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 microorganisms1 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

1Live 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, Binbo 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

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\(^2\)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 1942/2006 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.
A hedonic approach for health related-claims in yogurts

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. The sample included 508 yogurts 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 (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 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 undertakes that market goods are made of a set of characteristics that can be represented by a vector of attributes:

\[ z = (z_1, z_2, ..., z_k) \]  

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

\[ U = U(z_1, z_2, ..., z_k; \alpha) \]

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

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.

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 of attributes:
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 (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.

As a consumer will depend on the number of quantity (Qi) of different goods consumed. Units are related to zk through the variable xjk, that represents the amount of the k attribute contained in one quantity of the jth product. Under this assumption:

\[ Z_k = \int (Q_1, Q_2, ..., Q_n, x_{jk} x_{k}) ] (3) \]

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

\[ M = \sum_{j=1}^{n} P_j Q_j \] (5)

where Pj is the price of the market good jth. As result the maximization issue is given as:

\[ \hat{P}_j = \int (x_{j1}, x_{j2}, ..., x_{jk}) ] (6) \]

As result the maximization issue is given as:
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:

$$e^{\left(\frac{\theta-1}{\theta} \ln \theta \cdot \lambda - \lambda = 0 \right)}$$

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

However, individual and joint tests on the Box-Cox parameters may lead to un-conclusive results. According to previous literature (Sanjuán-López 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:

$$LR^i = \left(\frac{\lambda_j \theta_j \lambda_k \theta_k}{\ln \lambda_j \theta_j \ln \lambda_k \theta_k}\right) = ll_j^i - ll_k^i$$

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

$$Vuong = \frac{\sqrt{n} \left(\frac{\lambda_j \theta_j \lambda_k \theta_k}{\ln \lambda_j \theta_j \ln \lambda_k \theta_k}\right)}{\sqrt{\frac{1}{n} \sum_{i=1}^n (LL_j - LL_k)^2}}$$

where $n$ is the number of observations. The test is normally distributed, thus, values larger than the critical $N_{\alpha/2}$ (with $\alpha$ 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 a joint linear transformation is always

| 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 | Carlucchi 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 |
|                    | Discount store   | Disc     | 1 if the retail channel is a discount store |
| 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 |
|                    | Bifidus          | Bifidus  | 1 if the yoghurt is bifidus |
|                    | Natural          | Natural  | 1 if the yoghurt is plain (natural) |
|                    | Greek            | Greek    | 1 if the product has the Greek yoghurt texture |
|                    | Fruity / Flavors | Fruit_Flav | 1 if the product has fruits or flavors |
| Nutritional claims  | Fat-free         | N_FatFree | 1 if the product is fat-free |
|                    | No added sugar   | N_NoSugar | 1 if the product has no added sugar |
|                    | Source of fiber  | N_Fiber  | 1 if the product is a source of fiber |
|                    | High source of protein | N_Protein | 1 if the product is a source of protein |
|                    | Source of vitamin B6 | N_VitB6 | 1 if the product contains vitamin B6 |
|                    | Enriched with calcium (%) | N_Calcium | 1 if the product is enriched with calcium |
| Health claims      | Vitamin B6       | H_VitB6  | 1 if the product contains this HC |
|                    | Plant sterols/stanols contribute to the maintenance of normal blood cholesterol levels. | H_Cholsterol | 1 if the products contains this HC |
|                    | Fiber contributes to an acceleration of intestinal transit | H_Fiber | 1 if the product contains this HC |
|                    | Lactase enzyme improves lactose digestion in individuals who have difficulty digesting lactose | H_Lactase | 1 if the product contains this HC |
|                    | Calcium is needed for the maintenance of normal bones | H_Calcium | 1 if the product contains this HC |

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:

$$
(\frac{\partial P}{\partial Z_k})(1/P) = (\frac{\partial \ln P}{\partial Z_k}) = \beta_m
$$

(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):

$$
100 \times (\exp[\beta_m - 0.5 \text{Var}(\beta_m)] - 1)
$$

(11)

where $\text{Var}(\beta_m)$ 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

| Parameter          | Coefficient (SE) | p-value  | PI (%) | IP (£/kg) | R^2 | Adjusted R^2 | F-test |
|--------------------|------------------|----------|--------|-----------|-----|-------------|--------|
| Constant (α)       | 1.6358 (0.11)    | 0.000*** | -      | -         | 0.6565 | 0.6424 | 14.82 (0.00) |
| 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)   | 0.013*   | -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     |      |             |        |

*p*-values calculated with robust HC3 standard errors. **PI**: percentage impact over price. **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 & Gámbaro (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 & Gámbaro, 2007; Landström et al., 2007). Moreover, Marette et al. (2010) found positive WTP for cholesterol HC’s 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.

References

Annunziata A, Vecchio R, 2013. Consumer perception of functional foods; a conjoint analysis with probiotics. Food Qual Prefer 28: 348-355. https://doi.org/10.1016/j.foodqual.2012.10.009

Annunziata A, Vecchio R, Kraus A, 2016. Factors affecting parents’ choices of functional foods targeted for children. Int J Consum Stud 40 (5): 527-535. https://doi.org/10.1111/ijcs.12297

Ares G, Gámbaro A, 2007. Influence of gender, age and motives underlying food choice on perceived healthiness and willingness to try functional foods. Appetite 49: 148-158. https://doi.org/10.1016/j.appet.2007.01.006

Ares G, Gimenez A, Deliza R, 2010. Influence of three non-sensory factors on consumer choice of functional yoghurts over regular ones. Food Qual Prefer 21: 361-367. https://doi.org/10.1016/j.foodqual.2009.09.002

Argüelles-Arias F, Ledo P, Tenías J, Otero M, Casellas F, Cortés G, Alfredo L, Domínguez-Jiménez J, Carballo F, 2015. Manejo de la intolerancia a la lactosa entre los médicos de atención primaria y su correlación con la de los especialistas en digestivo: Encuesta Nacional SEPD-SEMG. Rev Esp Enferm Digest 107 (9): 554-559.

Astrup A, 2014. Yoghurt and dairy product consumption to prevent cardio metabolic diseases: epidemiologic and experimental studies. Am J Clin Nutr 99 (5): 1235S. https://doi.org/10.3945/ajcn.113.073015

Berengueras MJ, 2017. Mercadona bate su record de cuota de mercado en el primer trimestre. El Periodico. http://wwwelperiodico.com/es/noticias/economia/mercadona-bate-record-cuota-mercado-primer-trimestre-2017-6001049

[29/04/2017].

Barreiro-Hurle J, Garcia A, De-Magistris T, 2010. The effects of multiple health and nutrition labels on consumer food choices. J Agr Econ 61: 426-443. https://doi.org/10.1111/j.1477-9552.2010.00247.x

Bechthold KB, Abdulai A, 2014. Combining attitudinal statements with choice experiments to analyze preference heterogeneity for functional dairy products. Food Policy 47: 97-106. https://doi.org/10.1016/j.foodpol.2014.05.007

Bimbo F, Bonanno A, Viscechia R, Nardone G, 2014. Market valuation of health claims’ types and strength: the Italian yoghurt market. EAAE-Congress of Agri-Food and Rural Innovations for Healthier Societies.

Bimbo F, Bonanno A, Liu X, Viscechia R, 2015. Hedonic analysis of ultra-high-temperature treated milk prices in Italy. J Dairy Sci 99: 1095-1102. https://doi.org/10.3168/jds.2015-10018

Bimbo F, Bonanno A, Viscechia R, 2016. Do health claims add value? The role of functionality, effectiveness and brand. Eur Rev Agr Econ 43 (5): 1-20. https://doi.org/10.1093/eragrevf/erw002

Bitzios M, Fraser I, Haddock-Fraser J, 2011. Functional ingredients and food choice: Results from a dual-mode study employing means-end-chain analysis and a choice experiment. Food Policy 36: 715-725. https://doi.org/10.1016/j.foodpol.2011.06.004

Bonanno A, 2013. Functional foods as differentiated products: The Italian yoghurt market. Eur Rev Agr Econ 40: 45-71. https://doi.org/10.1093/eragrevf/erj066

Bonanno A, 2015. A hedonic valuation of health and nutritional attributes in the U.S. yoghurt market. Agribusiness 32 (3): 299-313. https://doi.org/10.1002/agr.21448

Box GEP, Cox DR, 1964. An analysis of transformations. J Roy Stat Soc B 26: 211-252.

Cabrera E, Arriaza M, Rodriguez-Entrena M, 2015. Is the extra virgin olive oil market facing a process of differentiation? A hedonic approach to disentangle the effect of quality attributes. Grasas y Aceites 66(4): e105. https://doi.org/10.3989/ga.0253151

Carlucci D, Stasi A, Nardone G, Seccia A, 2013. Explaining price variability in the Italian yoghurt market: A hedonic analysis. Agribusiness 29 (2): 194-206. https://doi.org/10.1002/agr.21332

Caswell J, 1998. How labelling of safety and process attributes affects markets for food. Agr Resour Econ Rev 27: 151-158. https://doi.org/10.1016/S1068280500000647X

Cavaliere A, Ricci CE, Banterle A, 2015. Nutrition and health claims: Who is interested? An empirical analysis of consumer Preferences in Italy. Food Qual Prefer 41: 44-51. https://doi.org/10.1016/j.foodqual.2014.11.002

Chase D, Emunu JP, Nilsson T, McCann-Hiltz D, Peng Y, 2009. Canadian consumers’ purchasing behavior of Omega-3 products. J Food Distrib Res 40 (2): 12-23.
A hedonic approach for health related-claims in yogurts

Cormier H, Thifault É, Garneau V, Tremblay A, Drapeau V, Pérussé L, Vohl MC, 2016. Association between yoghurt consumption, dietary patterns, and cardio-metabolic risk factors. Eur J Nutr 55 (2): 577-587. https://doi.org/10.1007/s00394-015-0878-1

Cox DN, Evans G, Lease HJ, 2011. The influence of product attributes, consumer attitudes and characteristics on the acceptance of: (1) novel bread and milk, and dietary supplements and (2) fish and novel meats as dietary vehicles of long chain omega 3 fatty acids. Food Qual Prefer 22: 205-212. https://doi.org/10.1016/j.foodqual.2010.10.003

de-Magistris T, Lopez-Galan B, 2016. Consumers' willingness to pay for nutritional claims fighting the obesity epidemic: The case of reduced-fat and low salt cheese in Spain. Public Health 135: 83-90. https://doi.org/10.1016/j.puhe.2016.02.004

Desobry-Banon S, Vetier, N. & Hardy, J. 1999. Health benefits of yoghurt consumption. A review. Int J Food Propert 2 (1): 1-12. https://doi.org/10.1008/10942919990524585

Diaz-Lopez A, Bullo M, Martinez-Gonzalez MA, Corella D, Estruch R, Fito M, Gomez-Gracia E, Fiol M, Garcia de la Corte FJ, Ros E, et al., 2015. Dairy product consumption and risk of type 2 diabetes in an elderly Spanish Mediterranean population at high cardiovascular risk. Eur J Nutr 55 (1): 349-360. https://doi.org/10.1007/s00394-015-0855-8

Gracia A, Pérez y Pérez L, 2004. Factores determinantes del precio de la carne de ternera: un análisis hedónico. Agr Resour Econ 4: 87-104.

Hellyer NE, Fraser I, Haddock-Fraser J, 2012. Food choice, health information and functional ingredients: An experimental auction employing bread. Food Policy 37 (3): 232-245. https://doi.org/10.1016/j.foodpol.2012.02.005

Hirogaki M, 2013. Estimating consumers' willingness to pay for health food claims: A conjoint analysis. Int J Innov Manage Technol 4 (6): 541. https://doi.org/10.7763/IJIMT.2013.V4.458

Jurado F, Gracia A, 2017. Does the valuation of nutritional claims differ among consumers? Insights from Spain. Nutrients 9: 132. https://doi.org/10.3390/nu9020132

Kantar Worldpanel, 2016. El sector de la distribución en 2017. Madrid. www.es.kantar.com [11/06/2016].

Kennedy PE, 1981. Estimation with correctly interpreted dummy variables in semilogarithmic equations. Am Econ Rev 71 (4): 801.

Krutilyte R, Grunert KG, Scholderer J, Lahteenmäki L, Hagemann KS, Elgaard P, Nielsen B, Graverholt JP, 2011. Perceived fit of different combinations of carriers and functional ingredients and its effect on purchase intention. Food Qual Prefer 22 (1): 11-16. https://doi.org/10.1016/j.foodqual.2010.06.001

Krystalis A, Chrysochou P, 2011. Health claims as communication tools that enhance brand loyalty: The case of low-fat claims within the dairy food category. J Market Commun 17 (3): 213-228. https://doi.org/10.1080/13527260903432836

Lähteemäki L, Lampila P, Grunert K, Boztug Y, Ueland Ø, Åström A, Martinsdóttir E, 2010. Impact of health-related claims on the perception of other product attributes. Food Policy 35 (3): 230-239. https://doi.org/10.1016/j.foodpol.2009.12.007

Lancaster K, 1966. A new approach to consumer theory. J Polit Econ 74 (2): 132-157. https://doi.org/10.1086/259131

Landström E, Hursti UKK, Becker W, Magnusson M, 2007. Use of functional foods among Swedish consumers is related to health-consciousness and perceived effect. Brit J Nutr 98: 1058-1069. https://doi.org/10.1017/S0007114507761780

Landström E, Hursti UKK, Magnusson M, 2009. Functional foods compensate for an unhealthy lifestyle. Some Swedish consumers' impressions and perceived need of functional foods. Appetite 53: 34-43. https://doi.org/10.1016/j.appet.2009.04.219

Leschewski A, Weatherspoon DD, Kuhns A, 2016. A segment hedonic analysis of the nutritional composition of fruit beverages. Int Food Agribus Manage Rev 19 (3): 119-140.

López-Galán B, de-Magistris T, 2017. Prevalencia de las declaraciones nutricionales en la prevención de la obesidad en el mercado español. Nutrición Hospitalaria 34 (1): 154-164. https://doi.org/10.20960/nh.991

Lourens-Hattingh A, Viljoen BC, 2001. Yoghurt as probiotic carrier food. Int J Dairy Technol 11: 1-17. https://doi.org/10.1080/10959-6946(01)00036-X

Masson E, Debuquet G, Fischler C, Merdji M, 2016. French consumers' perceptions of nutrition and health claims: A psychosocial-anthropological approach. Appetite 1: 618-629. https://doi.org/10.1016/j.appet.2016.06.026

Marette S, Roosen J, Blanchemanche S, Feinblatt-Meleze E, 2010. Functional food, uncertainty and consumers' choices: A lab experiment with enriched yogurts for lowering cholesterol. Food Policy 35 (5): 419-428. https://doi.org/10.1016/j.foodpol.2010.04.009

Mozaffarian D, Hao T, Rimm EB, Willett WC, Hu FB, 2011. Changes in diet and lifestyle and long-term weight gain in women and men. New Engl J Medic 364 (25): 2392-2404. https://doi.org/10.1056/NEJMoa1014296

Muñoz RR, Moya LM, Gil MJ, 2014. Market values for olive oil attributes in Chile: A hedonic price function. Brit Food J 117 (1): 358-370.

Pavlov I, Kušar A, 2015. Consumers' exposure to nutrition and health claims on pre-packed foods: Use of sales weighting for assessing the food supply in Slovenia. Nutrients 7 (11): 9353-9368. https://doi.org/10.3390/nu7115474

Rayner M, Wood A, Lawrence M, Mhurchu CN, Albert J, Barquera S, Friel S, Hawkes C, Kelly B, Kumanyika S, et al., 2013. Monitoring the health-related labelling of foods and non-alcoholic beverages in retail settings. Obes Rev 14: 70-81. https://doi.org/10.1111/obr.12077

Rosen S, 1974. Hedonic prices and implicit markets: product differentiation in pure competition. J Polit Econ 82: 34-55. https://doi.org/10.1086/260169
San Esteban N, 2017. Estas son las marcas que sobreviven al imperio de Hacendado en Mercadona. El Español http://www.elespanol.com/economia/empresas/20170612/232228165_0.html [15/06/2017].

Sanjuán-López AI, Resano-Ezcaray H, Camarena-Gómez DM, 2009. Developing marketing strategies for Jiloca saffron: A price hedonic model. Span J Agric Res 7 (2): 305-314. https://doi.org/10.5424/sjar/2009072-421

Serafeimidou A, Zlatanos S, Laskaridis K, Sagredos A, 2012. Chemical characteristics, fatty acid composition and conjugated linoleic acid (CLA) content of traditional Greek yoghurts. Food Chem 134: 1839-1846. https://doi.org/10.1016/j.foodchem.2012.03.102

Szathvary S, Trestini S, 2014. A hedonic analysis of nutrition and health claims of fruit beverages. J Agr Econ 65 (2): 505-517. https://doi.org/10.1111/1477-9552.12056

Urala N, Lahteenmaki L, 2007. Consumers' changing attitudes towards functional foods. Food Qual Prefer 18 (1): 1-12. https://doi.org/10.1016/j.foodqual.2005.06.007

USDA-The Food Guide Pyramid, 1992. The food guide pyramid. USDA's Center Center for Nutrition Policy and Promotion, Supersedes-HG249.

Van Wezemuel L, Caputo V, Nayga RM, Chryssochooidis G, Verbeke W, 2014. European consumer preferences for beef with nutrition and health claims: A multi-country investigation using discrete choice experiments. Food Policy 44: 167-176. https://doi.org/10.1016/j.foodpol.2013.11.006

Vuong QH, 1989. Likelihood ratio test for model selection and non-nested hypothesis. Econometrica 57: 307-333. https://doi.org/10.2307/1912557

WHO/FAO, 2001. Health and nutritional properties of probiotics in food including powder milk with live lactic acid bacteria. Technical Report of a Joint FAO/WHO Expert Consultation on Evaluation of Health and Nutritional Properties of Probiotics in-food Including Powder Milk with live Lactic Acid Bacteria. Cordoba, Argentina, pp: 1-4.