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RESEARCH ARTICLE

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Valuation of nutritional and health claims for yoghurts in Spain: A hedonic price approach

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Abstract

This article investigates price effects of nutritional claims (NC) and health claims (HC), in addition to other attributes, on yoghurts in the Spanish market. Prices and product characteristics are collected from yoghurt label references found on the shelves of the main representative retail shops in the capital city of Aragon (Zaragoza) Spain. The total sample included 508 yoghurts. Nutritional and health claims (NHCs) are selected based on the official definitions of the (EC) Regulation No 1924/2006 and No 432/2012. Premium prices of the NHCs and other attributes included were assessed through a hedonic price approach. Results show that yoghurt is a highly differentiated food product. NCs related to fat-free, low in sugar and fiber content did not affect yoghurt prices while most of the health claims received significant positive effects. Health claims outperform nutritional claims leading to higher premium prices. These findings are a useful source in a better understanding of the evolution of NHCs in the Spanish market. Our findings suggest that NCs accompanied by the corresponding HC, which exactly defines the benefits of that nutrient in our health may be a promising strategy for product differentiation.

Additional keywords: hedonic price analysis; functional food; nutritional claims; health claims.

Abbreviations used: EU (European Union); HC (health claims); INFORMAS (International Network for Food and Obesity Research, Monitoring and Action Supporting); NC (nutritional claims); NHCs (nutritional and health claims); WTP (Willingness To Pay).

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Introduction

Developing functional food with increased health benefits and acceptable sensory properties has been one of the main objectives of the food industry for the past 20 years. In Europe, consumers' demand for healthier food products is rising continuously with special concern toward nutritional aspects. Increased awareness in health issues has led to an increase consumption of functional dairy products, and more specifically yoghurts enriched with nutrients. Yoghurt is obtained through a fermentation process of milk active bacterial cultures and by-products (Serafeimidou *et al.*, 2012) that can be used as a vehicle for probiotic cultures (Lourens-Hattingh & Viljoen, 2001), and it is associated with a healthy dietary pattern (Cormier *et al.*, 2016). The consumption of sufficient amounts of yoghurt live microorganisms[1] promotes health benefits (WHO/FAO, 2001). Such benefits include a reduction risk of type 2 diabetes (Diaz-Lopez *et al.*, 2015), reduction in weight gain (Mozaffarian *et al.*, 2011) and prevention of certain cardiovascular diseases (Astrup, 2014).

Commercial yoghurt has created a widely segmented market offering a variety of functional products whose nutritional and health benefits are reported in nutritional

[1]Live and active culture yoghurts must contain an amount of ≥ 108 organisms/g live Lactic Acid Bacteria (LAB) (Desobry-Banon *et al.*, 1999). According to the USDA's ChooseMyPlate website, for anyone over the age of 9, the recommended dairy product intake is 3 cups (735 g) per day, out of which, 1 cup (245 g) is yoghurt (USDA-The Food Guide Pyramid, 1992).

claim (NC) and health claim (HC). One of the hurdles in the success of these products is that a nutritional or/ and a health benefit delivered by a functional food is a credence attribute[2] which cannot be easily recognized even after repeated consumption. Products that are characterized by credence attributes may result to asymmetric information. In order to fill this gap, the European Union (EU) has introduced regulations[3] with a main objective to reduce the asymmetric information, guarantee truthful and understandable claims by the 'average consumer' and aim in healthier informed food choices.

Within the European context, recent studies on consumer preferences and willingness to pay (WTP) report distinct preferences among consumers from different countries for NCs and HCs. More specifically, a study of Van Wezemael *et al.* (2014) investigates consumer preferences for nutritional and health claims (NHCs) on lean beef steak in four EU countries (Belgium, France, the Netherlands and United Kingdom) found that in Belgium, the Netherlands and France, NHCs on saturated fat yielded higher utilities than claims on protein and/or iron, while the opposite was found among consumers in the UK. On the other hand, studies conducted in different countries covering a broad range of issues including consumers' attitudes and perceptions (Urala & Lahteenmaki, 2007; Masson *et al.*, 2016), preferences (Betchtold & Abdulai, 2014; Annunziata & Vecchio, 2016) and WTP for functional food products with NHCs (Hellyer *et al.*, 2012; Hirogaki, 2013; Cavaliere *et al.*, 2015; de-Magistris & Lopez-Galan, 2016; Jurado & Gracia, 2017; Lopez-Galan & de-Magistris, 2017) found that health-conscious consumers have positive perception and are willing to pay premium prices for food products with NHCs. Others indicate that healthier perceptions and acceptance of functional foods with NHCs depend on the ingredients and their combination within the product. More specifically, Landström *et al.* (2009) and Cox *et al.* (2011) found that consumers have healthier perceptions and positive acceptance of food products when the bioactive ingredient is 'naturally added' or inherited. Results are also confirmed by previous studies (Chase *et al.*, 2009; Krutulyte *et al.*, 2011) who found that consumers have negative perceptions toward yoghurts enriched with omega 3 because the combination of this ingredient is perceived to be artificial. On the other hand, Krutulyte *et al.* (2011) and Ares & Gámbaro (2007) found positive attitudes on dairy products enriched with calcium rather than antioxidants and iron since the functional component (calcium) is 'naturally' inherited to this product category. Thus, not all type of functional nutrients within the same product category may be perceived positively and generate premiums.

Concerns for healthier food choices have also derived consumers to pay premium prices for functional food with NHCs. In the case of the Italian yoghurts, Carlucci *et al.* (2013) found premium prices for the added fiber (+32.33%), probiotic (+24.45%) and calcium (+27.18%) attributes. In the case of fruit beverages, Szathvary & Trestini (2014) found positive effects for NCs (5.7%) and for HCs (20.6%), respectively. In the same line, Bimbo *et al.* (2015) found premium prices for added fiber (0.183€/L) and added vitamins (0.044€/L) to the UHT-treated milk. Barreiro-Hurle *et al.* (2010) found higher WTP for HCs related to health risks. This result was also confirmed by Annunziata & Vecchio (2013) and Ares *et al.* (2010) who reported that in the case of dairy products, consumers mostly prefer those HCs that reduce the risk of osteoporosis and cardiovascular diseases.

In spite of the fact that there are many studies focused on consumer acceptance of NHCs, to the best of our knowledge, there is a scant literature assessing (among other attributes) the analysis of specific NHC premium prices on food products in Spain. Hence, the main objective of this work is to fill these gaps and assess the market valuation of (among other attributes) specific NHCs for yoghurts in Spain. This is the first contribution of this paper. To achieve this objective, we used the hedonic price approach as the most appropriate analytical tool due to high range of yoghurts retail prices in the Spanish market. Moreover, hedonic approach has the advantage to explain how yoghurt prices vary depending on NHCs. In Spain, the hedonic price approach has been used by Cabrera *et al.* (2015) on the extra virgin olive oil, Gracia & Pérez y Pérez (2004) on veal and Sanjuán-Lopez *et al.* (2009) on saffron. Nevertheless, the present study is the first that analyzes NHCs on yoghurt in Spain using this methodology. Thus, this is the second contribution of our paper. Finally, through an identification of the

[2]Credence attributes of a good are quality aspects difficult, or in some cases, impossible to detect by consumers, but that play an important role for them (*e.g.*, organic) (Caswell, 1998).

[3]Regulation 1942/2006 defines a nutritional claim as '*…any claim which states, suggests or implies that a food has particular beneficial nutritional properties…*' In other words, NCs are the simplest type of claim about the nutrients (protein, carbohydrate, fat, fiber, vitamin and minerals) a food contains (*e.g.*, a yoghurt containing vitamin B6). Regulation 1924/2006 and the updated Regulation No 432/2012 define a health claim as '*… any claim that states, suggests or implies that a relationship exists between a food category, a food or one of its constituents and health…*' There are four types of HCs: (i) Article 14 health claims are those related to the reduction of disease risk claims, (ii) and claims regarding children's development and health; (iii) Article 13(5) health claims are based on newly developed scientific evidence and may include a request for the protection of proprietary data and (iv) Article 13 health claims also known as ´General health claims´ are those that describe the effect of a substance on a body function.

individual effect of each NHC on the overall price of yoghurt, our results will provide guidance for food manufactures and distribution presenting investment opportunities in the development and marketing of functional food.

Material and methods

Data collection

Results from the most recent studies focused on yoghurts (Carlucci *et al.*, 2013; Bonanno, 2015) have determined that extrinsic attributes best explain the final product price although in the markets with experienced consumers, some intrinsic attributes are significant. To determine the presence of NC and HC and the rest of yoghurt attributes, we created a database that collects information regarding yoghurt products available between July and September 2015. The creation of the database was based on the standardized protocols established by the International Network for Food and Obesity Research, Monitoring and Action Supporting the (INFORMAS) of Rayner *et al.* (2013) and Pravst & Kušar (2015). The final sample included yogurts that contained one nutritional and/or health claim in the package and were in accordance to the official EU definitions[4]. The sample included 508 yoghurts in total marketed in three types of stores present in the national territory. To guarantee the representativeness of the sample, the data were collected in the online stores and were validated with visits to the physical stores of 'Carrefour', 'Mercadona' and 'Dia' food distribution chains, which account for 40% of the sector's market share[5] (Kantar Worldpanel, 2017). Natural yoghurts were a selection of all plain yoghurts with no fruits / flavors but from different textures (*e.g.*, liquid). Table 1 summarizes the attributes included in this study and the descriptive statistics of variables. The database was created in Microsoft Excel 2010 that allowed the collection of the following information: Name of the distribution chain, product category, product name, brand, price, presence or absence of NCs, and the HCs (if any). This study only includes nutritional statements expressed in text and not as symbols unlike the study of Pravst & Kušar (2015).

As shown in Table 1, yoghurt prices varied depending on quantity from a minimum of €0.89 to a maximum of €6.75 with an average price of €3.07/kg. The quantity content varied between 100 g and 2 kg, with an average weight of 607 g. The most common size found was 400-500 g (46%), mainly in plastic Quattro pack of 125 g (500 g) followed by 600-1000 g (17%) and containers of 500-600 g (12%). The hypermarket provided around 52% of the total number of references followed by the discount store with about 26% of yoghurts. Neighborhood store had lower number of references compared to the hypermarket distribution chain and slightly lower (22%) compared with the discount store. Records imply that yoghurts were mostly marketed with the own distributor's private brands (51%) in comparison to processor's leader brands (49%). In terms of sensory characteristics, the majority of yoghurts were marketed with fruits and flavors (86%) followed by natural plain yoghurts (27%) and drinkable yoghurts (23%), in comparison to the rest (*e.g.*, Bifidus and Greek yoghurts).

Yogurts baring the 'fat-free' NC (31%) followed by yoghurts with 'source of calcium' (15%), 'no added sugar' (9%) and the ones with 'source of vitamin B6' (8%) had the highest presence in the local market, while, yoghurts with the 'source of fiber' (1%) and 'high in protein' (2%) type of claims had the lowest presence. Records implied that the HCs that dominate the yoghurt market were the ones that described the effects of 'lactose digestion' (12%), the ones that 'control cholesterol levels' (4%) followed by those that contain 'vitamin B6 that contributes to the normal functioning of the immune system' (4%).

Hedonic price approach

The basis of the hedonic price theory comes from two formative studies of Lancaster (1966) and Rosen (1974), who question the traditional utility function and suggest that consumers' utility increases based on the attributes a product possess instead of the product itself. Following Rosen (1974) the hedonic price function undertakes that market goods are made of a set of characteristics that can be represented by a vector *k* of attributes:

$$z = (z_1, z_2, \ldots, z_k) \quad (1)$$

The utility function for a representative consumer is then expressed as:

$$U = U(z_1, z_2, \ldots, z_k ; \alpha) \quad (2)$$

where z_k is the quantity of the k^{th} attribute contained in market goods and α is a parameter of consumer preferences. The level of the n^{th} attribute achieved by

[4](EC) No 1924/2006 and (EC) No 432/2012 for NHCs.

[5]It is worth to mention that while in countries like UK a handful of large operators control more than 80% of the market, in Spain the local chains and small distribution companies still distribute about 45% of the pie.

Table 1. Characteristics of the sample.

Attribute category	Attribute levels	No. of observations (%)
Price	€/kg	508 (100)
Retail channel	Hypermarket (Carrefour)	266 (52.36)
	Discount (Dia)	130 (25.59)
	Neighborhood store (Mercadona)	112 (22.05)
Brand	Leader	259 (50.98)
	Private	249 (49.02)
Sensory characteristics	Drinkable	116 (22.83)
	Bifidus	51 (10.04)
	Natural	137 (26.97)
	Greek	49 (9.65)
	Fruity / Flavors	434 (85.93)
Nutritional claims	Fat / Free fat	157 (30.91)
	Sugar / No added sugar	44 (8.66)
	Fiber / Source of fiber	4 (0.79)
	Protein / High source of protein	8 (1.57)
	Vitamin B6 / Source of vitamin B6	39 (7.68)
	Calcium / Enriched with calcium (%)	78 (15.35)
Health claims	Vitamin B6 contributes to the normal functioning of the immune system	21 (4.13)
	Plant sterols/stanols contribute to the maintenance of normal blood cholesterol levels	22 (4.33)
	Fiber contributes to an acceleration of intestinal transit	7 (1.38)
	Lactase enzyme improves lactose digestion in individuals who have difficulty digesting lactose	64 (12.59)
	Calcium is needed for the maintenance of normal bones	4 (0.79)

	No. cases (%)	Minimum price	Maximum price	Average price	*SD*
Total sample	508 (100)	0.89	6.75	3.07	1.06
		Package size mean 607 (g)			
100-250 (g)	61 (12)	0.89	4.79	1.01	0.63
250-400 (g)	23 (4.53)	0.90	1.89	1.39	0.31
400-500 (g)	232 (45.67)	0.52	3.80	1.38	0.63
500-600 (g)	63 (12.40)	1.37	3.92	2.50	0.91
600-1000 (g)	84 (16.54)	0.71	4.74	1.69	0.97
>1000 (g)	45 (8.86)	0.79	6.75	3.17	1.66

Source: Own elaboration.

a consumer will depend on the number of quantity (*Qi*) of different goods consumed. Units are related to z_k through the variable x_{jk} that represents the amount of the k^{th} attribute contained in one quantity of the j^{th} product. Under this assumption:

$$Z_k = f_n(Q_1, Q_2, \ldots, Q_n, x_{1k}, x_{2k}, \ldots, x_{nk}) \quad (3)$$

Taking into consideration equation (2) and (3), an individual´s level of utility is based on the level of attribute per quantity of product and the number of products consumed:

$$U = U(Q_1, Q_2, \ldots, Q_n, x_{1t}, \ldots, x_{nk}; \alpha) \quad (4)$$

As the economic theory states, consumers will maximize utility (4) subject to a budget constraint, defined as:

$$M = \sum_{j=1}^{n} P_j \times Q_j \quad (5)$$

where P_j is the price of the market good j^{th}. As result the maximization issue is given as:

$$P_j = f(x_{j1}, x_{j2}, \ldots, x_{jk}) \quad (6)$$

where x_{jk} is the quantity of attribute *k* associated with a unit of Q_j. Expression (6) can adopt different functional forms. A linear function implies that implicit prices are

constant while a non-linear function implies that the prices of an additional unit of a characteristic will depend on the quantity. Few studies in Table 2 have mainly used linear functions and have adopted different methodological solutions.

Model specification

As in most cases of hedonic price applications, a dependent price model was specified. The '*Price*' and '*Quantity*' variables were measured in €/kg and grams, respectively, and were introduced to the model as continuous variables. The rest were exploratory variables which explained the characteristics of the currently marketed product. Each possible level was specified as a dummy variable. Table 3 presents the description of variables used in the estimation of the hedonic price function.

Box-Cox transformation

The most frequently functional forms applied in the literature are the semi-logarithmic (log-lin), the logarithmic (lin-log) and the double-logarithmic (log-log). Since the economic theory does not solve the problem as to which is the most suitable functional form of the hedonic price function, it is a decision that researchers have to make empirically. The Box-Cox transformation approach (Box & Cox, 1964) has usually been applied for this purpose. The approach nests alternative functional forms, by adding non-linear parameters, θ and λ on the dependent and independent variables, respectively expressed as:

$$P_k^{(\theta)} = \begin{cases} \frac{P^{\theta}-1}{\theta} \; if \; \theta \neq 0 \\ \ln \theta \; if \; \theta = 0 \end{cases} \; z_k^{(\lambda)} = \begin{cases} \frac{Z^{\lambda}-1}{\lambda} \; if \; \lambda \neq 0 \\ \ln \lambda \; if \; \lambda = 0 \end{cases} \qquad (7)$$

The Box-Cox transformation provides four possible functional outcomes: (i) linear, when θ=λ=1; (ii) semi-logarithmic, when θ=0 and λ=1; (iii) double-logarithmic, θ=λ=0 and (iv) liner-logarithmic, θ=1 and λ=1.

However, individual and joint tests on the Box-Cox parameters may lead to un-conclusive results. According to previous literature (Sanjuán-Lopez *et al.*, 2009; Cabrera *et al.*, 2015) the Vuong test (Vuong, 1989) may be applied in order to select the functional form that best fits the data. The Vuong test determines the predicted probabilities of two models, choosing the best values in terms of log-likelihood and the variance estimate of their difference. For each functional form *i*, the likelihood ratio is expressed as:

$$LR^i = \left(\lambda_j \, \theta_j, \lambda_k \, \theta_k\right) = ll_j^i - ll_k^i \qquad (8)$$

where *j, k* are one of any of the four models (*m*) defined by the Box-Cox transformation and the ll_m is the log-likelihood function for observation *i* evaluated at the parameter estimates of the model *m*. The Vuong test than is given by:

$$Vuong = \frac{\sqrt{n}\left[\frac{1}{n}\Sigma_{i=1}^{n} LR_i\right]}{\sqrt{\frac{1}{n}\Sigma_{i=1}^{n}\left(LR_i - \overline{LR_i}\right)^2}} \qquad (9)$$

where *n* is the number of observations. The test is normally distributed, thus, values larger than the critical $N_{\alpha/2}$ (with α the significance level) favor model *j*, negative values $-N_{\alpha/2}$ are in favor of model *k* and Vuong $\leq N_{\alpha/2}$) indicates no significant differences between the two models.

Results

The first step includes the estimation of the Box-Cox regression. Table 4 provides the results indicating that two possible functional forms are not rejected. If we consider that that a joint linear transformation is always

Table 2. Hedonic price applications

Topic	Authors	Functional form
Nutritional composition of fruit beverages in USA	Leschewski *et al.* (2016)	Log-lin
Do HCs add value?	Bimbo *et al.* (2016)	Log-lin
An examination of the olive oil price structure	Cabrera *et al.* (2015)	Log-log
Hedonic analysis on the UHT milk prices in Italy	Bimbo *et al.* (2015)	Log-lin
NHCs valuation on fruit beverages in Italy	Szathvary & Trestini (2014)	Log-lin
Valuation of yoghurt HCs in Italy	Bimbo *et al.* (2014)	Log-lin
Values of olive oil in Chile	Muñoz *et al.* (2014)	Log-lin
Price variability in the Italian yoghurt market	Carlucci *et al.* (2013)	Log-log
Developing marketing strategies for Jiloca saffron	Sanjuán-Lopez *et al.* (2009)	Log-log
Determinant factors of veal price	Gracia & Pérez y Pérez (2004)	Log-lin

Source: Own elaboration

Table 3. Description of variables used in the estimation of the hedonic price function.

Attribute category	Attribute levels	Variable	Value
Price	-	Price	Continuous (€/kg)
Quantity	-	Quantity	Continuous (g)
Retail channel	Hypermarket	Hyper	1 if the retail channel is hypermarket 0 otherwise
	Discount store	Disc	1 if the retail channel is a discount store 0 otherwise
	Neighborhood	Neigh	(α) is expressed as constant
Brand	Leader	Brand	1 if is a leader brand
	Private		0 if is a private (supermarket) brand
Sensory characteristics	Drinkable	Drink	1 if the product is liquid 0 otherwise
	Bifidus	Bifidus	1 if the yoghurt is bifidus 0 otherwise
	Natural	Natural	1 if the yoghurt is plaint (natural) 0 otherwise
	Greek	Greek	1 if the product has the Greek yoghurt texture 0 otherwise
	Fruity / Flavors	Fruit_Flav	1 if the product has fruits or flavors 0 otherwise
Nutritional claims	Fat-free	N_FatFree	1 if the product is fat-free 0 otherwise
	No added sugar	N_NoSugar	1 if the product has no added sugar 0 otherwise
	Source of fiber	N_Fiber	1 if the product is a source of fiber 0 otherwise
	High source of protein	N_Protein	1 if the yoghurt is a high source of protein 0 otherwise
	Source of vitamin B6	N_VitB6	1 if the product contains vitamin B6 0 otherwise
	Enriched with calcium (%)	N_Calcium	1 if the product is enriched with calcium 0 otherwise
Health claims	Vitamin B6 contributes to the normal functioning of the immune system.	H_VitB6	1 if the product contains this HC 0 otherwise
	Plant sterols/stanols contribute to the maintenance of normal blood cholesterol levels.	H_Cholesterol	1 if the products contains this HC 0 otherwise
	Fiber contributes to an acceleration of intestinal transit	H_Fiber	1 if the product contains this HC 0 otherwise
	Lactase enzyme improves lactose digestion in individuals who have difficulty digesting lactose	H_Lactase	1 if the product contains this HC 0 otherwise
	Calcium is needed for the maintenance of normal bones	H_Calcium	1 if the product contains this HC 0 otherwise

Source: Own elaboration.

rejected then we choose the semi-logarithmic log-lin functional form for further analysis.

Since the Box-Cox transformation might lead to un-conclusive results, very common in the hedonic price empirical literature, in addition, Vuong´s test was applied (Table 5). Likewise, the results of the Vuong test indicate that the semi-logarithmic (log-lin) functional form is suitable.

In line with Muñoz *et al.* (2014) and Cabrera *et al.* (2015) additional statistical parameters have been performed to verify the functional form that best fits the model. Two likelihood ratio statistics were performed

to verify if the semi-logarithmic (log-lin) functional form was significantly preferred to a semi-logarithmic (lin-log) or a double-logarithmic (log-log) specification, respectively. Results clearly indicated that the adopted functional form was superior to the other two alternatives. Goodness-of-fit ($R^2 = 0.66$) and the adjusted $R^2 = 0.64$ were higher and significant (F-statistic < 0.01) while the Akaike and Schwarz information criterion was lower than those of the log-lin and log-log model, respectively. Moreover, the model showed no problem with the normality of residuals (probability of Jarque-Bera statistic of 0.00). The heteroscedasticity was tested by the Breusch-Pagan-Godfrey and White test statistic and the null hypothesis of the homoscedasticity in the error term was rejected (probability F-statistic 0.00), that indicates homoscedasticity problems. White's robust estimation strategy to obtain the parameter standard errors was used to solve this problem. The estimated hedonic price function parameters are shown in Table 6.

When analyzing, the magnitude of the coefficients must be understood as the percentage change of the price variable in view of the change in a unit of the independent variable. In the case of a continuous variable this percentage change can be determined as:

$$(\partial P/\partial Z_K)\,(1/P) = (\partial LnP/\partial Z_K) = \beta_m \qquad (10)$$

that can be expressed as a percentage $100\times\beta m$. Percentage variation for the rest of the variables were calculated according to Kennedy (1981):

Table 4. Box-Cox transformation

Functional form	θ value	λ value	Statistic (*p*-value)	Result
Log-lin	0	1	0.05 (0.83)	Not rejected
Lin-log	1	0	56.76 (0.00)	Rejected
Lin-lin	1	1	1.29 (0.26)	Not rejected
Log-log	0	0	34.21 (0.00)	Rejected

Source: Own elaboration

Table 5. Vuong's test results.

Ho:	Vuong statistic	Accepted form
Log-lin *vs.* lin-log	-15.296*	Log-lin
Log-lin *vs.* lin-lin	-0.016	-
Log-lin *vs.* log-log	-0.004	-
Lin-log *vs.* lin-lin	0.001	-
Lin-log *vs.* log-log	0.002	-
Lin-lin *vs.* log-log	0.001	-

* indicates the values were higher or lower than the critical values of 1.96 and -1.96 respectively, rejecting the null hypothesis of no-differences among functional forms. *Source:* Own elaboration.

$$100 \times (\exp[\beta_m - 0.5Var(\beta_m)] - 1) \qquad (11)$$

where *Var* (βm) is the estimated variance of parameter *m*.

All the percentage variations for each of the attributes used in the estimation model are shown in the fourth column of Table 6 (percentage impact that each dummy variable has over price). Values appearing in the fifth column were the result of applying the percentage impact on a reference price. In this case the average price of the sample is €3.07/kg, so implicit prices were calculated. Observations from Table 6 show that the '*Quantity*' variable was statistically significant and negative at 1% with a coefficient equal to -0.0007. Taking into account the logarithmic form of the equation, the coefficient of a continuous variable such as '*Quantity*' can be directly interpreted in terms of elasticity. Therefore, a negative but less than one coefficient means that an increase in the total amount of product contained in the package leads to a less-than-proportional decrease in its price. This is an expected result since discount on a unit price is usually given when a larger quantity of product is purchased.

Regarding the two types of brands the model gives a negative impact of -43.66% for the '*Leading*' brands in comparison to '*Private*' (supermarket) brand. The different type of retail channels where the product is sold significantly affects product prices and in particular, in comparison with '*Neigh*' store, the price decreases at -9.59% for '*Hyper*'. The '*Disc*' store was not statistically significant therefore did not receive any premium or price discount compared to the other type of stores. With respect to the different types of sensory characteristics, '*Greek*' yoghurt is found to be the most valued type of yoghurt with a positive impact price of 21.54%. '*Drink*' yoghurts have lately become very popular in the local market for being enriched with different types of vitamins (*e.g.*, B6, B12 etc.) and perceived as healthier yoghurts. In our case, this type of yoghurt is the second mostly valued with a positive impact of 12.00%. In particular, Spanish consumers pay an additional price of €0.66/kg for '*Greek*' yoghurts and an additional of €0.37/kg/l for '*Drink*' type of yoghurts. '*Bifidus*' '*Natural*' and '*Fruit_flav*' yoghurts are not statistically significant therefore these types of yoghurts do not receive premium or price discounts.

Unexpectedly, three most familiar NCs with the highest presence in the market ('*N_FatFree*', '*N_NoSugar*' and '*N_Fiber*') did not seem to affect yoghurt prices. In contrary, two NCs '*N_VitB6*' and '*N_Protein*' that were introduced later in the market received positive impact prices of 62.19% and 27.19% and were valued with additional implicit prices of €1.91/kg/L and €0.84/kg, respectively. On the other

Table 6. Parameters estimates of the price hedonic equation

	Semi-logarithmic (log-lin)				
	Coefficient	**(SE)**	***p*-value[a]**	**PI[b] (%)**	**IP[c] (€/kg)**
Constant (α)	1.6358	0.11	0.000***	-	-
Quantity	-0.0007	0.00	0.000***	-0.07	-0.002
Brand	-0.5493	0.05	0.000***	-43.66	-1.340
Hyper	-0.0772	0.05	0.103*	-9.59	-0.294
Disc	-0.0528	0.05	0.295	-7.50	-0.230
Drink	0.1408	0.05	0.011***	12.00	0.368
Bifidus	0.0774	0.05	0.158	5.13	0.158
Natural	-0.0733	0.05	0.113	-9.18	-0.282
Greek	0.2181	0.05	0.000***	21.54	0.661
Fruit_flav	-0.0302	0.06	0.594	-5.69	-0.175
N_FatFree	-0.0428	0.04	-1.16	-5.94	-0.182
N_NoSugar	0.0076	0.06	0.892	-2.01	-0.062
N_Fiber	0.0249	0.06	0.697	-0.71	-0.022
N_Protein	0.2609	0.04	0.000***	27.19	0.835
N_Vitb6	0.5263	0.09	0.000***	62.19	1.909
N_Calcium	-0.0904	0.04	0.033***	-10.55	-0.324
H_Vitb6	0.1898	0.10	0.051**	15.19	0.466
H_Cholesterol	0.5885	0.08	0.000***	73.18	2.247
H_Fiber	0.0750	0.15	0.612	0.11	0.003
H_Calcium	0.1781	0.05	0.000***	16.84	0.517
H_Lactase	0.4346	0.08	0.000***	48.65	1.494
R^2	0.6565				
Adjusted R^2	0.6424				
F-test	14.82 (0.00)				

[a]*p*-values calculated with robust HC3 standard errors. [b]PI: percentage impact over price. [c]IP: implicit price. Average price of the sample: €3.07/kg. ***,**,*: significant at 1%, 5% and 10% level, respectively. *Source:* Own elaboration.

hand, the coefficient of '*N_Calcium*' was negative with a percentage impact change over price of -10.55 and an implicit price of €-0.32/kg. By contrast, HCs seemed to better respond and affected yoghurt prices in the local market in comparison to NCs. In particular, the highest premium price was received by yoghurts that bared the '*H_Cholesterol*' claim (€2.25/kg) with a positive impact on price of 73.18 %. The HC related to lactose digestion was the second most valued type of claims. More specifically, '*H_Lactase*' claim received 48.65% positive impact and a premium price of €1.49/kg. In contradiction to the negative valuation of the '*N_Calcium*' nutritional claim, the HC that explains the effect of '*H_Calcium*' in our body, revealed to have a positive percentage impact change over price of 16.84% and received a premium of €0.52/kg. This means that when the '*Calcium*' nutritional and health claim appeared jointly the estimation effect was positive. Yoghurts baring the HC of '*H_VitB6*' also had a positive impact of 21.12% over price and were valued with an additional price premium of €0.65/kg/L. Lastly, '*H_Fiber*' HC was totally neglected therefore this attribute did not have a premium of discount price.

Discussion

The main objective of this study was to measure the market value in terms of implicit prices given to yoghurts with nutritional and health claims in the Spanish market. Results show that yoghurt is a highly differentiated food product. The market competition is based in quality attributes related to quantity, brand, type of retailer, the type of yoghurt (*e.g.*, natural, with fruits-flavors, bifidus, Greek etc.) and nutritional and health claims. The applied hedonic function provides a measure of the

market value of these attributes and investigates some important features of the Spanish yoghurt industry to offer insights on certain competitive strategies.

Results showed that yoghurt prices are positively affected by private brands purchased at neighborhood stores in comparison to leader brands purchased at hypermarkets. This is an expected result because in the Spanish market the neighborhood store ('Mercadona') has the highest market share (23.6%) in comparison to the rest of supermarkets, including also the hypermarket of 'Carrefour' (8.5%) (Berengueras, 2017). In addition, while in the rest of super-hypermarkets the presence of private brand did not exceed 34.1%, the percentage of private brands in the neighborhood store ascended to 56.6% in 2017 (San Esteban, 2017). With respect to the different types of yoghurts present in the Spanish market, the Greek type received the highest premium price followed by drinking yoghurts. Drinking yoghurts have lately become very popular in the local market for being enriched with different types of vitamins (*e.g.*, B6, B12 etc.) and are perceived as healthier yoghurts. Consistent with Bonanno´s (2013) findings in the Italian yoghurt market, consumers seem to prefer drinking yoghurts over regular ones, in particular with regard to functional alternatives. Bifidus, natural and yoghurts with fruits and flavors have negligible effects on the Spanish yoghurt prices.

Surprisingly, negligible effects on yoghurt prices are seen for the nutritional claims related to fat-free, no added sugar and fiber contents. These results are in contrary to consumers' preference growth for low-calorie and free-fat food products, and in contradiction to previous studies who state that consumers have stronger preferences for simple (Bitzios *et al.*, 2011) and more familiar claims (Lahtenmaki *et al.*, 2010). The neglected valuation of the free-fat nutritional claim is partially in line with Bimbo *et al.* (2016) who found negative marginal price for zero-fat (-1.9%) yoghurt attributes in Italy and in line with Carlucci *et al.* (2013) who found negative but not significant relationship between the low-fat attribute and yoghurt's prices in Italy. In general, our results are consistent with Van Wezemael *et al.* (2014) and Krystallis & Chrysochou (2011) who found that consumers across five different countries have very heterogeneous preferences on nutritional claims. More precisely, consumers from Belgium, the Netherlands, France and Greece give higher value on NCs related to fat content and saturated fat while it is the opposite for consumers in the UK. With respect to the fiber content nutritional claim our result is in line with Ares & Gambaro (2007) who found that fiber added to yoghurt are perceived as interfering with the naturalness and healthiness of the product, and this may reduce consumers' acceptance and price.

Another reason that might influence the negative and not significant impact of the three most present NCs ('*N_FreeFat*', '*N_NoSugar*' and '*N_Fiber*') in the yoghurt Spanish market is that since these types of claims have been introduced long time ago they might be in the maturity stage of the product lifecycle. To the contrary, two nutritional claims related vitamin B6 and protein contents that were later introduced in the national yoghurt market have positive influence on price and receive premiums. This outcome seems understandable since both claims are considered to be innovative, are still in the growth stage of the product lifecycle, are perceived as healthy attributes on yoghurts and have a limited competition in the local market (only 'Danone').

On the other hand, findings report that health claims, outperform nutritional claims leading to higher premium prices in the Spanish market. In particular, the highest premium price is received by yoghurts that bare the cholesterol claim. These estimates are consistent with other studies who found that product claiming to prevent cardiovascular diseases by lowering or controlling cholesterol levels are well accepted by dairy product consumers (Ares & Gámabro, 2007; Landström *et al.*, 2007). Moreover, Marette *et al.* (2010) found positive WTP for cholesterol HCs even for participants without high cholesterol problems. HCs regarding lactose digestion receive positive valuation being the second mostly valued after the cholesterol claim. This is an expected result due to the fact that in 2015 the Spanish Society of Digestive Pathology in collaboration with the Spanish Society of General and Family Physicians found that between 30 and 50% of the Spanish population suffers from lactose intolerance (Argüelles-Arias *et al.*, 2015).

In contradiction to the calcium content nutritional claim who negatively affects yoghurt prices, the calcium type of HC was found to have a positive impact and received an important premium. This result is in contrast with Szathvary & Trestini (2014) and Barreiro-Hurle *et al.* (2010), who found negative interaction effects when nutritional and health claims are labeled together. Premium prices were also received by yoghurts bearing the vitamin B6 joint NHCs. Lastly, the fiber health claim was totally neglected, therefore the attribute did not receive any premium price. This result was similar to Ares & Gámbaro (2007) who found that consumers show positive attitudes on dairy products enriched with calcium rather than fiber since the functional component (fiber) is 'artificially' inherited to this product category.

Our finding imply that NHC matters in determining a yoghurt's premium price due to a differentiation strategy of processors or manufacturers which should take into account the growing consumer concerns on

healthier food products and heterogeneous preferences. Especially in the yoghurt market, health enhancing product differentiated by functional food ingredients seems to be the most profitable way of product differentiation. Even though, certain nutritional claims had no effect on yoghurt product prices, a profitable strategy may be to introduce them accompanied by the corresponding health claim that exactly defines the benefits of that nutrient on our health (*e.g.*, the case of enriched with calcium nutritional and health claim). Further research is needed in the future to better understand Spanish consumer preferences towards yoghurts with nutritional and health claims. Future research may analyze to what extent consumer preferences and willingness-to-pay for these specific attributes are related to price structures and provide guidance to food manufacturers in deciding whether or not to invest in the development of marketing strategies. This constitutes our future research. Even though this study's interest is more limited to Spanish market, the methodology used can be replicated in other countries.

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