

# The Costs of Eating Gluten-Free

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## Abstract

We leverage a large dataset of U.S. bakery products to comprehensively study price and nutritional composition of gluten-free products in comparison with conventional items. Using data between 2013 and 2022, and controlling for time and manufacturer fixed effects, our findings suggest that gluten-free products are up to 87% more expensive than conventional ones. In addition, the macro-nutrient content tends to be poorer in gluten-free products. In particular, across product subcategories, they contain more fat than conventional products, as much as 117% more in the bread subcategory. However, gluten-free products receive better scores on some characteristics which differ by product subcategory. In our data, bread is the product subcategory in which gluten-free products fare the worst compared to conventional products, both in terms of price difference and nutrient composition. We conclude that unless a gluten-free diet is medically prescribed, most consumers' financial and nutritional health would benefit from avoiding processed gluten-free products.

Keywords: gluten-free, nutrition, health, pricing, product differentiation

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## **Introduction**

Recent years have shown an increase in adoption of “better-for-you” yet unproven diets, such as the gluten-free and paleolithic diets. This increase in interest has been attributed, at least in part, to the prevalence of social media, celebrity endorsements, and a consumer desire for healthy eating (Jansson-Knodell and Rubio-Tapia, 2021, Spadine and Patterson, 2022). We contribute to the understanding of the potential health and financial consequences of adopting these diets.

Our study focuses on the gluten-free diet since gluten-free products have become widely available. The diet eliminates products that contain gluten – the protein that gives dough its elastic texture and is found in wheat, barley, rye and triticale. While it is prescribed for those with celiac disease, wheat allergy, and non-celiac gluten sensitivity, for the rest of the population no benefit has been scientifically proven.

Previous studies suggest that processed gluten-free products can be nutritionally inferior, more expensive and of poorer sensory characteristics (i.e., taste and texture) than their conventional counterparts (e.g., Melini and Melini, 2019; Lee et al., 2019; Alencar et al., 2021). Yet, almost a third of U.S. consumers avoid gluten in their diet (Egan, 2016) believing that gluten-free products are healthy and beneficial to all (Roberts, Jr., 2018). In 2020, the sale of gluten-free products in the United States was valued at \$6.4 billion and was projected to reach \$11 billion by 2026 (PR Newswire, 2022). Of new product introductions in 2020, 6.5 percent bore the gluten-free claim – the third most popular claim behind “kosher” and “low-allergen or no/reduced allergen” (USDA ERS, 2021).

In this article, we examine the nutritional value and price of new food products introduced in the United States between 2013 and 2022 in the bread, cookies, and pastries subcategories, providing, to our knowledge, the most comprehensive comparison yet of gluten-free and

conventional products. Gaining a better understanding of the nutritional value and price of gluten-free products is important for several reasons. First, while there are obvious benefits to those for whom the diet is prescribed, there may also be health consequences. There is evidence that the diet can lead to nutritional deficiencies (e.g., Vici et al., 2016) and that gluten-free processed products may contain more added sugar and fat, which are associated with diabetes and obesity (Reilly, 2016). Further, when consumers believe that ailments can be cured with dietary adjustments, they may delay seeking medical help (Ayoob et al., 2002). Second, there may be economic consequences to widespread dietary changes. Ates and Lusk (2020) calculate that the gluten-free diet has contributed to a \$7.2 million per year reduction in wheat and barley producers' profit in the United States. Finally, from a public-health perspective, understanding the nutritional value and personal financial impact of the gluten-free diet may help the U.S. medical community counter misinformation and disseminate evidence-based information to the general population (Chou, Oh and Klein, 2018).

## **Materials and Methods**

Our data come from the Mintel Global New Products database and contains products introduced, reformulated, relaunched, and those with new packaging in U.S. markets in the cookies, bread, and pastries subcategories between January 2013 and April 2022. The database provides prices (adjusted to 2013 dollars), nutrition information, and product claims; the relevant claim for us is “gluten-free.” For each year except 2022 we observe between 1,200 and 1,660 products. Total product numbers are 3,619, 5,780, and 3,699 products, respectively, for bread, cookies, and pastries. Out of those, 367, 827, and 329 products, respectively, are gluten-free.<sup>2</sup>

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<sup>2</sup> We drop pizza and tortillas from the bread subcategory to generate a more homogenous sample that focuses on products like rolls and white bread. Our results do not change qualitatively when including those products.

Table 1 provides some summary statistics. Most notable is the large difference in prices between gluten-free and gluten-containing products. However, the difference in many nutrition values varies by product category.

<Table 1 about here>

We analyze the difference between gluten-free and conventional products on the following outcome variables: price, and content in energy, fat, saturated fat, cholesterol, sodium, fiber, sugar, and protein. All variables are measured on a per-100g basis.

We regress each outcome variable on a dummy equal to one if the product is gluten-free (zero otherwise), and manufacturer and year fixed effects. We include manufacturer fixed effects to account for horizontal or vertical differentiation by manufacturers that presumably transcends the conventional-gluten-free divide. For instance, gluten-free Oreos are designed to be similar to conventional Oreos. This makes it likely that the nutritional content of the variants is related. The year fixed effects capture the possibility that product composition changes over time for reasons independent of specific manufacturers or gluten content.

For each outcome variable, our regression equation is:

$$Y_i = \gamma_m + \delta_t + \beta g_i + \varepsilon_i$$

where  $Y_i$  is the outcome variable for product  $i$  of manufacturer  $m$  introduced in year  $t$ ,  $\gamma_m$  is the manufacturer fixed effect,  $\delta_t$  is the year fixed effect,  $g_i$  is the dummy indicating whether product  $i$  is gluten-free,  $\beta$  is the coefficient of interest, and  $\varepsilon_i$  is the error term which we assume to be independent across observations.

## Results

Table 2 presents the results – estimated coefficient of interest, standard error, and number of observations for each regression. Numbers of observations can vary within one product

subcategory because of missing data. The table also indicates significance at the 99%, 95%, and 90% thresholds where we use sharpened q-values (Benjamini et al., 2006; Anderson, 2008) to control the false discovery rate, accounting for the fact that we run a total of 27 regressions.

<Table 2 about here>

Across all product subcategories we find that prices of gluten-free products are higher than those of conventional products. This difference is large (between \$0.49 and \$0.72 per 100g), highly statistically significant, and represents a premium as high as 87% in the bread category. The picture is less clear across subcategories with respect to nutrients. For the bread subcategory, gluten-free products contain significantly more energy (10% more), fat (117%), saturated fat (84%), and cholesterol (448%) while also providing 37% less protein. On the plus side, gluten-free bread products contain 17% less sodium than their conventional counterparts. Gluten-free cookies contain more fat (6%), saturated fat (12%), sodium (10%) and sugar (4%), but also more fiber (27%) than conventional ones. For the pastries subcategory we find that gluten-free products contain more fat (13%), more sodium (8%), less protein (29%), less energy (4%), more fiber (29%), and less sugar (19%) than conventional products.

Overall, our results show that gluten-free products are more expensive than conventional ones even when controlling for manufacturer and year. There is also reason to believe that these products are less healthy as in each product category they do worse than conventional products along several nutritional dimensions. In particular, gluten-free products across product categories contain more fat than those containing gluten. However, in each product category, gluten-free products seem superior to those containing gluten for at least one nutrient (less sodium for bread, more fiber for cookies, and less energy, more fiber, and less sugar for pastries). The exact way gluten-free products differ from those containing gluten varies by product category. We find the

biggest effects in the bread subcategory. This is intuitive as bread relies most heavily on gluten-containing grains like wheat or rye.

## **Discussion**

Our results suggest important costs to consuming gluten-free products. Part of these costs is monetary due to the substantially higher prices compared to conventional products. Besides accounts of poor sensory characteristics, another cost appears to be lower nutritional value of many gluten-free products and, in particular, higher fat content. Overall, most consumers would likely be well-served by sticking to gluten-containing products unless they are medically proscribed.

As with most studies of firm behavior, there is the potential for endogeneity. Our use of manufacturer fixed effects, controlling for cost and recipe differences on the producer side, and year fixed effects, controlling for demand shifts and changes in technology that may lead to altered product composition, mitigate this concern. Nonetheless, leveraging more sophisticated approaches would be a valuable future contribution but is beyond the scope of this note.

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