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Performance of the Nutri-Score and Warning Labels in Identifying the Healthier Product. Rendimiento de la Nutri-Score y de las etiquetas de advertencia en la identificación del producto más saludable.

Isaac Orzuna Flores [a], Rafael López Pérez [b]

[a] Université de Bourgogne Franche-Comté, Besancon, France.
[b] Evidentia University, Kissimmee, Florida, USA.
Contact email: isaac.orzuna_flores@edu.univ-fcomte.fr

ABSTRACT

Different types of Front-of-Package (FOP) have been designed around the world to help consumers assess the healthiness of foods and promote healthier options. An online study was conducted with Mexican and Spanish consumers to compare the current Mexican warning labeling system and the European Nutri-Score, which has been adopted by Spain and other European countries. 156 participants were asked to choose between 30 pairwise comparisons. When employing the British FSA/Ofcom nutrient profile score to measure product healthiness, the Warning Label System provided the most accurate results in determining the healthier of two yogurt brands in comparison to the Nutri-Score and the control condition.

RESUMEN

En todo el mundo se han diseñado diferentes tipos de información en la parte frontal del envase (FOP) para ayudar a los consumidores a evaluar la salubridad de los alimentos y promover opciones más saludables. Se realizó un estudio en línea con consumidores mexicanos y españoles para comparar el actual sistema mexicano de etiquetado de advertencia y el europeo Nutri-Score, que ha sido adoptado por España y otros países europeos. Se pidió a 156 participantes que eligieran entre 30 comparaciones por pares. Al emplear la puntuación del perfil nutricional británico FSA/Ofcom para medir la salubridad de los productos, el sistema de etiquetado de advertencia proporcionó los resultados más precisos para determinar la salubridad de dos marcas de yogur en comparación con la Nutri-Score y la condición de control.

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Semáforo múltiple
Nutri-score
Etiquetas de advertencia
Evaluación de la salubridad
Nutrición

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1. Introduction

In the light of the current obesity and diabetes epidemic, governments and organizations are considering the role of processed packaged food consumption effects on human health. The use of Front-of-Pack labeling has been a strategy that health agencies have adopted to promote the consumption of healthier food options in packaged food. As the consumption of packaged food has become more frequent, nutrition education has also an important role to provide consumers with useful information to help them decide.

Around the globe different Front-of-Pack labels have been tested and implemented that can vary on the information presented such as nutritional facts, health warnings, specific nutrients, or in their design. However, there is an ongoing debate on the effectiveness of the use of these different labels and their role in helping consumers make better decisions.

Recently behavioral economics research has shed some light on how consumers make decisions and help them face everyday challenges, with strategies such as nudging (Thaler & Sunstein, 2009). As information is important but not enough, nutritionists and economists have included behavior change techniques. Thus behavioral economics principles (Guthrie, 2017) should be included in information strategies, possibly enhancing their efficacy and acknowledging that consumers seek heuristics that will simplify food choice decisions.

Therefore, the use of Front-of-Pack labels can be a strategy for both providing information and promoting behavior change. The use of labels is also not limited to food choices but has also been useful for consumer decision-making in different fields and products like financial products or food (Drescher et al., 2014).

Among the different Front-of-Pack labels this research will be focusing on two that have grown in usage between several countries. First, the Nutri-Score is a traffic-light label system that uses a five-color scale and a letter associated with it to evaluate the healthiness of the product. Recently the governments of France, Belgium, Germany, Luxembourg, the Netherlands, Spain, and Switzerland announced a coordination framework for the use of the Nutri-Score nutrition label on front-of-pack packaging.

The second is the Chilean Warning Label system, which was first introduced in 2016 and consists of the black octagon (similarly as a stop sign) for all foods that exceed the limit established in the number of critical nutrients (sugars, sodium, calories, saturated fat). This system now has been adopted by Chile, Peru, Mexico, and Uruguay.

Both Front-of-Pack labels have been adopted in two different regions and growing in popularity. However, are the front-of-pack labeling schemes helpful in identifying healthier products? And which front-of-pack nutritional label is more effective?

This study has two objectives. First, seek to measure the effectiveness of nutrition labels by conducting an online experiment comparing the two front-of-pack labels to a control condition. Second, compare the effectiveness of two of the label systems in place, the Nutri-Score, and the Chilean Warning System, and determine which one was more helpful.

The significance of this study rests on the comparison of these two specific labels as to the best of our knowledge there has not been a comparison between these two systems that are now widely used in several countries.

2. Literature review

Dietary indicators are linked to the development of chronic illnesses such as heart disease, stroke, obesity, and diabetes, as strong evidence indicates (Astrup, 2001; Calder et al., 2011; Joint WHO/FAO Expert Consultation, 2003; Kromhout et al., 2002).

In Latin America this has been especially challenging for the health system as the number of cardiovascular diseases is on the rise (Anauati et al., 2015). Therefore, the need for evidence-based public policies that help reduce the current health epidemic (Roberto et al., 2014)

For consumers to make healthier decisions they must differentiate between non-healthy and healthy products. While consumers are presented with the ingredients list, however only a low proportion of consumers consider the ingredient list a source of information (Cheung et al., 2016)

Food and beverage companies are encouraged to enhance the nutritional content of their goods by using nutrition labels. This is also of the secondary positive effects of labeling, that the presence of labels on food packages creates an incentive for the food industry to reformulate their products and offer healthier options (Kanter et al., 2018).

While governments have created a variety of Front-of-Pack labels to help consumers in making better-informed decisions, only research can speak about its efficiency. Among the different labels that exist, Guidelines Daily Amounts (GDA) explains how much of a portion of the recommended number of calories, sugars, fat, saturated fat, and salt that an average adult should consume in a single day.

Another popular label is the Multiple Traffic Light (MTL) system which is a color-coded system also known as the traffic-light labeling system. It shows energy and fat, saturates, sugar, and salt with colors helping consumers in determining how 'healthy' a product is. The government agencies have to determine the red, amber, and green colors, levels in a piece of food or drink.

Furthermore, a new system was developed in Chile (Reyes et al., 2019) displaying effectivity of warnings labels to alert consumers when the levels of a specific threshold of energy, salt, saturated fats, or sugar have been surpassed. The Chilean government established this labeling in 2016 and it has been shown that there has been a positive impact by reducing consumption of regulated products (Quintiliano Scarpelli Dourado et al., 2021; Taillie et al., 2021). Also considering that regulated foods cannot be advertised to children under 14 years.

This allows consumers to make an informed choice and promotes the reformulation of products. As producers of packaged foods reduced the content of sugar, energy content, and fat for their products (Quintiliano-Scarpelli et al., 2020; Reyes et al., 2020). With also consumer reducing their consumption of the regulated products, especially true for sugar-sweetened beverages (Krieger et al., 2020)

Comprehensive research has been performed in comparing different nutritional labels in different countries. According to studies based on eye-tracking methodology, Front-of-Pack labels, particularly those that employ a traffic light system, are more able to grab consumers' attention (Becker et al., 2015; Jones & Richardson, 2007), compared to the GDA label system. Another eye-tracking study (Tórtora et al., 2019) now employing nutritional warnings found that they were more effective at grabbing customers' attention and took less time and fixations to comprehend than the facts on the front panel. Furthermore, their presence on the labels greatly reduced the number of labels available to customers.

In Mexico, the GDA was first established as a voluntary label in 2011, and in 2016 was established as a mandatory FOP. However, there is growing evidence (De la Cruz-Góngora et al., 2017; Stern et al., 2011; Tolentino-Mayo et al., 2018) that GDA labels have a complex quantitative format, these studies have demonstrated that the Mexican people have a problem understanding and interpreting the information presented.

As a result, in 2020 Mexico decided to implement the Warning Label (WL) system on packaged foods, for consumers to make a better purchase decision based on nutritional criteria. While it is still a little early to see results, mathematical models have been done showing a positive impact on the implementation of the Warning Labels (Basto-Abreu et al., 2020).

Another comparison between Front-of-Pack labels (Vargas-Meza et al., 2019) shows that MTL and WL were preferred by a higher percentage of participants, who thought they were appealing and had a reduced perceived cognitive effort. In comparison to the GDA system, WL or MTL may encourage healthier food choices in Mexico's low- and middle-income consumers.

In 2018, Spain decided to use the Nutri-Score which was created in France and is now implemented by several European countries. The Nutri-score is considered as a summary indicator system that provides a global evaluation of the product is carried out with positive or negative results, considering favorable and unfavorable criteria. While the implementation of the Nutri-score has been recent, it has been shown (Julia & Hercberg, 2017) that it can adequately characterize the nutritional quality of foods.

More studies (Ducrot et al., 2015; Egnell et al., 2018; Hagmann & Siegrist, 2020) have shown that Nutri-score has been found to be more effective for consumer health choice than other labeling systems. Particularly, Hagmann & Siegrist (2020) have also shown that compared to the MTL or the nutrition fact table, the Nutri-score nutrition label led to the greatest accuracy in identifying the healthier option.

Additionally, Hagmann & Siegrist (2020) declare that the label must be present in all products so the comparisons for consumers to compare products effectively. In many situations, however, the use of nutrition labels is currently not mandatory in Spain (Kanter et al., 2018) however the discussion is still in progress.

For these reasons, this study proposes to compare two interpretive Front-of-Pack nutrition labels (Warning Label and Nutri-Score) identifying how well consumers evaluate the healthiness of yogurt products. A variety of yogurt products was supplied by the same retailer, all of which are actual brands accessible in shops, to create a somewhat realistic shopping-choice situation. We selected yogurt due to its nutritional variability, in terms of sugar, energy, and fat content. Additionally, this study intends to determine if the Front-of-Pack labels are indeed more effective in helping consumers identify the healthier choice compared to the controlled condition.

3. Methodology

To perform the study the purpose was to design an online survey, to ask participants between two options and measure the accurateness of their choice. For this, we conduct an online study that consists of a survey and a short questionnaire. The survey consists of a comparison between pairwise combinations of different yogurt brands with three different conditions.

The Ofcom/ FSA NP score of each food was determined based on its nutritional content to evaluate the relative healthiness of the 15 yogurt brands (FSA UK, 2013; see Appendix 1). The score is based on the nutritional content per 100 g of a specific item and offers an objective and verified assessment of a food's healthiness. The final score might vary from –15 to 40, with higher values indicating a worse level of health.

Foods with a score of 4 or higher are considered 'less healthful' (for more details, see FSA UK, 2013) compared to the -5 score obtained by another product. The health classification is calculated according to 'A' and 'C' points, 'A' can range between 0 and 10 points which are assigned for each unhealthy aspect (i.e., for the quantity of energy, total sugar, saturated fat, and sodium), and the 'C' points represent the healthy aspect, they range between 0 and 5 and they are assigned depending on the number of fruits, vegetables, and nuts, fiber, and protein that the product can contain. To obtain, the Ofcom/FSA NP score, the 'C' points are subtracted from the 'A' points and the final score can range between –15 and 40, with lower scores indicating a healthier product.

If the product with the lower NP score (meaning it is healthier) was chosen in the pairwise comparison, the replies were counted as correct. The options were categorized as not different if the difference in the NP score was minor (i.e., between 0 and 1 point), and both alternatives were therefore counted as correct. Appendix 1 lists the Ofcom/FSA NP ratings for each yogurt brand food utilized in the investigation.

3.1 Selection of products

We selected several yogurt products from the same retailer store in Mexico to guarantee a real-world scenario where consumers must choose between products.

The following criteria adopted by one previous study performed by Hagmann & Siegrist (2020) it was applied and assessed for the selection of products:

- Selected products should come from the same retailer store.
- Selected products ought to exhibit variability in their healthiness (in the content of fat, sugar, and calories), flavor, type, ingredients, and origin to ensure variability in the labels.
- The products should not be overly similar (e.g., if two products have the same Ofcom/FSA NP score).

3.2 Selection of front-of-pack labels.

Our study intends to compare the efficacy of different front-of-pack labeling schemes that are currently in use

in Mexico against the Nutri-Score which is a scheme that has been adopted in a few European countries.

While many of the Front-of-Pack labels have been tried around the world, they have been designing considering the nutritional information but not considering how humans make decisions and which way we can help consumers take the healthier option.

Therefore, the participants of our study were presented one of the following schemes:

a) Control condition. In this scheme, participants were only shown the product alone without any additional nutritional information.

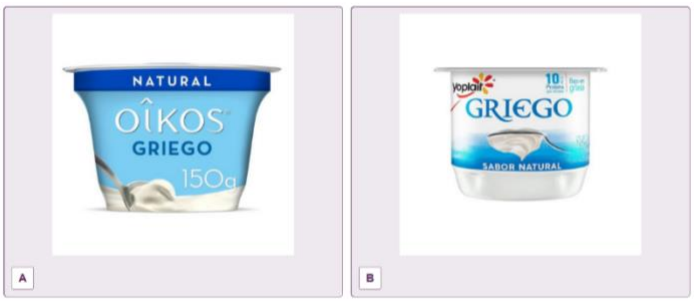
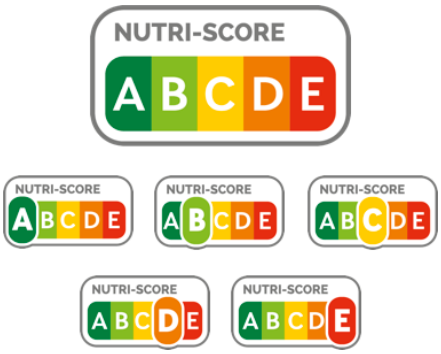


Figure 1: Control condition comparaison.



b) Nutri-Score. An adaptation of the Nutri-Score is currently used in the UK and some other European countries that are adopting it. There are three categories represented by a capital letter from A to E, in which A represents the healthier option. The letters are assigned based on the NP system of the FSA UK, 2013, that provides a score based on the nutrition contents of the product.

Figure 2: Nutri-Score labeling example

c) Health warning label. In Chile, black-shaped warnings (similar to stop signs) were first introduced in 2016 for packaged food and drinks that exceed the limits for sugar, salt, saturated fat, or calories. This scheme was adopted in Mexico in October 2020. And they use the 'High in' (or '*Alto en*' in Spanish) to signal high levels of one nutrient according to the country's daily nutrition guidance.

Figure 3: Warning label in use in Mexico.

3.3 Procedure

Define the healthiness of each of the products selected based on Ofcom/FSA NP score, to be able to determine whether consumers are choosing the healthier option in the random comparisons.

After selecting the products and determining the healthiness score, we created the product pairwise comparison, for participants in the survey to choose the healthier option among the products available. And then determine if the responses are correct based on their decision.

Figure 4: Illustration of comparison presented to participants with Warning Label system.

To do this we need to gather participants living in Mexico who are currently exposed to the GDA's, Chilean scheme and comparing it to the Nutri-score. After randomly assigned one type of scheme to each participant we have analyzed the data to see with which system the participants are able to choose the healthier product.

3.4 Data collection and participants.

The participants were recruited from Mexico and Spain, through Facebook advertisements. Participants were given a link they had to click, and a link rotator was employed to be able to randomize the surveys, the control

condition, and both labels to be compared. Then using the platform *Typeform*, they had to answer one of the three surveys, in which a short questionnaire was also included.

In total 156 participants completed the online study, Table 1 lists the number of participants in each condition, as well as the gender, age, of each participant who remained in the study (N = 156); these are reported separately for each of the three conditions and the overall sample. And the study was conducted in Spanish as both countries are populated by mainly Spanish-speaking populations.

Table 1. Characteristics of the consumer sample and each of the experimental groups.

Characteristic	Total (n = 156)	Control (n = 50)	Nutri-Score (n = 54)	Warning system (n = 52)
Gender				
Female	91	27	32	32
Male	64	23	22	19
Age				
18-25	26	10	7	9
26-35	71	21	28	22
36-50	30	8	11	11
More than 50	24	11	5	8
Country				
Mexico	127	41	45	41
Spain	28	9	9	10
Yoghurt frequency consumption				
Occasionally or rarely (0-2 times per week)	54	21	14	19
Sometimes (3-5 times per week)	79	24	29	26
Very often or daily (6-7 times per week)	22	5	11	6
Usefulness of the FoP label				
Not to slightly useful (0-2)	18	-	5	13
Somewhat useful (3-5)	47	-	22	25
Very to extremely useful (6-7)	40	-	27	13

Participants were asked if they experienced red-green color blindness or had trouble distinguishing between green, amber, and red before the experiment. In all, 4 individuals said they experienced one of these issues with their color vision. Most of the participants were in the 26 to 35 age range and 81% of participants coming from Mexico.

Regarding the consumption of yogurt, 50% of participants declared to consume 3 to 5 times a week yogurt. And regarding the usefulness of the Front-of-Pack label (a question that only appeared to the participants in

the Nutri-score and Warning Label conditions), 50% of participants in the Nutri-score condition found the label very to extremely useful which was higher than the 25% in the Warning Label condition.

The data analysis was performed using the R studio software (version 1.4.1717). To compare the three experimental conditions (control, Warning Label, Nutri-Score) for their proportion of correct choices ANOVA analysis of variance was used, as the homogeneity of variances assumption for ANOVA was not violated. And to test differences between conditions, Tukey's test was used for post hoc comparison of means with a significance level of 5% ($p < .05$) was considered.

The proportion of accurate selections was computed, as in a prior study (Hagmann & Siegrist, 2020). This metric takes into consideration the magnitude of the correct in the healthiness ratings – that is, how much the compared items differed in terms of their healthiness.

4. Results

In all situations, the median proportion of comparisons in which the healthier snack food (as defined by the Ofcom/FSA model) was properly recognized was considerably greater than the chance likelihood (i.e., 50%).

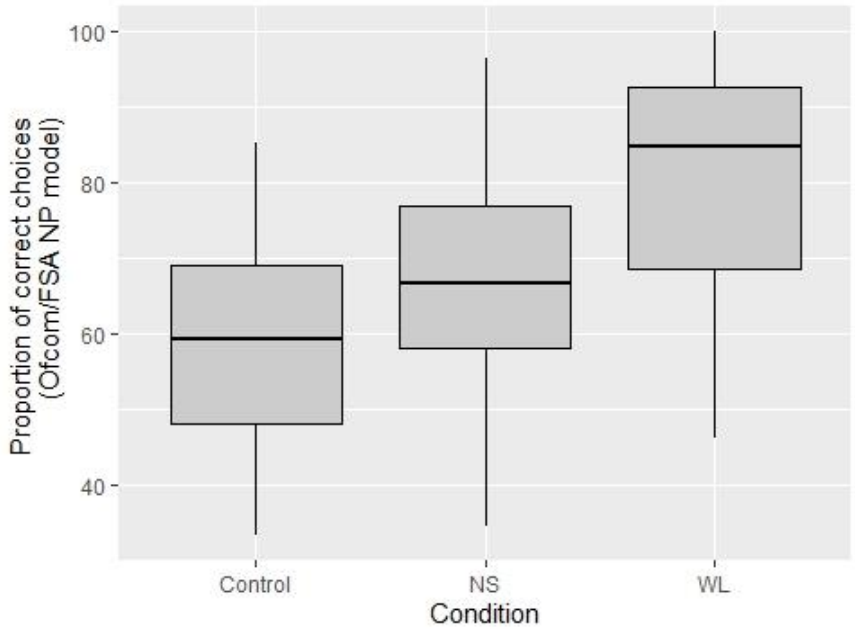


Figure 5: Boxplots of the proportion of correct choices in the three conditions.

One Way ANOVA test revealed that the three conditions significantly differed in the proportion of correct choices; $F(23.2)$ ($p < 0.001$). We also estimated the effect size using the partial eta-squared ($\eta^2=0.2327$),

suggesting a small effect size of the Front-of-Pack labels.

The Tukey post hoc tests showed that the participants in the Warning Label (M = 80.03, SD =15.90) condition made the most correct evaluations compared to participants in each of the two other conditions ($p < 0.001$).

Nutri-score (M = 65.95, SD =15.53) participants gave higher average healthfulness ratings than the control condition (M=59.55, SD=14.69), however when performing Tukey's test we found no significant differences between the means.

Most nutrition labels, which provide unambiguous and easy-to-understand nutrition information, are seen as a key method for assisting customers in identifying healthier food options and, perhaps, promoting healthier food choices. However, there is still no agreement on which format is ideal for communicating nutrition facts.

Our findings demonstrate that, even in the lack of explicit nutrition information on product packaging, consumers have an intuitive ability to reliably assess the relative healthiness of yogurt brands, which is considerably higher than chance or guesswork.

Table 2. Post hoc Tukey's test.

Condition				
	Mean differences	Lower	Upper	P-value
NS-Control	6.84	-0.34	14.04	0.065812
WL-Control	20.47	13.21	27.73	0.000000
WL-NS	13.62	6.50	20.75	0.0000356

At the 95% confidence, we observe that the Nutri-Score condition is not significantly different than the control condition. But there is a clear difference from the Warning Label condition as its mean is significantly different than the rest of the conditions.

5. Discussion

One of the public policies that may be implemented to increase consumer capacity to identify healthy and unhealthy food products is to include nutrition labeling on the front of the package (Hawley et al., 2013). Front-of-Pack nutrition labels with explanations assist consumers in identifying healthier yogurt brand selections.

The current study looked at two Front-of-Pack nutrition labeling methods that varied in how well they help consumers evaluate product healthfulness: Nutri-score and the Warning Label system. With one informing of the overall nutritional properties of the product and the other one warning consumers on the excess of certain nutrients.

According to previous research (Borgmeier & Westenhoefer, 2009; Ducrot et al., 2015; Gorski Findling et al., 2018), interpretive FOP nutrition labels, such as WL and the Nutri-Score labels, lead to greater accuracy in choosing healthier food options than the control condition. But in this study, we confirm this information for the control Warning Label condition but not entirely for the Nutri-Score.

The Chilean Warning System was shown to be superior to the control condition for helping consumers choose the healthier option. However, and the Nutri-Score even with a higher mean than the control condition does not prove to be significantly higher than the control condition. Similar studies (Arrúa, Curutchet, et al., 2017; Arrúa, Machín, et al., 2017; Lima et al., 2018) have shown similar results when comparing the traffic signal system to warnings According to these authors, warnings had a greater impact on consumers' perceptions of the healthfulness of goods with an unfavorable nutritional profile than traffic lights and were more effective in discouraging the purchase of unhealthy products.

This is also in line with research that compares to a more diverse arrange of Front-of-Pack labels, such as Multi Traffic Light, GDA, and WL, and they have found warning labels to be more effective in advising consumers when the packaged food exceeds the recommended levels of one nutrient (Neal et al., 2017). This difference can be explained by the fact that warnings solely emphasize high nutritional content and, as a result, clearly transmit the concept that items are unhealthy. Therefore, future studies should investigate the psychological effects of the warnings against all other types of labels to identify unhealthy products.

Some limitations of the present study are that findings are based on a hypothetical choice of items, a health aim was produced by the task description, and a non-representative sample of respondents from two countries was used, which are all limitations of this study. Even when the study was not done in a real retail setting, it employed a sample of yogurt brands that were representative of the range of products Mexican customers may see in real-world grocery shopping circumstances.

Furthermore, effects of using Front-of-Pack labels were not found when consumers choose according to preference (Aschemann-Witzel et al., 2013), as in the situation where consumers were asked to decide by preferences the results tend to vary as health motivation might be a major element in determining whether or not the FOP labeling is used. This can imply that for FOP schemes to be effective in changing consumer

behavior, a consumer propensity to consider health in their food choices is required. Hence these labels need to be reinforced by advertising campaigns that favor healthy choices when consumers perform their grocery shopping.

While Front-of-Pack nutrition labels have been found effective for determining the healthy option than the lack of (Machín et al., 2018), they may not be chosen by the consumer as they can still choose by preference/taste as although consumers evaluate the nutrition table most positively, it receives little attention and does not stimulate healthy choices (van Herpen & Trijp, 2011).

For measuring the healthiness of products, it is worth mentioning the well-rounded Ofcom/FSA approach for classifying foods based on their healthiness, also the Nutri-Score app is a quick method for measuring the healthiness of products giving an overall score of the nutrients of products. Still, the Chilean Warning Label System was found helpful in warning consumers to identify unhealthy products, as it warns consumers of certain nutrients surpassing the recommended levels.

More research is needed to compare the Nutri-score and Warning Labels to other systems in terms of label use in different food categories and food choices in real-world scenarios. And if the Warning Label is more effective it needs to be seen whether this conclusion holds true when comparing with various label formats.

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7. Appendix 1.

Product name	Product description	Brand	Energy kcal/100 g	Fat g/100 g	Saturated fat g/100 g	Carbo-hydrates g/100 g	Added sugars g/100g	Total sugar g/100 g	Dietary fibre g/100 g	Protein g/100 g	Nurtri-Score	UK Ofcom/FSA nutrient profiling score
Yogurt Chobani	Estilo griego natural sin grasa 150 g	Chobani	50	0	0	4	0	4	0	10	A	-5
Yoghurt Lala	Griego sabor natural 120 g	Lala	147	7	4.3	15.8	11.4	15.3	0	5.3	C	4
Vitalinea Triple Cero%	Estilo griego natural 125 g	Vitalinea	68.8	0	0	10.6	0	8.6	0	6.6	A	-3
Yogurt Santa Clara	Natural 125 g	Santa Clara	76.97	2.45	1.44	8.45	0	8.45	0	5.28	A	-1
Yoghurt Yoplait	Griego natural bajo en grasa 145 g	Yoplait	84	2.2	1.2	8.7	2	8.7	0	7.3	A	-2
Yoghurt Oikos	Estilo griego natural 440 g	Danone	120.1	5.3	3.4	13.3	8.5	12.5	0	4.8	C	3
Yoghurt Yoplait	Griego fresa bajo en grasa 145 g	Yoplait	78	1.8	1	9.2	1.9	7.8	0.3	6.2	A	-1
Yoghurt Oikos	Estilo griego con fresa en el fondo 150 g	Danone	120.7	4.3	2.8	16.5	11.3	15.2	0.2	4	C	3
Yogurt Chobani	Estilo griego con fresa 150 g	Chobani	76	0	0	11	7	10	0.5	8	A	-2
Yogurt Santa Clara	con fresa 125 g	Santa Clara	91.84	1.6	0.98	16	10.14	15.62	0	3.36	B	1
Yoghurt Lala	Griego sabor frutos rojos 120 g	Lala	150	6	3.7	19.3	14.5	18	0	4.6	C	5
Yoghurt Alpura	Batido con mango 125 g	Alpura	94	2.2	1.4	15.5	12	15.5	<1	3.1	C	3
Yogurt Santa Clara	con mango 125 g	Santa Clara	96.88	1.6	0.97	17.2	10.76	15.28	0	3.42	B	1
Yoghurt Lala	con mango 120 g	Lala	97	1.7	1	17.2	10.5	15.8	0.1	3.3	B	1
Yoghurt Yoplait	Griego mango sin azúcar bajo en grasa 145 g	Yoplait	67	1.8	1.1	6.8	0	6.4	0.1	6	A	-1