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**The Impact of a Gluten-Free Claim on the Perceived Healthfulness, Calories,  
Level of Processing and Expected Taste of Food Products**

Marília Prada, Cristina Godinho, David L. Rodrigues, Carla Lopes, and Margarida V.  
Garrido

Instituto Universitário de Lisboa (ISCTE-IUL), CIS-IUL, Lisboa, Portugal

Note: Marília Prada, Cristina Godinho, David L. Rodrigues, Carla Lopes and Margarida V. Garrido, Department of Social and Organizational Psychology, ISCTE-IUL, CIS-IUL, Lisboa.

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Correspondence concerning this article should be addressed to M. Prada, ISCTE-IUL, Av. das Forças Armadas, Office AA110, 1649-026, Lisboa, Portugal.

E-mail: marilia\_prada@iscte-iul.pt

## Abstract

In recent years, gluten-free (GF) diet has become quite popular among non-celiac individuals and GF versions are now available for an array of processed foods. In this study, we examined how including a GF label in packaging impacts the evaluation of food products in several evaluative dimensions. Participants ( $N = 202$ ; 63.2% female,  $M_{\text{age}} = 27.87$ ,  $SD = 10.72$ ) were presented with images of four food products and asked to evaluate the healthfulness, caloric content, expected taste and level of processing of each product. Overall, results showed that GF (vs. control) products were perceived as more healthful, as having fewer calories and as less processed. No main effect of the GF label was observed for expected taste. In some cases, the impact of the GF label was moderated by the type of product. These findings were independent of participants' positive beliefs toward GF diet, and of their low self-reported knowledge about GF products. Our findings clarify a potential source of bias for the consumer and may inform evidence-based strategies or policies aiming to promote healthy eating habits.

Keywords: gluten-free; processed food; food perception; healthfulness; taste; calories; food level of processing.

## 1. Introduction

Nowadays, in addition to objective nutritional data, food packages often include a myriad of information such as claims regarding how and where that food was produced (e.g., “organic”; “local”) as well as claims about the presence or absence of specific substances (e.g., “with vitamin C” or “gluten free”).

People tend to perceive food either as “healthy” or “unhealthy” (Oakes & Slotterback, 2001); hence, inferring the healthfulness of a product based on a single attribute is potentially problematic, in particular because seeking nutritional information becomes less likely (Williams, 2005). For example, a consumer who chooses a product with a front-of-package “low fat” claim may ingest more sugar than intended (Wansink & Chandon, 2006), because lower fat versions of foods often contain more sugar (Nguyen, Lin, & Heidenreich, 2016). Therefore, it is highly relevant to understand how the presence of such claims can shape the way consumers perceive and behave toward food. To illustrate, research has shown that based on an “organic” claim, individuals infer proprieties unrelated to the food production method. Specifically, in comparison to conventional food, organic food is generally perceived as more healthful, safer to consume, tastier, as well as less caloric and less processed (for a review, see Prada, Garrido, & Rodrigues, 2017). In the current study, we experimentally examine how a claim related to product composition – gluten-free (GF) – influences the perception of food exemplars.

There has been a substantial increase in the availability of “free-from” products, particularly GF food. The GF diet combines foods that naturally do not include gluten (i.e., a protein that is present in cereals such as wheat, rye or barley) with GF substitutes of cereal-based foods (e.g., products manufactured with ingredients specially processed to remove gluten, Pellegrini & Agostoni, 2015). Although this

diet is essential for individuals with gluten sensitivity or allergy, the sales trend of GF products is not solely accounted by a higher prevalence of celiac disease (Kim et al., 2016). For example, 25% of Americans reported to consume GF food in 2015 (a 67% increase compared to 2013), while less than 1% have been diagnosed with celiac disease (Bulka, Davis, Karagas, Ahsan, & Argos, 2017). Such discrepancy is even more noticeable for specific groups. For instance, 41% of a sample of 910 non-celiac athletes reported following a GF diet at least half of the time (Lis et al., 2015).

The popularity of GF products among individuals without celiac disease seems to be related to a widespread belief that GF diet is healthier and adequate to manage weight (Christoph, Larson, Hootman, Miller, & Neumark-Sztainer, 2018; Gaesser & Angadi, 2012). However, these alleged benefits of the GF diet have not been supported by systematic comparisons of the nutritional quality between GF and conventional products (e.g., Miranda, Lasa, Bustamante, Churruga, & Simon, 2014; Wu et al., 2015). In fact, research has shown several negative outcomes associated to a GF diet, such as increased fat and calorie intake, overweight prevalence and deficiencies in minerals and vitamins (for a review, see Reilly, 2016). In light of this evidence, simply adhering to a GF diet (or regularly consuming GF products) is unlikely to confer health benefits to the general population.

In contrast to research on other food claims, experimental research examining the impact of GF claims on food perception is still scarce. The available studies focused on the perception of “free-from” foods indicate that consumers perceive this type of products as more healthful than conventional ones. For example, Priven, Baum, Vieira, Fung and Herbold (2015) presented two identical packages of crackers, with the exception that only one contained a GF claim. Participants’ task simply consisted in selecting the healthier option and, as expected, the GF option was chosen

more frequently than the control package. Another recent study examining the influence of different “free-from” labels showed that GF bread, pasta and cookies were perceived as healthier than their conventional counterparts (Hartmann, Hieke, Taper, & Siegrist, 2018).

The current study aims to replicate these findings (i.e., impact of the GF claim on perceived healthfulness) and further examine if the impact of the GF claim also extends to other evaluative dimensions. Indeed, previous research has shown that food claims may also influence ratings of perceived caloric content, expected taste and level of processing (i.e., the amount of transformation a given food product underwent until its current stage; Prada, Garrido et al., 2017).

In contrast with previous studies (Hartmann et al., 2018; Priven et al., 2015), we manipulated the type of claim (i.e., GF vs. control) using a between-participants design to reduce the likelihood of task demands. We expected foods with the GF claim to be perceived as more healthful than products without such claims. Likewise, we also expected GF products to be evaluated as having fewer calories. Predictions for the other two dimensions were not as straightforward. Following past evidence, we expected participants to perceive GF products as tastier and less processed than control ones, showing a halo effect (see, Chandon & Wansink, 2007; Prada, Rodrigues, & Garrido, 2016). However, the GF label could also negatively impact these evaluations. For instance, it was recently suggested the existence of lay beliefs regarding the inferior taste of some GF products (Shin & Mattila, 2018) and these products could be perceived as more processed because some need to undergo particular transformations to remove gluten.

## **2. Method**

### **2.1 Participants and Design**

The sample included 208 Portuguese speaking individuals who volunteered to collaborate in an online study. Six of the participants were excluded because they reported to follow a GF diet due to medical recommendation (e.g., diagnosed with celiac disease). The final sample included 202 participants (63.2% female,  $M_{\text{age}} = 27.87$ ,  $SD = 10.72$ ; 55.0% were students and 40.1% were employed; 54.5% completed at least a college degree). Sample size was determined based on previous research (e.g., Prada, Garrido, et al., 2017; Priven et al., 2015).

The design included two factors: 2 (claim: GF vs. control) x 4 (product: flour, bread, rice, rice crackers). The second factor was manipulated within-participants.

## **2.2 Procedure and Measures**

All procedures were conducted in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki). Individuals were invited through social network websites to collaborate in a consumer behavior web survey (hosted in Qualtrics) about the perception and evaluation of food images. After reading the informed consent information and agreeing to participate, participants provided sociodemographic information (i.e., age, gender, occupation and education). The main task consisted of evaluating four packaged food products (flour, bread loaf, rice and rice crackers, presented in a random order)<sup>1</sup>. Participants were randomly assigned by the software to one of the conditions. In the experimental condition ( $n = 107$ ), we included a GF label (green circle with the crossed grain symbol and “gluten free” information) in the packages, whereas in the control condition ( $n = 95$ ) a similar label (green circle without verbal information) was placed in the same position (see example in Figure 1). Participants were asked to indicate their subjective evaluation

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<sup>1</sup> These images were retrieved from the webpage of an international grocery retailer and edited to remove nutritional information. The products were presented in color against a white background (500 × 500 pixels).



of each product in four evaluative dimensions using 9-point rating scales (“In my opinion, this product is...” 1 = *Not at all healthful/tasty/caloric/processed* to 9 = *Very healthful/tasty/caloric/processed*, Prada, Rodrigues, Garrido, & Lopes, 2017), presented in random order. Next, participants reported their dietary habits regarding gluten consumption (e.g., “I follow a GF diet because I was diagnosed with celiac disease by a healthcare practitioner”). This was followed by the assessment of their beliefs about the GF diet using 9-point rating scales (five items, “In your opinion, when compared to a conventional diet, the GF diet is...”, 1 = *Less caloric/healthful/adequate to weight loss/processed/natural* to 9 = *More caloric/healthful/adequate to weight loss/processed/natural*). Lastly, we assessed participants’ knowledge about GF products using 9-point rating scales. Specifically, they were asked to subjectively rate their knowledge (“How do you rate your knowledge about GF products?”, 1 = *Very low* to 9 = *Very high*) and then asked to indicate whether a group of 14 food products<sup>2</sup> typically contain gluten or not (1 = *Certainly does not contain gluten* to 9 = *Certainly contains gluten*).



Figure 1. Example of materials (bread) used in the GF and control conditions.

### 2.3 Data Analysis

<sup>2</sup> The products included the food exemplars used in the current study and 10 others selected on the basis of previous studies (e.g., Silvester, Weiten, Graff, Walker, & Duerksen, 2016). Some of the foods typically include gluten (i.e., wheat flour, wheat bread, sausages, seafood sticks, crispbread), and other foods typically do not (i.e., rice, rice crackers, milk, balsamic vinegar, cocoa, flavored yogurt, beans, corn).

To characterize our sample, we examined participants' beliefs about a GF diet by considering each belief separately, as well as by computing a general index comprising the five items ( $\alpha = .78$ ; items regarding caloric content and weight loss adequacy were reverse-coded). We also analyzed participants' self-reported knowledge about GF products and certainty about the gluten content of products. In these analyses, we compared mean scores against the scale midpoint (i.e., one-sample  $t$  tests, test value: 5). Moreover, we checked if the GF and the control groups differed regarding the beliefs about GF and self-reported knowledge (independent samples  $t$  test). To test our main hypotheses regarding the impact of the GF claim on food evaluation we conducted a 2 (claim) x 4 (product) mixed repeated-measures ANOVA for each of the four evaluative dimensions.

### **3. Results**

#### **3.1 Beliefs about GF diet and Knowledge about GF products**

Overall, participants evaluated the GF diet more positively ( $M = 5.57$ ,  $SD = 1.33$ ) than a conventional one,  $p < .001$ . No differences between the GF and control groups were found in the general beliefs index about these diets,  $t(200) = 0.23$ ,  $p = .818$ . Specifically, the GF diet was perceived as more healthful ( $M = 5.98$ ,  $SD = 1.77$ ), less caloric ( $M = 5.97$ ,  $SD = 1.56$ ) and as more adequate to weight loss ( $M = 5.70$ ,  $SD = 1.79$ ), all  $ps < .001$ , being equally rated, on average, as natural ( $M = 5.00$ ,  $SD = 1.91$ ),  $p = 1.000$ , and processed ( $M = 5.20$ ,  $SD = 2.06$ ),  $p = .173$ . Nonetheless, participants' self-reported knowledge about GF products was low ( $M = 3.30$ ,  $SD = 2.06$ ),  $t(201) = 11.74$ ,  $p < .001$ . Again, no differences between the GF and control groups were found in relation to knowledge about GF products,  $t(200) = 0.15$ ,  $p = .880$ .

Additionally, we also asked participants to indicate how certain they were about the gluten content of food products (see Table 1).

Table 1

*Judgments about the Gluten Content of 14 Food Products*

	<i>M</i>	<i>SD</i>
Typically GF		
Milk	4.76	2.98
Vinegar	3.06***	2.13
Rice	5.64***	2.75
Cocoa	4.49**	2.48
Oats	5.34	2.80
Rice Crackers	5.18	2.79
Yogurt (flavored)	4.71	2.81
Beans	3.70***	2.44
Corn	5.27	2.74
<i>Total</i>	4.68**	1.55
Typically with Gluten		
Flour (wheat)	7.56***	2.01
Sausages	5.00	2.66
Bread (wheat)	7.85***	1.81
Seafood sticks	4.04***	2.72
Crispbread	7.33***	1.93
<i>Total</i>	6.35***	1.30

*Note.* Response scale: 1= *Certainly does not contain gluten*; 9 = *Certainly contains gluten*. No differences between the GF and control groups were found for judgments about the gluten content of each food product, all  $t < 1$ .

Asterisks represent significant differences against the scale midpoint. \*\*\*  $p \leq .001$ , \*\*  $p \leq .010$ .

As shown in Table 1, judgments about gluten content varied according to the product. For products that are typically GF, participants were quite certain about the absence of gluten in certain cases (e.g., vinegar, beans), but unsure in other cases (e.g., milk, oats). For products that typically contain gluten, participants were certain about bread, flour and crispbread, and unsure about sausages. Notably, participants were quite certain that rice contains gluten (which is actually not the case) and that seafood sticks do not (even if they actually do).

### 3.2 Impact of the GF Claim on Food Evaluation

As expected, we found a main effect of the GF claim on perceived healthfulness,  $F(1, 200) = 4.93, p = .028, \eta_p^2 = .024$ , caloric content,  $F(1, 200) = 8.85, p = .003, \eta_p^2 = .042$ , and level of processing,  $F(1, 200) = 4.15, p = .043, \eta_p^2 = .020$ . As shown in Table 2, products with a GF claim were perceived as more healthful, less caloric and as less processed than the same products without such claim (i.e., control condition). However, no effects were detected for expected taste,  $F(1, 200) = 0.73, p = .396, \eta_p^2 = .004$ .<sup>3</sup>

There was also a main effect of type of product on healthfulness,  $F(3, 600) = 96.86, p < .001, \eta_p^2 = .326$ , caloric content,  $F(3, 600) = 114.77, p < .001, \eta_p^2 = .365$ , taste,  $F(3, 600) = 68.80, p < .001, \eta_p^2 = .256$ , and level of processing,  $F(3, 600) = 44.23, p < .001, \eta_p^2 = .181$ . For example, post-hoc comparisons showed that bread was rated as the least healthful, all  $ps < .019$ , the most caloric, all  $ps < .004$ , and the most processed product, all  $ps < .001$  (see Table 2).

Results showed that claim did not interact with product for healthfulness,  $F(3, 600) = 0.95, p = .417, \eta_p^2 = .005$ , neither for level of processing,  $F(3, 600) = 1.78, p = .151, \eta_p^2 = .009$ . Instead, there was a significant interaction for caloric content,  $F(3, 600) = 5.05, p = .002, \eta_p^2 = .025$ , and for taste,  $F(3, 600) = 7.75, p < .001, \eta_p^2 = .037$ . Planned contrasts showed that GF (vs. control) bread,  $t(200) = 3.83, p < .001, d = 0.54$ , and rice,  $t(200) = 3.33, p = .001, d = 0.47$ , were perceived as less caloric. Furthermore, GF (vs. control) rice crackers were rated as tastier,  $t(200) = 2.13, p = .035, d = 0.30$ , whereas GF rice was rated as less tasty,  $t(201) = -4.63, p < .001, d = 0.65$ .

Table 2

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<sup>3</sup> The impact of GF label on food evaluation was not moderated by beliefs toward GF diet, all  $ps > .224$ , or subjective knowledge about GF products, all  $ps > .411$ .

*Means and Standard Deviations for Each Dimension According to Claim and Food*

*Product*

	Flour		Bread		Rice		Rice Crackers		Total	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Healthfulness										
Control	4.77	(1.57)	4.19	(1.98)	6.12	(1.47)	6.54	(1.69)	5.40 <sup>l</sup>	(1.08)
Gluten Free	5.12	(1.55)	4.79	(1.92)	6.42	(1.57)	6.65	(1.63)	5.75 <sup>2</sup>	(1.13)
Total	4.96 <sup>b</sup>	(1.56)	4.52 <sup>a</sup>	(1.97)	6.28 <sup>c</sup>	(1.53)	6.60 <sup>c</sup>	(1.66)		
Calories										
Control	5.42	(1.81)	6.17	(1.58)	5.55	(1.54)	3.18	(1.44)	5.08 <sup>2</sup>	(1.04)
Gluten Free	5.11	(1.80)	5.29	(1.67)	4.80	(1.62)	3.32	(1.70)	4.63 <sup>l</sup>	(1.09)
Total	5.26 <sup>b</sup>	(1.81)	5.70 <sup>c</sup>	(1.68)	5.15 <sup>b</sup>	(1.62)	3.25 <sup>a</sup>	(1.58)		
Taste										
Control	4.11	(2.02)	5.23	(2.08)	7.03	(1.51)	4.04	(2.28)	5.10 <sup>l</sup>	(1.18)
Gluten Free	3.91	(2.03)	5.26	(2.04)	5.94	(1.82)	4.73	(2.30)	4.96 <sup>l</sup>	(1.23)
Total	4.00 <sup>a</sup>	(2.02)	5.25 <sup>b</sup>	(2.05)	6.45 <sup>c</sup>	(1.77)	4.41 <sup>a</sup>	(2.31)		
Processing										
Control	5.57	(1.89)	6.84	(1.88)	4.71	(1.81)	5.53	(1.82)	5.66 <sup>2</sup>	(1.08)
Gluten Free	5.16	(2.02)	6.13	(1.78)	4.51	(1.63)	5.54	(1.77)	5.33 <sup>l</sup>	(1.18)
Total	5.35 <sup>b</sup>	(1.97)	6.47 <sup>c</sup>	(1.86)	4.60 <sup>a</sup>	(1.71)	5.53 <sup>b</sup>	(1.79)		

*Note.* Means in the same line – <sup>a,b,c,d</sup> – refer to the main effect of food product (Bonferroni adjustment for multiple comparisons). Means in the same column – <sup>1,2</sup> – refer to the main effect of claim. In both cases, means with identical superscripts did not differ significantly.

**4. Discussion**

Free-from products are a widespread trend, particularly GF options of an array of processed foods (from flour and bread, to desserts and candy). In this study, we examined how the inclusion of a GF label shapes the way consumers perceive food products. Overall, our results suggest that participants inferred positive attributes based on this label and are consistent with a halo effect (see Prada et al., 2016). Indeed, not only GF products (vs. control) were perceived as more healthful (e.g., Priven et al., 2015), but also as less caloric and less processed. In some cases, however, the impact of the claim was moderated by the type of product. For instance, the advantage of including a GF label on caloric content was only observed for bread

and rice. For expected taste, there was also an advantage of the GF label for rice crackers. In contrast, participants reported a negative expectation regarding the taste of GF rice.

Results also showed that, although participants report having low knowledge about GF products, they view GF diet more positively than a conventional one (e.g., more healthful and adequate to lose weight). Arguably, these positive beliefs are likely to be associated with the acceptance of GF products among non-celiac individuals. To further understand this matter, a comprehensive assessment of shopping patterns and consumption habits of GF products should be included in future studies. Moreover, our study does not allow to conclude if our findings were due to the impact of the specific GF label or reflect a general positivity to “free-from” products. For example, Priven et al. (2015) found that a factitious claim (i.e., “MUI-free”) produced a pattern of results (i.e., increased perceived healthfulness) similar to the GF claim. This hypothesis should also be tested in future studies.

We assessed the impact of the GF claim in the evaluation of four products, which contrasts with the single product approach in previous research (e.g., Priven et al., 2015; Shin & Mattila, 2018). Still, in order to test the generality of the effect, it is also relevant to further extend the number of food exemplars under evaluation. Moreover, it would be important to compare the impact of the GF claim in the evaluation of different types of foods (e.g., less vs. more processed; hedonic vs. utilitarian). For example, the level of processing of food has shown to moderate the impact of an organic claim (e.g., Prada, Garrido, et al., 2017).

## **5. Conclusion**

The current findings indicated that, overall, participants reported a low level of knowledge about GF products and were unsure about the gluten content of several

food items. Nonetheless, they reported having positive beliefs about the GF diet (e.g., more healthful and more adequate to weight loss than a conventional diet). These positive expectations about GF products were also observed in the evaluation of food exemplars.

Importantly, we showed that the impact of a GF claim is not restricted to the healthfulness dimension, but also extends to the perception of how caloric and processed a food product is. Our findings are therefore relevant for the development of evidence-based interventions and policies aimed to promote awareness about the impact of GF claims on food perception. Specifically, it is important to help consumers assess the nutritional quality of GF products in order to prevent potential bias, and ultimately facilitate healthier food choices.

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