

A Comparison of Gluten-Containing and Gluten-Free Food Products in Terms of Cost and Nutrient Content in the City of Antalya, Turkey

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ABSTRACT

BACKGROUND/AIMS: Gluten is a protein that constitutes the main structure of flour, and thus, its removal from food products causes many gluten-free products in the market to be low in quality and taste while high in cost. Therefore, the purpose of this study was to compare gluten-containing and gluten-free food products.

MATERIALS AND METHODS: In this study, which is descriptive-comparative in nature, 64 gluten-free products and their 64 gluten-containing equivalent products in the same categories were randomly selected in large supermarkets in Antalya.

RESULTS: 50% of the products in this study were gluten-free, and bread and bakery products constituted the major group with 31.3%. The average price of all gluten-free products in this study was found to be significantly higher compared to gluten-containing products ($p<0.01$). The protein levels of the gluten-free products in all categories except for cereal were found to be significantly lower in comparison with the gluten-containing products ($p<0.01$). The average amount of fat in gluten-free flour ($p<0.05$), the average amount of sugar in the gluten-free pasta group ($p<0.01$) and the average energy level of the gluten-free cereals were found to be lower ($p<0.05$) in comparison to their equivalent gluten-containing food products.

CONCLUSION: In this study, it was found that gluten-free products are not only limited in availability and more costly but they also have significantly lower protein values. Therefore, it is important to monitor the development of children with celiac disease and to support their diet with alternative food sources.

Keywords: Gluten, gluten-free food, nutrient content, cost

INTRODUCTION

Although a gluten-free diet is a lifetime treatment regime in order to prevent small intestine damage as a result of gluten exposure in people with celiac disease,^{1,2} the number of individuals who follow a gluten-free diet is higher than the number of individuals diagnosed with celiac disease, and the popularity of these products in recent years has increased over time and transformed into a health service.³

The preference for healthy gluten-free food products plays an important role, particularly in curing individuals with celiac disease, as nutrition is the only method of treatment.⁴ However, it is not easy to sustain a gluten-free diet. It is not enough for patients only to avoid grain products containing gluten. They also should be on the alert constantly,⁵ because excessive consumption of food products containing grain and the use of grain and its derivatives for purposes including colouring, preserving, or stabilizing products makes it difficult for celiac patients to adjust to

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a gluten-free diet.¹ Also, as a protein constituting the main structure of flour, gluten contributes to the structure and appearance of many baked products. Thus, the removal of gluten from food products causes many gluten-free products in the market to be lower in quality and taste while higher in price.^{2,6} Additionally, patients following a gluten-free diet are known to be exposed to nutrition that has high levels of fat and energy but low levels of nutrients such as iron, zinc, magnesium, calcium, vitamins D and B12, and folate.⁷⁻⁹

Although a gluten-free diet is considered to be a healthy diet in general, considering the potential of this diet to cause certain nutritional deficiencies, celiac patients should be aware when selecting gluten-free products that are both nutritious and economical in order to prevent any problems. This condition imposes an increased financial and emotional burdens on patients. In spite of this, no studies have been carried out in Turkey comparing gluten-free and gluten-containing products in terms of cost, energy, and content. Therefore, this study was designed to compare gluten-free products with gluten-containing products in terms of cost, energy and content.

MATERIALS AND METHODS

Design of the Study

This study was planned as a descriptive-comparative research with the purpose of comparing packaged gluten-free products with gluten-containing products in terms of cost, energy, and nutrient content.

Categorization of Food Products

In this study, products with a label or in the statement of “gluten-free” on the packaging were categorized as gluten-free food products, while those without such a label or statement were considered as gluten-containing food products. According to the Communiqué for Food Products Suitable for Gluten Intolerance in the Turkish Food Codex,¹⁰ a food product is labelled as “gluten-free” when the gluten level in food products produced for individuals with gluten intolerance does not surpass 20 mg/kg. According to the Turkish Food Codex Labelling and Consumer Information Communiqué,¹¹ it is mandatory to include the amount of energy and nutrients (fat, sugar, protein, salt) in 100 grams of food products on the packaging. In this study, the contents of energy, protein, fat, sugar and salt in 100 grams of both gluten-free and gluten-containing products sold in Antalya were compared. Also, a cost-comparison for 100 grams was completed for these products. Five food categories representing the majority of packaged food products were used in selecting and comparing gluten-free and gluten-containing products based on traditional grain formulations. These food categories were: 1) flour, 2) bread and bakery products (cake, cookies, biscuits, pizza etc.), 3) pasta (pasta, noodles, vermicelli etc.), 4) snacks (chocolate, wafers, pretzels, chips, etc.), and 5) cereals.

Sample of the Study

For the purpose of comparing the nutrient content and costs of gluten-free and gluten-containing products, all of the gluten-free products sold in the five biggest supermarkets in Antalya were included in the “gluten-free” group and the same number of their equivalent “gluten-containing” products in the same categories were included in the sample. Thus, a total of 64 gluten-free food products in 5 categories sold in supermarkets included in the study and their equivalent 64 gluten-containing food products in the same categories were randomly selected. The two sub-category sample sizes (64 and 64) provide the

total sample size (128) proposed by Cohen in calculating the medium effect size for the statistical methods in which the difference between the two group averages was calculated.¹² The data were collected between August 2018 and September 2018 by the researchers in the designated supermarkets. Non-packaged bakery products and food products without a food label were not included in the sample. With the consideration of potential influences on the results, food products with the labels “no added sugar” or “low sodium” were not included in the sample. In stores where the same products or different sizes of the same products (with no difference in nutrient content) were sold, the product was counted only once and the average price of these products was taken. For products of different sizes, their prices for 100 grams were calculated and included in the sample. For this, the direct package price of the products with 100 grams packs was taken, and for those products larger than 100 grams, the cost for 100 grams was calculated by proportioning. Micronutrients, vitamins, minerals, and fiber in these food products were not included in this study.

Statistical Analysis

Statistical Package for the Social Sciences (SPSS) version 23 (Chicago, IL, USA) software was used in analysing the data. Number and percentage for the distribution of food groups; mean, standard deviation and Mann–Whitney U tests were used to compare the prices and nutritional content of gluten-containing and gluten-free foods. $P < 0.05$ was accepted as statistically significant.

RESULTS

Table 1 presents the distribution of food groups included in the sample by categories. As can be seen, 50% of the products are gluten-free and 50% are gluten-containing. The major group in these categories is bread and bakery products with 31.3%, and the smallest group is cereals with 9.4% (Table 1). A comparison of the mean prices of gluten-free and gluten-containing products in each category is presented in Table 2. The mean price of all gluten-free food groups was significantly higher than that of the gluten-containing group ($p < 0.01$ for cereals, and $p < 0.001$ for others) and the greatest price difference was seen in the snacks category, with a six-fold difference (Table 2).

Table 3 shows a comparison of nutrient amounts in gluten-containing and gluten-free products in each category. The protein level of gluten-free products in all categories except for cereals was found to be significantly lower compared to the gluten-containing products ($p < 0.01$). Also, the amount of fat and sugar in gluten-free and gluten-

Table 1. Distribution of foods by groups (n=128)

	n	%
Gluten content		
Gluten-containing	64	50.0
Gluten-free	64	50.0
Food group		
Flour	32	25.0
Bread and bakery products	40	31.3
Pasta group	24	18.8
Snacks	20	15.6
Breakfast cereals	12	9.4
n: number.		

containing flour showed a significant difference ($p < 0.05$). The average fat amount in gluten-free flour was lower while the amount of sugar was 22 times higher compared to gluten-containing flour. However, the amount of sugar in the gluten-free pasta group was lower than in the gluten-containing pasta group ($p < 0.01$). In the cereal group, only the energy level showed a significant difference ($p < 0.05$), with the energy of gluten-free cereal being lower. The nutrient amounts in gluten-free and gluten-containing products in other food categories did not show any significant differences ($p > 0.05$).

DISCUSSION

In this study comparing the content and prices of gluten-free and gluten-containing food products, only 64 gluten-free products were

accessed despite the fact that the biggest stores in Antalya were included in the sample. This situation may contribute to the difficulty of obtaining gluten-free products especially for those individuals with celiac disease or gluten allergy. In addition to the limited availability of gluten-free products, the higher prices of these products may also have a negative impact. This study shows that the prices of gluten-free products in each food category are higher and that the differences can be up to 6 times higher. Other studies have also shown similar results, revealing that gluten-free products are limited in availability and more costly.^{13,14} Since gluten contributes to the appearance and texture of many baked products as it is the protein that forms the main structure of flour, removing gluten from foods causes many gluten-free products on the market to be lower in content and more expensive.^{2,6}

Table 2. Prices of gluten-containing and gluten-free food by groups (n=128)

Food category	Gluten-containing foods (for 100 g)*		Gluten-free foods (for 100 g)*		p-value**
	Mean	SD	Mean	SD	
Flour	1.13	0.66	2.72	1.57	0.000
Bread and bakery products	2.04	1.37	9.47	6.28	0.000
Pasta group	0.85	0.77	2.45	2.33	0.000
Snacks	2.97	1.58	17.99	9.01	0.000
Breakfast cereals	2.83	0.66	9.73	2.98	0.004

*Prices of 100 grams of food product have been compared. Prices were given in TL, **The difference between the groups was evaluated by the Mann–Whitney U test and $p < 0.05$, SD: standard deviation, n: number.

Table 3. Comparison of nutrients for gluten-containing and gluten-free products by food categories (n=128)

Food category	Energy (kcal)		Protein (g)		Fat (g)		Sugar (g)		Salt (g)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Flour										
GC	349.86	18.92	11.09	4.85	6.31	7.30	0.20	0.49	0.02	0.04
GF	355.48	22.40	3.82	3.03	4.05	6.29	4.36	8.56	0.23	0.41
p-value*	0.336		0.000		0.021		0.018		0.056	
Bread and bakery products										
GC	435.90	91.90	7.17	2.55	18.00	9.17	20.39	12.64	0.77	0.37
GF	432.65	111.64	3.64	1.95	18.89	10.16	16.63	12.49	0.65	0.51
p-value*	0.957		0.000		0.685		0.273		0.228	
Pasta group										
GC	353.42	9.81	12.06	1.08	1.93	1.14	3.21	1.17	0.02	0.03
GF	354.38	8.25	9.51	2.81	1.74	0.88	2.27	1.61	0.03	0.08
p-value*	0.523		0.000		0.523		0.004		0.322	
Snacks										
GC	474.53	49.47	8.22	1.63	20.77	8.57	23.21	16.76	1.17	0.95
GF	489.00	56.33	3.97	2.23	23.57	8.69	19.80	18.93	1.29	1.04
p-value*	0.427		0.001		0.326		0.545		0.910	
Breakfast cereals										
GC	379.83	6.49	8.83	1.40	4.10	2.09	19.53	6.53	0.78	0.26
GF	366.82	8.50	11.02	2.68	4.22	2.58	9.43	11.08	0.55	0.71
p-value*	0.016		0.128		0.810		0.149		0.335	

The amounts of energy, protein, fat, sugar and salt in 100 grams of food product have been compared. *The difference between the groups was evaluated by the Mann–Whitney U-test and $p < 0.05$, GC: gluten-containing, GF: gluten-free, SD: standard deviation, n: number.

This study showed that gluten-free products in each category except for cereals contain lower protein levels. Other studies conducted in different countries have shown similar results, in which gluten-free products contained low levels of protein.¹³⁻¹⁶ As gluten constitutes a significant portion of the total protein content in grains, the finding of protein deficiency due to the removal of gluten from flour-products is an expected result.^{10,17} Although the level of protein in grains is around 10%, it provides the basic needs of a continually increasing population, particularly in developing countries, as a protein source.¹⁸ At the same time, bread and bakery products in countries such as Turkey, in which the Mediterranean diet is dominant, constitute the widest part of the food pyramid as a fundamental carbohydrate and energy source.¹⁹ Considering that the majority (56.3%) of the gluten-free products available on the market in our study area consist of flour and bakery products, the lack of protein in these products becomes more important. Using different sources of protein is an important way to bridge this gap. With this in mind, by using gluten-free grains, legumes, grain-like products (buckwheat, amaranth, and quinoa) and animal proteins in formulations, a variety of products with improved nutrients can be produced.^{6,20}

It is known that gluten-free products contain more carbohydrates compared to gluten-containing products.^{21,22} In this study, the amount of sugar contained in gluten-free flour was found to be 22 times greater than gluten-containing flour. In gluten-free bakery products, to eliminate the poor appearance and taste due to gluten removal, rice flour, rice bran, and brown rice flour that do not contain gluten protein are used rather than whole wheat flour.²³ However, as the need for daily calories and carbohydrates of individuals with celiac disease or gluten allergy is similar to that of the normal population, it is important to prevent problems that may occur as a result of excessive carbohydrate consumption.²⁴ Therefore, using natural products such as beans, legumes and starchy vegetables as alternatives to grains and using natural carbohydrate sources such as potatoes in lieu of gluten-free flour is recommended.²⁵

One of the key findings in this study is that the average amount of sugar contained in gluten-free products in the five food categories except for flour was lower. At the same time, the average fat and energy amounts in products were found to be significantly lower in only one food category of the gluten-free products. Although previous studies reported that the amount of fat, sugar, salt, and energy in gluten-free products was higher,^{14,25-27} this study showed no significant difference between gluten-free and gluten-containing products in the food groups in terms of these parameters. This may be a result of positive developments in the manufacturing sector towards eliminating the disadvantages of gluten-free products in recent years. For example, to eliminate the negative effect of gluten removal on the quality of pasta, the use of formulations such as xanthan gum, guar gum, casein, egg white or fermented peas rather than flour can explain why gluten-free pasta now has low sugar levels.^{28,29} However, there are also studies reporting that the levels of sugar, fat, and energy in gluten-free products do not show significant differences compared to gluten-containing products.^{15,30} This is especially important for individuals who must consume gluten-free diets, such as celiac patients, to maintain a healthy weight and protect themselves from complications due to excessive consumption of these nutrients.³¹

CONCLUSION

Although not having gluten in food products is the main characteristic of a gluten-free diet, it can also lead to unintended results including nutritional deficiency and nutritional imbalance. However, having sufficient nutrient content in a gluten-free diet is important, particularly in children, because children are in constant need of maximum energy and food as they are growing, developing, and active. Thus, the nutrient quality of gluten-free products available on the market has received more attention in recent years. This study shows that the prices of gluten-free products are higher and that the number of available products on the market is limited. At the same time, the protein levels in gluten-free products are lower and the level of sugar in flour is significantly higher. That is why it is important to protect children and all individuals who follow a gluten-free diet from certain complications. Thus, it is important to raise awareness in parents, health care professionals working with children, and educators about the negative aspects of a gluten-free diet, alternative nutrition, and monitoring development.

In this study, gluten-free products in the food aisles of the largest supermarkets in Antalya were included in the sampling, and businesses such as small markets were not included. Therefore, the results of the study cannot be generalized to the whole food retail sector.

MAIN POINTS

- The number of gluten-free products on the market is limited and their prices are higher.
- The protein value in gluten-free products is very low.
- The amount of sugar (except for flour), fat, energy and salt in gluten-free products was not significantly higher than their counterparts.

ETHICS

Ethics Committee Approval: Ethics committee approval was received for this study from Akdeniz University Clinical Research Ethics Committee (decision no: 532, date: 25.07.2018).

Informed Consent: Informed consent is not necessary due to the nature of this study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: A.M., E.K., Design: A.M., E.K., Supervision: A.M., Data Collection and/or Processing: E.K., Analysis and/or Interpretation: A.M., Literature Search: A.M., E.K., Writing: A.M., Critical Reviews: A.M., E.K.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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