clinical symptoms, cause more damage to the intestines, and raise the chance of developing cancer in the future, such as Non-Hodgkin's lymphoma, esophageal cancer, melanoma, and small intestinal adenocarcinoma (Aljada *et al.*, 2021) [1]. A gluten-free diet necessitates the total removal of barley, rye, and wheat. In fact, enteropathy can be exacerbated by as little as 50 mg of gluten, which is present in a small piece of pasta or a few breadcrumbs. Moreover, gluten contamination can occur in a variety of items during harvesting, processing, or packaging (Marciniak *et al.*, 2021) [12]. As was already established, the only treatment for celiac disease is rigorous adherence to a gluten-free diet for life. However, because gluten is present in a large number of items, food can come into contact with gluten, food labels are inadequate, and social restraints make it difficult to follow a rigorous Gluten Free (GFD) permanently (Simon *et al.*, 2023) [19].

### Different types of fiber sources used in gluten-free products

Gluten-free Formulation	Fiber Source	Gluten-Free Product Type	Observed Effects
Amarnath flour, quinoa	Buckwheat	Pseudocereals flour	The water holding capacity, water solubility index, bulk density, swelling power, and oil absorption were decreased with an increase in the buckwheat and a decrease in the quinoa level in the formulation.
Rice flour and corn starch	Orange pomace	Bread	Orange pomace improved volume, gave compact structure, decreased hardness during storage.
Corn starch, rice flour.	Wheat, maize, oat and barley fiber	Bread	The addition maize and oat fiber gave high loaf volume, softer crumb, and appealing darker crust and a more uniform and finely grained crumb texture.
Potato starch, rice flour, xanthan gum	B-glucan and inulin	Bread	The addition of $\beta$ -glucan gave more elastic dough. Inulin gave higher volume, darker color and higher hardness. $\beta$ -glucan decreased volume, gave lighter and softer texture.
Corn starch, rice flour, rice starch, rice protein, guar gum, maltogenic amylase.	Psyllium and sugar beet fiber	Bread	Both fiber sources improved the workability of the doughs, but psyllium played a central role on gluten-free bread with antistaling effect, water binding capacity.
Sourdough fermentation	Sourdough	Bread	The use of sourdough fermentation in gluten free bakery products can help improve dough elasticity and enhance the properties of the final products.
Rice flour.	Chia seeds	Bread	The addition of chia reduced specific volume, increased the hardness of breads, minimized weight loss and gave a darker crust and crumb.
Corn starch, Potato starch, guar gum, pectin.	Defatted blackcurrant and strawberry seeds	Bread	The addition of defatted blackcurrant and strawberry seeds significantly modified viscoelastic properties of dough. Higher volume and lower firmness after 24 <sup>th</sup> was obtained.
Rice flour, guar gum, amyloglucosidase, glucose oxidase-peroxidase.	Inulin and oat fiber	Cakes	Fiber sources gave improved specific volume and brighter color.
Rice flour	Flaxseed and chia gel	Cake	Chia or flaxseed gels gave higher moisture content, more uniform texture and better sensorial characteristics.
Rice flour	Apple, carrot, and orange pomace	Cake	Enrichment of dietary fiber content of gluten-free cakes was obtained without significant effect on specific volume and other quality characteristics.
Corn starch	Pumpkin seeds	Cakes	The chemical composition of cakes improved in terms of lipids, proteins, and dietary fibers giving more uniform structure.
Chickpea flour and fava bean flour	Vegetable fat	Cookies and pasta	The manufacture of the cookies and pasta leads to an increase in the lipid content, which contributes to improving their taste quality.
Rice flour	Chia seeds	Pasta	The addition of chia seeds improved the nutritional profile of pasta, increased the slowly digestible starch fraction of rice flour.

**Source:** Demirkesen *et al.*, 2022; Poshadri *et al.*, 2023; Alper *et al.*, 2024; Ammouche *et al.*, 2024 [6, 16, 2, 3].

### Advanced Gluten Free Diet

For over 70 years, the only way that patients with Celiac Disease have seen improvements in their clinical, serological, and histological conditions is by following a gluten-free diet. Due to the widespread availability of wheat and other processed foods that contain even more gluten, making gluten-free goods less successful, it is rare to be able to completely eliminate dietary gluten these days (Nemteanu *et*

*al.*, 2022) [15]. Furthermore, despite the fact that gluten-free food technology has advanced significantly in recent years, many Gluten Free goods are still regarded as being of inferior quality, particularly when it comes to flavour, consistency, mouth feel, and texture. Additionally, patients frequently have trouble accepting alternative raw materials that are inherently gluten-free (Mazzola *et al.*, 2024) [13]. Recent research has been done to carefully examine a variety of gluten-free flours

in order to create an enhanced technology for making gluten-free bread. A successful recipe for gluten-free bread was developed by experimenting with numerous ingredient combinations and fine-tuning the technological process. The recipe calls for 40:40:20 of corn, green buckwheat, and plantain flour (Utarova *et al.*, 2024) <sup>[20]</sup>. In a different study, the appropriate proportion of rice flour to corn flour was established while accounting for the organoleptic markers and physicochemical characteristics of the final gluten-free baked goods. It has been shown that an 80:20 ratio is the reasonable ratio for corn and rice (Gorach *et al.*, 2024) <sup>[9]</sup>.

### Conclusion

A lifetime Gluten Free Diet (GFD) is currently the only proven successful treatment for Celiac Disease (CD). When a disease already has an established non-pharmacological therapy, drug development is faced with numerous obstacles. In patients with diet-responsive Celiac Disease (CD), recent development of gluten free product should be safe, easy to use and reasonably priced in order to take the role of a Gluten Free Diet (GFD). A Gluten Free Diet (GFD) needs to be prioritized and routinely checked as a result. Patients with Celiac Disease (CD) appear to have a higher death rate, probably if treatment is not received. Future and present studies on Celiac Disease (CD) should focus on advances in Gluten Free Diet (GFD) for celiac disease patient's healthy life.

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