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Impact of hedonic evaluation on consumers' preferences for beef enriched with Omega 3: A Generalized Multinomial Logit Model approach

Yasmina Baba[1], Zein Kallas[2], José María Gil[2], Carolina E. Realini[3],

[1]Instituto de Sostenibilidad, Universidad Politécnica de Cataluña, Barcelona, Spain.

[2] Centre for Agro-food Economy and Development (CREDA), Castelldefels, Spain.

[3]IRTA-Monells, Finca Camps I Armet, 17121 Monells, Spain.

Abstract. *The impact of hedonic evaluation on consumers' preferences towards beef attributes including its enrichment with polyunsaturated fatty acids (PFA) was evaluated. 647 Spanish consumers were divided into two groups differentiated by the information received. Consumers evaluated five beef attributes (origin, animal diet, amount of visible fat, meat colour and price) by conducting a choice experiment (CE) and using the recently developed Generelized Multinomial Logit (G-MNL). Subsequently, consumers conducted a blind tasting of four different beef samples and later informed about what they taste. Finally consumers repeated the CE. By estimating the G-MNL, it allows respondents to have different utility function scales that describe a different uncertainty levels with respect to the choices they make. In this case, hedonic evaluation of beef samples and information had a significant impact on consumer beef preferences, choices and scale parameters. Results show that giving consumers additional information, the average error scales decreased significantly.*

Keywords: *Consumer preferences, beef, Choice Experiments, Generalized multinomial logit.*

JEL codes*: C5, C90, Q13*

1. Introduction

When health claims are presented on food package, purchase intentions are favourably influenced and consumers risks perception of certain diseases decrease (Kozup, *et al*., 2003). Consumers are more aware of the contribution of food to their health (Siró *et al*. 2008) and thus, health concerns are becoming a main determinant factor for food consumption. To meet today's health and wellness concerns, food/beverage demands has evolved towards new range of products often related to health-promotion and disease prevention. In United States, health influenced the food purchase decisions of 64% of consumers in 2013, up from 61% in 2012 (IFIC, 2013). However, consumer perception and purchase behaviour of functional ingredients is not one-dimensional, and the final food result from a variety of factors such as sensory, socioeconomic, attitudinal, risk perception, cultural and information issues among others (Hellyer *et al*, 2012; Siró *et al*., 2008; Urala and Lähteenmäki, 2004).

Cultural and attitudinal factors play an important role in food choice. Siró *et al*. (2008) stated that there is a clear difference between western and eastern valuation of functional food. Western perception of maintenance of original food characteristics is more important for Europeans than North Americans. The Mediterranean consumers are the ones more concerned with the "natural" characteristic of food. Therefore, the balance between the valuation of health effects/benefits of specific functional ingredients and the preservation of the original food characteristics are key points for the acceptability of functional food. In this context, Franchi (2012) mentioned that beliefs and identity are influence preferences by indicating to individuals what foods are 'good' and 'right'.

Sensory attributes are also decisive factors for acceptance of food especially those dealing with health claims and well-being enhancement (Verbeke, 2006; Urala and Lähteenmäki, 2003 and 2004). Gabrielyan, *et al*. (2014) mentioned that the intrinsic cues such as taste are a primary basis for consumers' expectations of quality and decisions about whether to make repeat purchases of a product. Asioli *et al*. (2014) found that flavor and odor are the most important in driving consumers' choice for organic food. Annett *et al*. (2008) and Hobbs *et al*. (2006) verified that health and nutrition information together with sensory evaluation and eating experience are all relevant for a positive valuation of specific functional food (organic bread/functional meat).

Combris *et al*. (2009) noticed that personal experience, derived from a blind tasting, was significantly more important than label information regarding "appellation of origin" of wines. That is, experience plays a very important role in defining individuals' perception and willingness to pay. Lange *et al*. (2002) and Noussair *et al*., (2004) compared hedonic ratings and experimental auctions to evaluate food preferences, stating that hedonic ratings provided similar aggregate results. Poole *et al*. (2006) employed an experimental auction to test fruit quality perceptions by evaluating consumers' willingness to pay (WTP) after three alternative sensory experiments (visual appearance, touching and peeling, and tasting). The authors concluded that "experience" modifies product quality perceptions and scoring behaviour, as well as it is likely to affect repurchase decisions. Lange *et al*. (1998) compared consumers' behaviour using two scenarios: just packaging exposure and packaging exposure and taste. The authors reported that tasting had an important role on consumers' purchase decisions. Respondents do consider different food attributes after tasting than before tasting with a modification on their purchase decisions.

Many studies have analysed consumers' preferences, attitudes and acceptance towards beef (Carpenter, *et al*., 2001; Resurreccion, 2004; Verbeke *et al*., 2010; Font-i-Furnols & Guerrero, 2014 among others). However, literature that analyses the impact of hedonic valuation on consumers' purchasing decisions is still scarce and remains untreated for beef enriched with polyunsaturated fatty acids, particularly in Spain. In this context, we applied a methodological approach that attempts to mimic consumers' behaviour towards a novel product in Spain (enriched beef with beneficial fatty acids), which can be summarized in 3 main subsequent steps:

a. When consumers face an new product on the shelf stores they generate expectations (expected or pre sensory preferences) on the basis of their past experiences and available information related to the characteristics of the product or to similar products (Deliza and MacFie, 1996)
b. Tasting the new product allows constructing a set of current experience information (hedonic evaluation test) that is useful to decide for a repeated choice or not.
c. After tasting the new product, consumers' acceptance may result in agreement or disagreement with what they expected. These changes play an important role in the

acceptance or rejection of the new product (Font-i-Furnols and Guerrero, 2014), and may affect the final choice of the consumers (final or post sensory preferences).

In this context, the main objective of this paper was to analyse the impact of hedonic evaluation, for both informed and non-informed consumers, on the expected preferences for beef attributes including its enrichment with polyunsaturated fatty acids (omega-3 and Conjugated Linoleic Acid, CLA) by comparing the expected preferences before ante after tasting experience. In addition we assessed if the provided information had influenced the overall acceptability scores for beef. From one hand, empirically, this is the first paper that analysed the sensory impact on the expected preferences towards the enriched beef meat with polyunsaturated fatty acid. On the other hand, methodologically, this paper contribute to the literature of the Discrete Choice Modelling (DCM) using the recently developed Generalised Multinomial Logit Model (G-MNL) of Fiebig *et al*., (2010) allowing for both preference and scale heterogeneity. This is the first application, in the literature of food and meat preferences studies that analyse the impact of sensory experience on consumers' preferences using the G-MNL and how the scale heterogeneity is affected.

2. Materials and methods

In accordance to the main objective, our methodological framework consisted of three main steps:

a. The first part focussed on analysing the expected consumers' preferences using choice experiments (CE) towards beef meat attributes and its enrichment with n-3 and CLA (expected or pre-sensory preferences). In this initial step, consumers were divided into two groups. While the first one received information about the enrichment process and the health benefits of CLA and omega-3 fatty acids, the second group did not receive any explanation.
b. The second part was based on a sensory test of four types of beef samples from animals fed one of four different diets (hedonic evaluation test). In this second stage, consumers' acceptability was carried out by blind tasting of four types of beef samples: a) conventional, b) enriched with n-3, c) enriched with CLA and d) enriched with both n-3 and CLA. Consumer overall acceptability of beef samples was assessed using a 9-point hedonic scale

(1 = dislike extremely to 9 = like extremely). After tasting of samples, all consumers were told what type of beef they have tasted in order to associate their score with the different types of beef meat.

c. In the third phase, we repeated the choice experiment carried out in the first step in order to analyse the potential impact of sensory evaluation on consumers' preferences for beef attributes including its enrichment with n-3 and CLA (final or post sensory preferences).

A summarized scheme of the followed methodological framework is presented in Figure 1. As can be seen, this approach allowed first to analyse the impact of health information on the expected preferences (point 1) that has been reported by Kallas *et al*. (2014). It permitted analysing the hedonic evaluation regarding beef attributes in particular the n-3 and CLA attributes (point 2) that has been presented and discussed by Realini *et al*. (2014).

Figure 1

2.1. Theoretical foundation of the Discrete Choice Experiments

DCE rely on Lancaster's Theory of Value (Lancaster, 1966) and on the Random Utility Theory (RUT) of Thurstone (1927). Subjects choose among alternatives according to a utility function with two main components: a systematic (observable) component and a random error term (non-observable):

$$U_{jn} = V_{jn}(X_j, S_n) + \varepsilon_{jn} \qquad (1)$$

where U_{jn} is the utility of alternative j to subject n, V_{jn} is the systematic component of the utility, X_j is the vector of attributes of alternative j, S_n is the vector of socio-economic characteristics of the subject n and ε_{jn} is the random term.

2.2. Choice Experiments modelling

To predict the subjects' preferences for attributes (k), we need to define the "probability of choice" that an individual *n* chooses the alternative *i* rather than the alternative j (for any i and j within choice sets, T). McFadden (1974) developed an econometric model that formalized respondents' decision making process. This model is often referred to as the multinomial logit (MNL) model, which is considered the base model for DCE. However, the MNL imposes homogeneity in preferences for observed attribute. Thus, only average attributes' utilities are estimated which is often unrealistic as consumers' preferences are, by nature, heterogeneous. Therefore, the mixed or *heterogeneous* logit models (MIXL) have been introduced. The MIXL models (also in known as Random Parameter Logit model, RPL) extend the MNL allowing for unobserved heterogeneity by allowing random coefficients on attributes (Ben-Akiva et al., 1997). According to this model, the utility to person *n* from choosing alternative *j* in choice set *t* is includes a vector of person *n* specific deviations from the mean value of the β s.

However, recently Louviere and Mayer (2007), Louviere *et al*. (2008) argued that much of the preference heterogeneity captured by MIXL can be better captured by the scale term. In addition, they mentioned that the normal distributions of the random parameters, that is usually assumed, do not appear to be very close to it. Thus, thus model turns to be likely a poor approximation if scale heterogeneity is not accounted for. Feibig *et al*. (2010) developed the Generalized Multinomial Logit model (GMNL) where the scale parameter follows a particular specification. According to the GMNL model, the utility to person *n* from choosing alternative *j* on choice set *t* is given by:

$$U_{njt} = [\sigma_n \beta + \gamma \eta_n + (1-\gamma)\sigma_n \eta_n] X_{njt} + \varepsilon_{njt} \quad (2)$$

where γ is a mixing parameter and σ_n is a scaling factor that represents the person-specific scale of the idiosyncratic error, η_n is the vector of person *n* specific deviations from the mean value of the β s.

The GMNL model is specified by default to consider the η_n as uncorrelated. However it may include correlation as choice situations containing the same attributes may have unobserved effects that are correlated (Hensher *et al*., 2005) where the diagonal value of the Cholesky matrix are the true standard deviation of random parameters. Another relevant approach is that the GMNL generally assumed that the heterogeneity in β_n that is η_n, is uncorrelated with υ_n the heterogeneity in σ_n. This restriction can be also relaxed. This adds a new set of parameters to the model $\lambda = Cov(\eta_n, \upsilon_n)$. More details on the estimation procedure and specification of the GMNL model can be found in Fiebig *et al*. (2010)

In our case, study, we used a full GMNL model specification that includes correlation between random parameters and correlated preference and scalar heterogeneity. This decision is it demonstrated the best goodness of fit.

Finally, the relative importance (I_k) of each level of the attributes are calculated by the ratio of a particular level utility to the sum of all levels' utilities as follows: (Smith, 2005 and Green and Rao, 1971):

$$I_k = \frac{\left(\max \beta_k - \min \beta_k\right)}{\sum_{k=1}^{K}\left(\max \beta_k - \min \beta_k\right)} \quad (3)$$

Where $(\max \beta_k)$ is the maximum utility of the attribute (i.e. the most preferred level) and $(\min \beta_k)$ is the minimum utility (i.e. the least preferred level).

2.3. Empirical application

- Attributes and levels

The identification of the attributes and levels is one of the most important steps when applying the CE. Thus, in our case study we focused on the main attributes that consumers take into consideration when purchasing beef meat on the basis of the different studies analysed. However, we also included the attribute that we were interested in which in our case study was the meat enriched with polyunsaturated fatty acids (omega-3 and CLA). In this context, due to the difficulty to cope with all the meat preference attributes we selected an array of the most important ones, relying on prior research performed on meat preference studies and on a discussion group comprised by university lecturers and researchers in the fields of agro-food marketing and meat science. The final set of attributes was reduced to five: animal diet (enriched meat), origin, colour, fat content and price. Finally, a pilot questionnaire was applied to a small sample of respondents to test for the complete understanding of the attributes.

Regarding the origin, several studies highlighted the importance of this attribute in consumers' final decision to purchase food (Ehmke *et al*., 2008; Chang *et al*., 2012). The relevance of this attribute generally rely on the fact that the consumers usually use it as an indicator to evaluate the quality of the product (Lim *et al*. 2013; lusk *et al*., 2006). In addition, the origin is also used by some consumers as an indicator about the proximity of the production (food distance concept) which is related to environmental friendly practice (Kemp *et al*, 2010). Thus, we identified two levels for this attribute, 'locally produced' or 'other Spanish origin' of the meat.

Meat colour is also a relevant factor affecting consumers' purchasing decisions as it is mainly associated to meat quality and freshness (Faustman and Cassens, 1990; Glitsch, 2000) which may influence the likelihood of purchase (Carpenter et al., 2001). Killinger *et al*. (2004) mentioned that colour is one of the important selection criteria since the perceived quality is the basis of their purchasing choices. In the present study we considered two colour levels 'pale red' or 'bright red' meat.

Another relevant attribute is the fat content of beef (Issanchou, 1996; Roosen *et al*., 2003) which is used as a health and quality indicator at the point of purchase. Killinger *et al*. (2004) mentioned that marbling contributes to the visual appraisal of fat content; therefore, consumer perception of marbling could be negative as it increases overall fat in the product and therefore it has long been used as a visual indicator of lean quality. In this study two fat levels in beef steaks were evaluated as 'slight visible fat' or 'moderate visible fat'.

Consumers are becoming more aware of the relationship between diet and health and this has increased consumer interest in the nutritional value of foods (Scollan *et al*., 2006). Food demand has been affected by the presence of functional components that play important roles in health maintenance and disease prevention. Factors affecting human health are gaining prominence in purchasing food products and thus, they are becoming one of the most relevant predictors for food consumption (Bayarri *et al*., 2010; Lusk *et al*., 2003; Roininen *et al*., 1999). The enrichment of food products with polyunsaturated fatty acids is gaining presence in markets especially, with omega-3 fatty acids. In this context, we were interested in analyzing beef meat enriched with beneficial fatty acids: omega-3 (n-3) and conjugated linoleic acid (CLA), achieved through modifications in the animal diet. In this study we focused on four types of beef meat: conventional meat (non-enriched) and enriched meat with n-3, with CLA and with both n-3 plus CLA.

The price of meat is also one of the key elements in consumers' purchasing decisions (Realini *et al*., 2014; Zanoli *et al*., 2013). The price vector was not determined by the actual prices of the product (there is no real market for enriched beef meat), but rather by the unobserved demand curves and thus, was based on prior knowledge concerning the maximum willingness to pay for such product (Mørkbak *et al*., 2010). In this context, a pilot study with 25 questionnaires was carried out, dealing with respondents' maximum willingness to pay for enriched beef meat using an open-ended valuation question. Finally, the price levels included in the choice sets were selected in order to cover the central 90% of the observed values across respondents. The selected level prices were defined in € per tray of 0.3 kg as follows: 6.6€ as high price, 5.7€ as medium-high price, 4.8€ as medium-low price and 3.9€ as low price.

All attributes, including the price, were coded with effect coding as discrete variables. The base level of each attribute was as follows: 'locally produced' for 'origin', 'bright red' for 'colour', 'slight visible fat' for 'fat content', 'conventional' for 'diet', and '3.9€ (low)' for the 'price' attribute.

- Choice set construction

We followed the Dual Response Choice Experiment design (DRCE) which allows respondents to be asked in the same choice exercise first to: a) select their preferred product in a forced-choice from an array of alternatives included in one choice set, and second, b) if they are willing to purchase the previous selected alternative in a non-forced scenario (Brazell, et al., 2006 and Kallas *et al*., 2013). According to this design, introducing a follow-up question after making a forced choice is significant as it allows respondents to face a "purchase/ no-purchase" decision response mode, which may better mimic the circumstances under which actual choices are made while replicating market situations (Ryan and Skatum, 2004). Asking consumers if they are willing to purchase the product emphasises the purchasing context, leading respondents to focus more on real market situation by again considering the price. In the traditional single-stage CE, respondents may be driven by reason and logical arguments in comparing attributes rather than by price considerations (McKenzie, 1993; Kallas and Gil, 2012).

To construct the choice sets, we first determined its size (i.e. the number of alternatives included, m) for our case study. We considered 3 alternatives by choice set as it showed the highest D-efficiency (100%) in the design. In a next step, we followed a full factorial design using the total number of attributes and levels which led to a total of 128 (2^4x2^3) hypothetical products. Thus, for each choice set there is a potential of (2^4x2^3)^3 possible combinations. To make the analysis more affordable, we followed an orthogonal fractional factorial design to estimate all main effects of the attributes enabling us to reduce the number of choice sets from all the initial possible combinations in the full design to only 16 choice sets. However, there were still too many questions for a single respondent which is cognitive burden and time consuming. Thus, a factorial blocking arrangement was carried out obtaining two blocks (Block 1 and block 2), each with 8 choice sets presented to individual respondents. Figure 2 shows one of these choice sets. Finally, to better mimic the meat real market, the steak images were processed using Photo Editor for obtaining the different colour and fat levels. As mentioned by Gerard *et al*., (1996) image processing was an effective tool for determining lean colour and marbling scores of fresh meat.

Figure 2

- Sample

Data were obtained from a sample that consisted of two different consumer groups. The first sample consisted of 322 consumers that did not receive any information (Sample A) about the enriched meat presented in the choice sets. The second group consisted of 325 consumers who received information (Sample B) about the enrichment process of beef and the potential health advantages of enriched meat as indicated in Figure 1. In both cases, consumers were selected in three Spanish cities (Barcelona, Zaragoza and Pamplona) by means of a probabilistic sampling per quotas trying to represent the national distribution by gender and age. A complete description of the demographic and socioeconomic characteristics of the samples in the three cities can be seen in Table 1.

Table 1

Beef samples for the consumer liking assessment were obtained from forty-eight Holstein entire males. Each group of animals was fattened using one of four concentrate diets over a period of 123 days±11.2 days. The ingredients and chemical composition of the experimental diets were reported by Albertí *et al*. (2013). Whole linseed was used as a rich source of n-3 fatty acids and rumen protected CLA as a direct source of CLA (Lutrell® pure, BASF, Germany). All four diets were formulated to be isoenergetic and isoproteic and had similar ether extract (7%) and starch (35%) contents, but differed in the percentage of added linseed and/or rumen protected CLA:

conventional (the conventional commercial ration, 0% linseed and 0%CLA), enriched with n-3 (the conventional ration enriched with n-3 fatty acids through the addition of 10% linseed), enriched with CLA (the conventional ration enriched with CLA through the addition of 2% CLA), and enriched with both n-3 and CLA (the conventional ration enriched with n-3 and CLA fatty acids through the addition of 10% linseed plus 2% CLA). Whole linseed was added to the ground concentrate.

Consumer liking scores for beef were evaluated in ten sessions with approximately ten consumers per session. Consumers evaluated in a blind condition, the overall liking of four different grilled samples of beef (representing the four diets: conventional, enriched with n-3, enriched with CLA, and enriched with both n-3 and CLA) identified with 3 digit random numbers, in the order printed on the recording sheet, which was established to avoid the effect of sample order presentation, first-order or carry-over effects (Macfie *et al*., 1989). Consumers conducted the hedonic evaluation under white light in individual booths, and ate unsalted toasted bread and drank mineral water to rinse their palate between samples. Each consumer rated overall liking using a 9-point category scale (1 'dislike extremely', 2 'dislike very much', 3 'dislike moderately', 4 'dislike slightly', 5 'neither like nor dislike' 6 'like slightly', 7 'like moderately', 8 'like very much', 9 'like extremely'; Peryam and Pilgrim, 1957). After the blind hedonic evaluation, each beef sample was identified by telling consumers what type of beef they have tasted.

3. Results and discussion

3.1. Impact of hedonic evaluation on expected preferences

Focusing on how sensory experience from the hedonic evaluation affect the expected preferences generated for both informed and non-informed consumers, The results from the full GMNL model showed the relative importance of the evaluated beef attributes before (expected preferences) and after (experienced preferences) the hedonic test conducted by consumers with and without information (Table 2). The order of the relative importance of the attributes was slightly different for each group of consumers, showing that the information provided had an impact on their choices, as reported by Kallas *et al*. (2014). The results are in agreement with the findings of Lee *et al*. (2015), who showed that information details provided to consumers for food processed with different technologies had an impact on their purchase intentions. Fenger *et al*. (2015) observed in a choice experiment on new processed meat products that the information provided increased respondents' likelihood of choosing the new products among those who were initially less positive towards them. As stated by Cardello (2003), expectations can be influenced by a wide range of variables, including past experiences, brand, nutritional information, advertising and, labelling among other factors

Table 2

In this context, for uninformed consumers, the expected choice of fat content was the most important attribute, while it was less important for informed consumers. There is a clear substitution effect between the diet and the fat content, showing the significant impact of information on consumers' preferences. It is evident that consumers are less concerned about the amount of visible fat in beef, as long as it is enriched with beneficial fatty acids. Regarding the expected preference for the diet attribute, it was not important in the beef purchasing decisions of uninformed consumers. However, once the product was experienced, diet was one of the most important factors.

For informed consumers, the animal diet attribute was highly significant for both the consumers' expected and experienced preferences. These results show that producing enriched beef with beneficial fatty acids may lead consumers to place less importance on its fat content, assuming that the beneficial compounds (n-3 and CLA) may counteract the negative effects of the amount of fat. The improvement of the fatty acid composition of beef through modifications to animal diet would provide consumers with a product that is closer to current nutritional recommendations for a healthy diet, increasing consumers' purchasing decisions regarding enriched meat. In addition, consumers would be less concerned about the amount of fat present in enriched meat, which is also positively related with the sensory properties of the meat. A minimum level of background intramuscular fat is required in beef for consumer satisfaction (Miller, 2004), and modifying the fatty acid content of beef as well as providing enough fat would offer both a palatable and healthier beef product.

Analysing preferences before and after the sensory test within each group, results show significant modifications in the relative importance of the attributes for uninformed consumers, while minor changes occurred for informed consumers in their beef purchasing preferences. These results confirm that consumers with little information or who do not know what to expect, as a result of the absence of information, may have tentative and uncertain expectations (McGill and Iacobucci, 1992). Therefore, the significant changes between the expected and experienced preferences for uninformed consumers are more remarkable. The results for uninformed consumers showed that after tasting, there was a significant change in the preference for the dietary attribute, which moved from an insignificant preference to the most important one, while the relative importance of the fat attribute decreased.

The results from Table 3 report the marginal utilities of the attributes, their unobserved heterogeneity and the scale parameters[1]. To better understand attribute preferences, the utilities of the different levels of each attribute from the GMNL estimation were obtained. Utilities for the amount of visible fat were higher for uninformed consumers, which indicates that consumers that do not receive information about the benefits of n-3 and CLA fatty acids or their role in human health are more concerned about the amount of fat in meat. These results are consistent with the previous findings of Van Wezemael *et al*. (2014), in which the fat attribute yielded higher disutility. For beef consumption, Van Wezemael *et al*. (2010) also identified that the fat content represents a major issue for consumers. Consumers' experienced preferences showed a reduction in the utilities for the fat attribute for uninformed consumers, since the relative importance of this attribute decreased significantly.

Table 3

For uninformed consumers, the relative importance of other attributes and their utilities, such as animal diet, increased significantly compared to the fat content, which decreased. Enriched beef had similar (enriched with n-3 plus CLA) or higher (enriched with n-3 or CLA) hedonic scores when compared to conventional beef (Table 3). Many authors have indicated that consumers are not willing to compromise on the taste of functional foods for eventual health benefits (Augustin, 2001; Cox *et al*., 2004; Gilbert, 2000; Verbeke, 2006). The results from this

[1] Results showed that the full version of the GMNL (including correlation between the random parameter and taste and scale preferences) had the best fit (AIC, Pseudo R^2).The estimated covariances of the attributes from the Cholesky matrix (45 parameters) are available upon request for interested readers.

study indicate that consumers may be less concerned about the amount of fat in meat if they are aware that sensory properties are not compromised when meat is enriched with beneficial fatty acids.

With respect to the levels of meat color and origin, results show a convergence of preferences for both types of consumers. Moreover, the hedonic test had no impact on consumer preferences, maintaining the status of the preferred color (bright red) and the preferred origin (locally produced). Finally, after the hedonic evaluation, there was a reduction of the utility associated with the high and medium-high prices, and a slight increase with the medium-low price for both groups of consumers. Focusing on the lower price level, informed consumers showed the highest utility increase. This may indicate that the positive tasting experience of the enriched meat (higher liking scores for n-3 or CLA enriched beef) was not enough to justify that the price of meat should be higher as a result of the enrichment. Regarding the opt-out option, the results show that the utility associated with it was not significant for informed consumers, showing that fewer of these selected the opt out option in comparison to the uninformed ones. In the latter case, the utility of the opt-out was positive and significant, which is an indicator that without information some products do not persuade consumers, mainly those enriched with CLA and those with high prices.

For the diet attribute, the utility for the enriched meat with n-3 increased and the preference for conventional meat decreased for both groups of consumers, but especially for uninformed consumers. However, there is a consensus in the lack of preference for the CLA enriched beef, both before and after tasting, for both informed and uninformed consumers. Consumer preferences regarding the diet attribute may be explained by the fact that most consumers are familiar with n-3 fatty acids, and with some commercial products enriched with these fatty acids, in contrast to CLA and the enrichment of food products with CLA. Siró *et al*. (2008) also indicated that well-known compounds are more acceptable than less-known components in food products. Van Wezemael *et al*. (2014) mentioned that the mere presence of familiar qualifying nutrients in beef is sufficient to trigger a favorable response. Verbeke *et al*. (2009) also reported the same results for n-3 fatty acids, as this compound has had a strong and favorable health reputation in previous years.

Finally, after the hedonic evaluation, there was a reduction of the utility associated with the high and medium-high prices, and a slight increase with the medium-low price for both groups of consumers. Focusing on the lower price level, informed consumers showed the highest utility increase. This may indicate that the positive tasting experience of the enriched meat (higher liking scores for n-3 or CLA enriched beef) was not enough to justify that the price of meat should be higher as a result of the enrichment. Regarding the opt-out option, the results show that the utility associated with it was not significant for informed consumers, showing that fewer of these selected the opt out option in comparison to the uninformed ones. In the latter case, the utility of the opt-out was positive and significant, which is an indicator that without information some products do not persuade consumers, mainly those enriched with CLA and those with high prices.

3.2. Impact of information on consumers' beef acceptability

Comparing the overall liking of the four types of beef, results show the information had a non-significant impact ($P>0.05$). This indicates that the information provided to one group of consumers about the benefits of n-3 and CLA fatty acids did not have an influence on their hedonic preferences for beef. In contrast to our results, Morales, *et al*., (2013) showed that information about beef production systems generated positive expectations and increased the acceptability ratings for beef from grazing animals. Meillon *et al*. (2010) also showed that the information on the product knowledge and involvement had a significant impact on overall liking. This may indicate that the impact of information on the hedonic preferences of consumers may depend on the type of information provided, as well as the type of product being evaluated. Since in our study there were no differences in the hedonic scores depending on information, we focused on the values obtained for the whole sample (all consumers) for the interpretation of the sensory scores. The results showed that beef enriched with n-3 fatty acids had higher liking scores than beef from the other three treatments. Beef enriched with CLA had similar liking scores to beef enriched with both n-3 and CLA, which in turn was similar to conventional beef. The results showed that beef enriched with n-3 fatty acids offers hedonic advantages (higher liking scores, $P<0.05$), while the combined enrichment with n-3 plus CLA offers no hedonic advantages over conventional beef. It should be noted, however, that the differences between consumer liking scores are within 0.5 on a 9-point scale, using a high number of consumers (n=642). Results indicate that differences in overall liking scores between the dietary treatments assessed by consumers, although statistically significant, are not large.

Table 4

4. Conclusion

The results showed that hedonic evaluation had a significant impact on defining consumer preferences for beef attributes, especially for uninformed consumers. Preferences for beef attributes differed before tasting, with animal diet being a major attribute for informed consumers but unimportant in beef purchasing decisions for uninformed consumers. However, preferences were similar after tasting for all consumers, with the decreased relative importance of fat content, color and origin attributes, and the increased importance of animal diet. Utilities for n-3 enriched beef increased significantly after tasting, particularly for uninformed consumers, while utilities for CLA enriched beef for all consumers were still not significant after tasting

The information provided about the enrichment process and the health benefits of n-3 and CLA fatty acids had a significant effect on consumer preferences for beef attributes, but no significant impact on overall liking scores. The results indicate that providing information to consumers about the role of beneficial fatty acids and their potential health benefits would favor marketing of n-3 enriched beef through modifications in animal diet. In addition, tasting n-3 enriched beef would result in a positive hedonic experience that may promote the repurchasing of this type of beef. However, the individual enrichment of beef with CLA was not positively valued by consumers, regardless of the information provided and the tasting experience.

After the hedonic valuation results showed that the unobserved heterogeneity is better described by the normally distributed deviations from mean coefficients and there is no additional value in describing it with a scaling factor. Thus, the beef tasting exhibit for both the informed and the uninformed consumers an evidence of a shift in the scaling factor across choice. The comparison of preferences from before and after the sensory test shows significant changes in the relative importance of some attributes. In this sense, the heterogeneous scale identified before the sensory test tended to be more homogeneous after tasting. The GMN-L model was first estimated with uncorrelated coefficients. Compared to this, the correlated version provides a better fit to the data. Beside preference heterogeneity, we also find statistically significant scale heterogeneity; therefore the assumption of identical scales across individuals is rejected. Results also showed that the full version of the GMN-L (including correlation between random parameter and between taste and scale preferences) had the best goodness of fit (AIC, Pseudo R^2). Analysing the attributes non-attendance and uncertainty before and after sensory are proposed for further research.

This study indicates that marketing opportunities for n-3 enriched beef seem promising in Spain. The development of new product concepts by the beef industry through modifications in animal feeding, represent an opportunity to modify bioactive components in meat that meet consumer demand trends for healthier food products. Information related to the enrichment process with beneficial fatty acids and their potential health benefits are key factors to promote such beef products.

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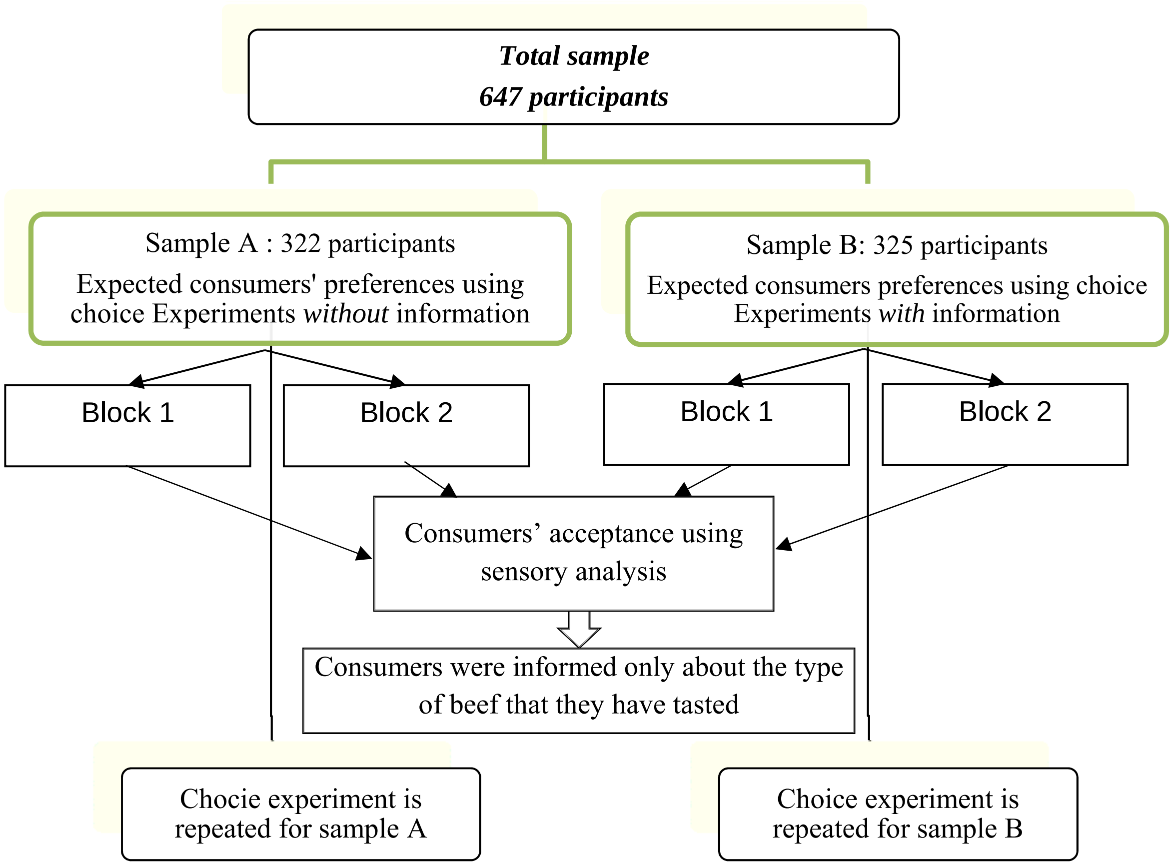

Figure 1: Scheme of the methodological framework

Figure 2: Example of a choice set

Table 1. The demographic and socioeconomics characterization of consumers by city

	Barcelona		***Zaragoza***		***Pamplona***	
N	100	106	113	115	109	104
	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
Gender (%)						
Female	46.0	47.2	49.6	52.9	54.1	53.9
Age (%)						
18-29	12.0	18.9	31.0	26.0	36.7	26.9
30-40	25.0	22.6	22.1	19.1	16.5	26.9
41-60	45.0	43.4	28.3	32.2	29.4	30.8
> 60	18.0	15.1	18.6	22.6	17.4	15.4
Age (year)	45.2	44.11	43.1	45.5	42.2[a]	42.2
Studies (%)						
Primary or lower	9.0	8.5	20.4	27.8	8.2	18.3
Secondary	60.0	57.5	22.1	27.0	16.5	15.4
University	31.0	34.0	57.5	45.2	75.2	66.3
Income (%)						
Below average	44.0	43.8	41.6	48.7	26.6	39.4
Average	45.0	45.7	46.9	40.9	56.9	43.3
Above average	11.0	10.5	11.5	10.4	16.5	17.3
Occupation (%)						
Student	11.0	13.2	17.7	16.5	33.9	15.4
Employee	39.0	35.8	47.8	48.7	36.7	54.8
Own business	4.0	9.4	5.3	1.7	3.7	2.9
Retired	10.0	16.0	14.2	15.7	14.7	12.5
Housewife	14.0	9.4	3.5	7.8	5.5	4.8
Unemployed	22.0	16.0	11.5	9.6	5.5	9.6

Table 2: Relative importance of beef attributes (%) from the G-MNL model

β	***Generelized Multinomial Logit m odel***			
	Without information		***With information***	
	Pre Sensory	***Post sensory***	***Pre Sensory***	***Post sensory***
Fat content	**36.74^{***a}** **(25.1; 48.4)**	**19.46%^{***b}** **(12.2; 26.7)**	**19.62^{**b}** **(7.7; 31.6)**	**16.45%^{***a}** **(9.4; 23.5)**
Colour	**21.88^{***a}** **(13.1; 30.6)**	**11.78%^{***b}** **(7.2; 16.2)**	**16.92^{***a}** **(10.3; 23.6)**	**10.57%^{***b}** **(6.5; 14.6)**
Origin	**19.34^{***a}** **(12.7; 25.9)**	**7.14%^{***b}** **(3.2; 11.0)**	**15.07^{***a}** **(9.1; 21.0)**	**8.62%^{***b}** **(4.8; 12.4)**
Diet	**1.72^{b}** **(-7.6; 11.0)**	**35.98%^{***a}** **(26.9; 45.1)**	**22.73^{***b}** **(15.4; 30.0)**	**34.79%^{***a}** **(25.8; 43.8)**
Price	**20.33^{***a}** **(11.1; 29.5)**	**25.66%^{***a}** **(19.3; 31.9)**	**25.67^{***a}** **(17.4; 33.9)**	**29.57%^{***a}** **(23.4; 35.8)**

Significance levels: *** $p<0.01$; **$p<0.05$; * $p< 0.10$

^{a,b}: Differences between preferences (pre sensory and post sensory) within each group at 95%.

Table 3: Results from model estimations for consumer data with and without information

	Without information		With information	
	Pre sensory	**Post sensory**	**Pre sensory**	**Post sensory**
	Random Parameters in utility functions (β)			
Moderate visible fat	-0.50***	-0.41***	-0.31***	-0.35***
Pale red	-0.30***	-0.25***	-0.27***	-0.22***
Other Spanish origin	-0.26**	-0.15**	-0.24***	-0.18***
Enriched with n-3	0.03	0.58***	0.19***	0.42***
Enriched with CLA	-0.01	0.12	0.01	0.10
Enriched with n-3 & CLA	0.11	0.22*	0.33***	0.49***
Price 6.6€ (high)	-0.52***	-0.69***	-0.67***	-0.87***
Price 5.7€ (medium-high)	0.11***	-0.07	0.20***	0.02
Price 4.8€ (medium-low)	0.37***	0.38***	0.32***	0.41***
Opt-Out	0.48***	0.44***	-0.15	0.16
	Scale parameters			
Variance parameter in scale parameter	0.56***	0.08	0.12*	0.11
Weighting parameter Gamma	0.34***	0.31***	0.10	0.10
	Standard deviations of parameters distribution			
Std. Dev. Moderate visible fat	1.63***	1.58***	2.14***	1.82***
Std. Dev. Pale red	0.95***	0.11**	0.90***	0.19***
Std. Dev. Other Spanish origin	0.15**	0.26***	0.16***	0.28***
Std. Dev. Enriched with n-3	0.48***	1.08***	0.52***	1.71***
Std. Dev. Enriched with CLA	0.31***	1.37***	0.20	0.52***
Std. Dev. Enriched with n-3 & CLA	0.56***	1.97***	0.65***	2.099***
Std. Dev. Price 6.6€ (high)	1.67***	1.48***	1.41***	1.57***
Std. Dev. Price 5.7€ (medium-high)	0.61***	0.76***	0.51***	0.76***
Std. Dev. Price 4.8€ (medium-low)	1.06***	0.916***	0.77***	0.79***
Std. Dev. Opt-Out	2.39***	2.30***	2.12***	2.60***
Log-Likelihood (θ)	-2,658.67	-2705.29	-2656.7667	-2801.51
Log-Likelihood (0)	-3,571.09	-3,571.09	-3,604.36	-3,604.36
LL ratio test	1,824.84***	1,731.60***	1,895.19***	1605.69***
Pseudo R^2	0.255	0.242	0.262	0.227
AIC/N	2.124	2.160	2.103	2.214

Significance levels: *** p<0.01; **p<0.05; * p< 0.10

Table 4. Overall acceptability scores of beef from animals fed different diets.

Type of beef meat	Overall acceptability[*] *Without* information	Overall acceptability[*] *With* information	*P value*[**]	*Whole Sample*
Conventional	5.73	5.70	*0.858*	5.71[c]
Enriched with omega-3	6.17	6.10	*0.611*	6.14[a]
Enriched with CLA	6.04	5.76	*0.051*	5.90[b,d]
Enriched with omega-3 & CLA	5.74	5.79	*0.712*	5.76[c,d]

[**] Differences between mean scores assigned by consumers with and without information.
[a, b, c, d] Statistical differences among types of beef meat for all consumers at 95 %.
[*] Consumer overall acceptability of beef samples was assessed using a 9-point hedonic scale (1 = dislike extremely to 9 = like extremely).