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Are consumers beef quality perceptions in accordance with objective beef quality?

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Abstract

The consumer has the final word in food choice, which is determined by his perceived quality. Within a project coordinated by the Faculty of Veterinary Medicine we tried to relate objective quality with the consumer quality evaluation. To do so, we have measured the expected and experienced quality of a sample of Portuguese consumers towards three types of beef (PDO, national and imported) at the shop, and compared this subjective evaluation with the beef objective quality. Results at the consumer level show that respondents perceived PDO beef to be of higher quality than the two other types of beef for different attributes and for overall quality at the shop location. In terms of objective quality results, the three types of beef showed highly similar physicochemical characteristics and there were no differences, on average, in terms of the aspects mostly considered by the consumers - tenderness, colour and fat content. Hence, it was not possible to show that physicochemical characteristics are good predictors of consumer preferences. However shear force revealed a positive asymmetry showing a higher probability to find a tender beef in PDO than in the other types of beef. This should constitute an area for further research.

Keywords: PDO beef, perceived quality, objective quality

JEL codes: Q130

1. Introduction

The present work had as main objectives to relate consumer preferences towards a particular type of beef with objective beef quality. In other words, we wanted to compare subjective beef expected and experienced quality, using a sample of Portuguese consumers at the shop, in the moment of choice and after a blind taste test, with objective beef quality, performed on the same beef types at the laboratory.

Beef is normally marketed as an undifferentiated beef implying that the possibility of making value is lost. We are also aware of the great pressure this sector has been under in the recent past. In such a scenario, differentiation might be a source of competitiveness. We wanted to understand how differentiated beef was in fact perceived by the Portuguese consumers. Quality labels such as Protected Designation of Origin (PDO) are a way to differentiate beef. In Portugal, PDO beef accounts for approximately 2.5% of the market (in terms of slaughters approved for consumption) constituting a niche market.

Before entering in the Data and Methods section, some aspects are worth mentioning, namely some similar works that have been undertaken and also what it is meant by perceived quality, expected quality, experienced quality and objective quality. Works like the ones by Grunert *et al.* (2004), Resurreccion (2003), Grunert (1997), Bredhal (2003), and Acebron and Dopico (2000) are worth looking at and we will not go here through a detailed literature review or critic of these articles since it is not the scope of this communication. Nevertheless, they confirm the relevance of the subject under study and the different analysis or experimental designs that have been developed to assess these issues.

In terms of the relevant concepts that are used within this work, we should remember what is meant by objective and subjective quality. According to Grunert (2005), “there is general agreement that quality has an objective and a subjective dimension. Objective quality refers to the physical characteristics built into the product

and is typically dealt with by engineers and food technologists. Subjective quality is the quality as perceived by consumers.”

Concerning food quality as perceived by the consumer, we should distinguish between expected and experienced quality. In order to infer upon the quality of a product consumers use pieces of information, which are in fact cues used to form the quality expectations of the product (Steenkamp, 1990). This quality expectation is what consumer anticipates from a product after using information at hand. If this is so, the decision to buy a particular food product will be highly influenced, amongst other factors, such as experiences and psycho-sociological features, by the expectations consumer forms about the product quality. At this stage, the consumer has not experienced the product yet. Once the product is eaten, consumer forms quality experiences, where, quality perception of food products are mainly characterised by the experience dimension (and to a certain extent by the credence dimension¹).

Sensory properties of beef are the main repeat purchasing criteria for consumers (Haugen and Kvaal, 1998). Tenderness is the major palatability characteristic of beef and defines its commercial value (Monin, 1991), and is highly correlated with overall appreciation (Aguar Fontes *et al.*, 2008). One of the major problems of beef industry is that tenderness is subject to considerable and unpredictable variability (Jeremiah *et al.*, 2003). For food products to have an optimum consumer appeal they must provide a high degree of eating satisfaction in a consistent way throughout the time. Therefore, the lack of consistency on the sensorial quality of beef can cause market problems, and any contribution to increase beef tenderness and its predictability is relevant to all the market players.

Organoleptic properties of beef are an ultimate consequence of meat characteristics. According to Purslow (1994) and Koochmaraie *et al.* (2002), connective tissue and muscle fibres are the main factors influencing beef. In fact, research often uses physical and chemical characteristics as indicators of sensorial properties because they are cheaper and faster to perform than sensorial evaluation. Despite the huge amount of research carried out, correlations obtained between sensory and instrumental parameters

¹ For an in-depth revision of these concepts see Bech *et al.* (2001).

are usually low (Huidobro *et al.*, 2005). Hence, the degree of relationship between instrumental data and sensory texture data is still of major concern in evaluating the relevance and significance of sensory research data.

The work we are presenting here was the result of a study that took place during three years within a broader research project entitled “A quality policy for the beef sector in Portugal: production systems, consumers’ tastes and preferences” (Project AGRO 422). This project had as main objectives the identification of beef quality parameters and the suggestion of some guidelines for a quality policy in order to improve Portuguese beef competitiveness in the present global market. To achieve these objectives four phases were developed: phase 1 included the characterisation of the evolution of tastes, preferences and consumption habits towards beef in Portugal; phase 2 consisted on the identification of the different production methods that influence beef objective quality parameters; phase 3 consisted of the identification of a quality beef for the Portuguese consumer and which was the position of Portuguese beef (PDO, brand, undifferentiated) from different production methods within the marketplace, and a last phase 4 tried to design a quality policy integrating all the results obtained in the previous phases. With all the phases described, which were sub-divided in twenty sub-phases, it was possible to cover all the levels of the beef chain and this was, in fact, one of the main objectives of the mentioned project. We wanted to cover the full beef chain—from the producer to the consumer, going through the slaughterhouse and the distributors.

We will now move on to the methodology used to analyse consumers’ quality expectations towards beef, experienced quality and objective quality, in the context of the research Project AGRO 422. Detailed analysis of the trials were the object of two PhD studies (SFRH/BD/21784/2005 and SFRH/BD/31091/2006), most of the results concerning the supermarket experiments have been published (Banović *et al.*, 2010; Banović *et al.*, 2009).

2. Methodology

The trials undertaken at the supermarket had, as main objective, to establish the relationships between expected and experienced quality having, as the main underlying research questions: (i) which factors really influence buying decisions and how are expectations towards beef built; (ii) how are the beef quality attributes evaluated after tasting the beef in a blind taste at the shop location; (iii) how are these attributes evaluated when tasting the beef at home, and (iv) how consumers' evaluation correlate with beef objective quality. This full analysis would allow us to know the position of a differentiated beef in the market, in relation to its direct competitors, and characterize consumer preferences towards particular intrinsic beef attributes (such as visible fat, colour and tenderness) and also taking into account certain features that are the result of the handling conditions throughout the chain.

The consumer trials took place at a large supermarket located in the area of "Grande Lisboa" (surrounding area of the Lisbon district) and it was chosen mainly due to the characteristics of its average consumer, but also due to the fact that a significant proportion is a regular buyer of PDO beef. It was decided that strip loin muscle would be used and this option had mainly to do with the fact that we would have to compare the results of the consumers' quality perceptions with the objective quality analysis at the laboratory and this, according to the literature, should be done on strip loin muscle. These beefs were of three types: a Portuguese PDO beef (Carnalentejana PDO beef with around 42% of the PDO beef market), an imported beef and a national beef, all priced differently where PDO beef was the most expensive one, followed by the national and then the imported one. Prices were established by the supermarket and remained constant throughout the days of trial though there were important absolute differences in the value of the three types of beef. All the three types of beef were exposed as usual, that is, in the cooling counter where they normally would be found. As soon as the beef purchasers picked one package of the mentioned beefs and put it in the trolley, they were approached in order to invite them to participate in the study. One hundred people were interviewed. They were asked at three stages: a first series of questions when they picked the beef package concerning the expected quality and they were asked not only about the package they picked but also about the other beef included in the study; a second series of questions concerned experienced quality were made when purchasers were invited to try the beef in a blind taste test; a third questionnaire was given to the

respondents, to be answered after eating the beef at home, who then sent it back in a prepaid envelope (we obtained a 85% response rate but we have not analysed these questionnaires yet). Further details of the experimental design are presented in Banović *et al.* (2010).

The relevant aspects beef consumers would have to appreciate were mainly divided in: (i) intrinsic information- cut, colour and visible fat; (ii) extrinsic information- price, brand, origin, label and package, and (iii) quality dimensions- taste, tenderness, juiciness, fat, freshness, health, nutritional content, safety and global appreciation (Banović *et al.*, 2010).

Concerning objective analysis, fifteen beef samples from the strip loin muscle (*longissimus lumborum*) of each beef type (Carnalentejana PDO, imported and national) were collected for laboratorial analysis so that objective quality concerning particular attributes such as tenderness, fat content, and colour could be compared with the evaluation of the same parameters made by the consumers, that is, with the subjective quality perception. Whenever possible these samples were collected from animals from the same lot of those used to consumer evaluation. Immediately after collection, muscle pH (Hanna HI 99163 pH-meter) and colour (Minolta CR 300 colorimeter) were measured. Samples were then minced, vacuum packed and frozen at -20 °C till later determination of chemical fractions that are considered to correlate with sensorial quality (intramuscular fat, total collagen and its solubility, myofibrillar fragmentation index). Also one steak 2.5 cm-thick were frozen and vacuum packed for Warner-Bratzler shear force (TA-tx2i Texture Analyser, Stable Micro Systems) and cooking losses determination. Shear force is negatively correlated with beef tenderness and values obtained below 5 kg indicate large beef acceptability by the consumers.

3. Results

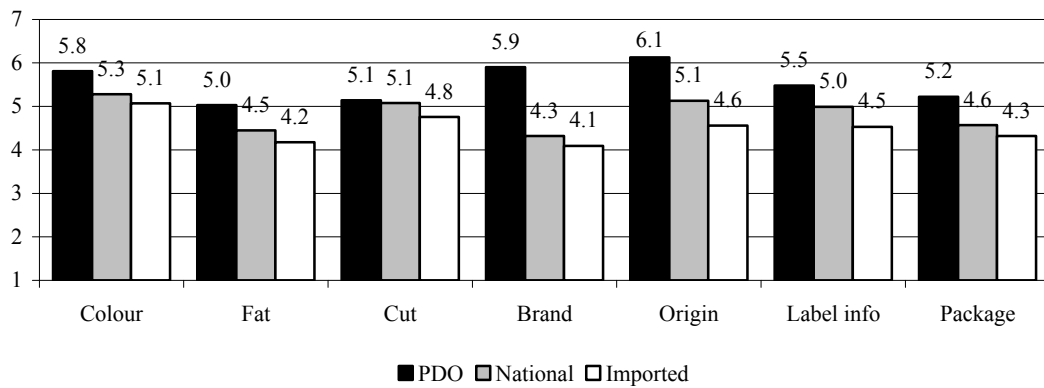
Subjective quality

The sample was mainly constituted by female (66%) which is not a surprise since in Portugal women are still the main responsible for the household food shopping. Approximately 62% of the participants were from the district of Lisbon and 38% from Setubal district (a district located in the South of Lisbon). Average age of respondents was 43 years. The sample was biased towards people with higher literacy levels and higher income. This sample is not representative of the Portuguese population though these are normally the characteristics associated with people who buy differentiated beef, namely PDO beef. Nevertheless PDO beef is a niche market and this sample can be used to infer this niche consumers' behaviour (for more details see Banović *et al.*, 2010).

Results show that the PDO beef was the chosen one by half of respondents (46% picked PDO beef, 29% imported beef and 25% national beef, from now on referred to as national beef) who frequently already knew this type of beef (87% had bought PDO beef before whilst awareness of imported beef was much lower since 62% had never bought it before).

Most of the results presented here are shown in detail in Banović *et al.* (2010). Regarding consumers' level of appreciation of intrinsic cues (Figure 1), results show that colour and visible fat of PDO beef is more in accordance with respondents' preferences.

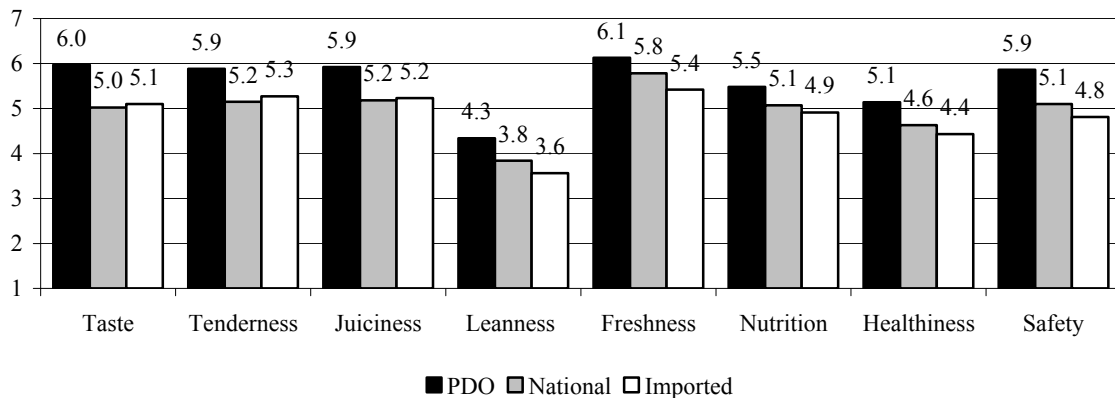
Figure 1. Level of appreciation of each cue (1= absolutely dislike; 7=absolutely like)



One-way ANOVA and post-hoc *t-test* showed statistical significance differences between PDO beef and the other two beefs for all cues, except cut, as expected since beef steaks were cut in the same way (Banović *et al.*, 2010).

Consumers expected PDO beef to be of better quality concerning all sensory beef attributes (Figure 2), and in terms of global appreciation (Figure 5).

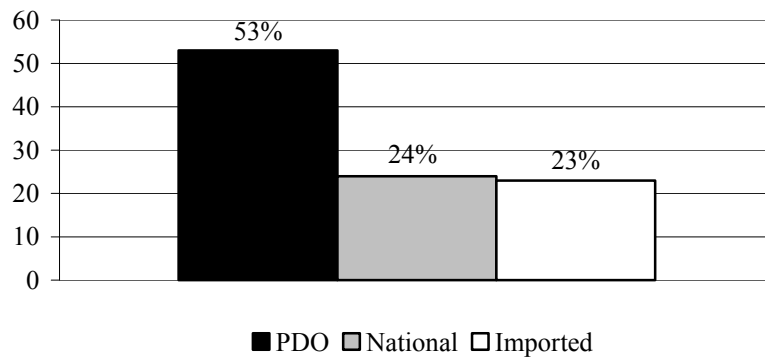
Figure 2. Expected quality for beef attributes (e.g. 1= not at all tasty; 7=extremely tasty)



Consumers' appreciation of PDO beef quality attributes (or dimensions) was always statistically different from the other two types of beef. Freshness was the only beef quality attribute statistically different amongst all beefs.

PDO beef was also the preferred beef after the blind taste by approximately 53% of the trial participants (Figure 3).

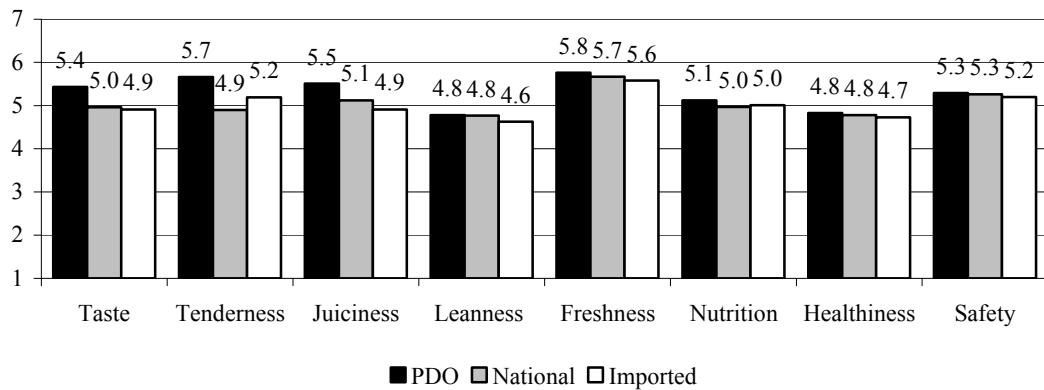
Figure 3. Preferred beef in the blind taste



After the blind taste PDO beef was considered of superior quality in almost all the quality attributes - such as taste, tenderness and juiciness- and in terms of overall (global) appreciation. One-way ANOVA and post-hoc *t-test* showed statistical significance difference between PDO beef and the other two beef types concerning the attributes taste, tenderness and juiciness, and concerning global appreciation (Banović *et al.*, 2010).

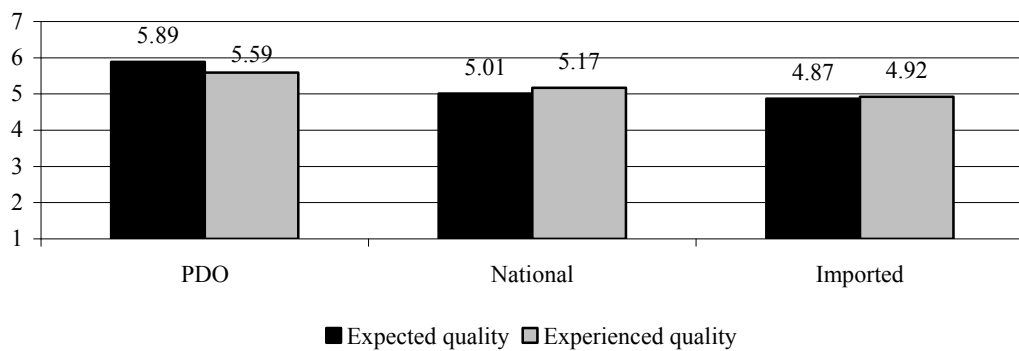
Evaluation of beef quality attributes after experiencing the beef in a blind taste showed this was normally below expected quality evaluation (Figure 2 *versus* Figure 4). This difference was particularly relevant for PDO beef.

Figure 4. Experienced quality of beef attributes: blind taste



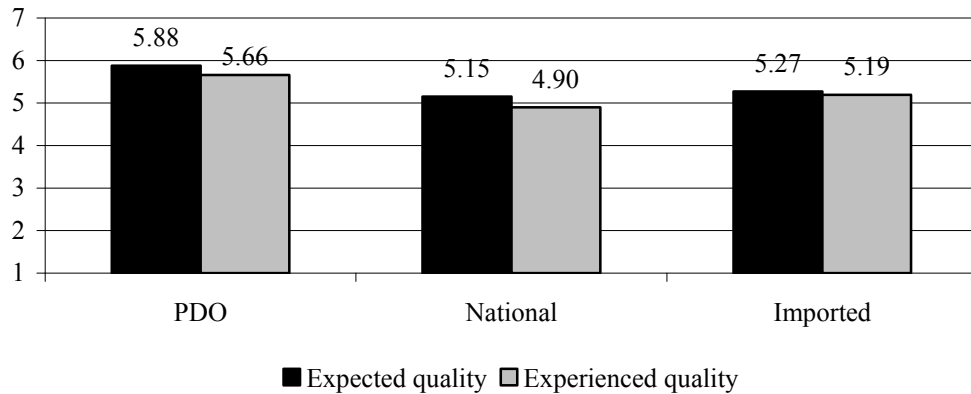
Global appreciation of the three types of beef, both expected and experienced, is now analysed. We will consider that this global appreciation should be a good indicator of the evaluation of all quality attributes. PDO beef global appreciation (both expected and experienced) is significantly different from the other two beef types (Figure 5). There are no significant differences between expected and experienced global appreciation for national and imported beef but this difference is significant for PDO beef.

Figure 5. Expected and experienced global appreciation



We will look now in detail for the attribute tenderness since this is the one that is normally used by consumers to decide upon a repeat purchase, or not, and also one that allows for comparison with the results of objective quality. PDO beef was the beef considered as more tender, both expected and experienced (Figure 6). Notice that for all the three types of beef evaluation of tenderness was always below expectations, though these differences were not statistically significant.

Figure 6. Expected and experienced tenderness



Objective quality

Detailed results of the analysis presented here are the subject of a PhD work (SFRH/BD/31091/2006) therefore only the preliminary results will be given. The experimental design included beef sample collection for objective analysis in the same days and from the same lots of the ones used in the consumer trials. However, this objective was only possible to achieve for three days due to beef unavailability, mainly concerning PDO beef.

In fact, these laboratory analyses require a large sample from the strip loin muscle of each beef type from different animals. This means that fifteen samples from fifteen different animals of each type (PDO, national and imported) were analysed.

As shown in Table 1, the three types of beef analysed showed, on average, similar characteristics in terms of colour (L^* , a^* , b^*) and parameters related to beef tenderness (intramuscular fat, total collagen and shear force).

Table 1

Colour (L*, a*, b*), intramuscular fat (IMFat), total collagen and its solubility, cooking losses and Warner-Bratzler shear force of PDO, National and Imported beef

	National	Imported	PDO	sem	Sig.
L*	33.28	33.45	33.69	0.739	NS
a*	19.90	20.80	21.01	0.476	NS
b*	3.39	4.44	3.83	0.434	NS
IM Fat (%DM)	2.95	2.45	2.93	0.369	NS
Total Collagen (%DM)	2.44	2.34	2.38	0.104	NS
WBSF (kg)	5.42	5.28	5.48	0.331	NS

sem: standard error of means; NS: p>0.05; %DM: percentage of Dry Matter

Considering the different genotype, origin and production systems of the three types of beef under analysis, these results were quite surprising as there were no differences between the three types of beef.

Let us now look in depth to the attribute tenderness (here measured by shear force) since this is the one used by the consumers as the most important factor in beef global appreciation. Though on average, shear force was similar across the three beef types, an in depth look at the data showed a huge variability within beef types (Table 2).

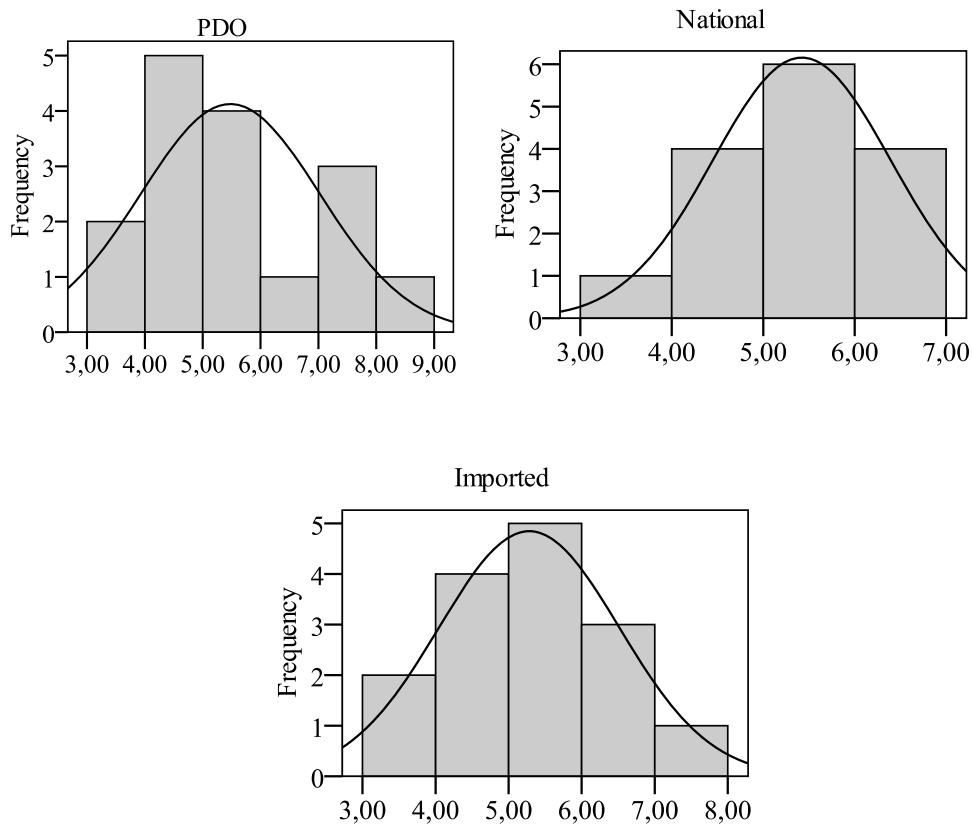
Table 2

Descriptive statistics of Warner-Bratzler shear force of PDO, National and Imported beef

	N	Min.	Max.	Mean	St. Dev.	Skewness	
						Statistic	Std. Error
PDO	16	3.225	8.291	5.478	1.547	.534	.564
Imported	15	3.014	7.720	5.281	1.235	.002	.580
National	15	3.429	6.962	5.422	.972	-.111	.580

Looking at skewness values for each beef type (Table 2), we can see that PDO beef shows a positive skew, that is to say, the values distribution is concentrated on the left; national beef shows a negative skew, whilst the distribution for imported beef is almost symmetric (Figure 7).

Figure 7. Skewness of Warner-Bratzler shear force of PDO, National and Imported beef



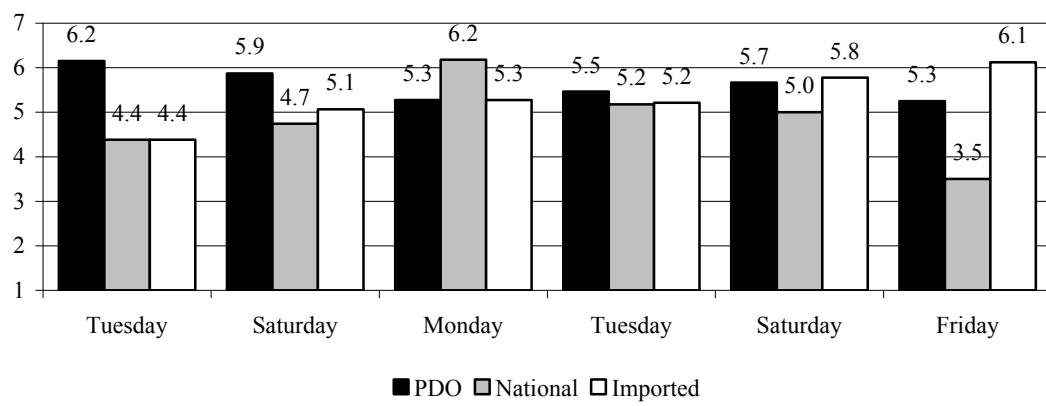
Shear force below 5 kg is associated with a large acceptability of beef by the consumer, and below 4.5 kg is considered a very tender beef. Therefore, these results show that there is a higher probability to find a tender beef with PDO beef, than with the national or imported beef.

Relationship between subjective and objective quality

Results obtained at the consumer level are not confirmed by the results obtained at the laboratory (objective analysis). In fact, consumers identified differences between PDO beef and the other two types of beef concerning colour, fat and sensorial characteristics (tenderness, taste and juiciness) but, on average, laboratory results did not show any differences. Obviously, these results are affected by the fact that samples for consumers tests and for lab analysis were not always from the same animal.

These results also confirm the existence of an unexpected and unpredictable variability on beef tenderness, being one of the major problems of the beef chain. In Table 2 we can see that PDO beef shows the highest variability, and Figure 7 shows that PDO beef had more samples considered tender or very tender, alongside with four samples with a high shear value, indicating lower tenderness. This variation in tenderness was also observed for all beef types during the trials with consumers (Figure 8).

Figure 8. Experienced tenderness per day



4. Concluding Remarks

The results concerning consumers' perceptions we have presented here, should be regarded with caution, as also mentioned in Banović *et al.* (2010; 2009). Although the trials designed were an innovation (took place on a real shop environment and the lag between evaluations was shortened), the sample dimension and its particular characteristics, are a limitation since it depicts only the behaviour of a small niche of consumers.

Results at the consumer level show that respondents perceived PDO beef to be of higher quality than the other two types of beef for different attributes and for overall quality at the shop location. Likewise respondents evaluated differently these three types of beef in a blind taste test. PDO beef was the preferred one after this blind test for

more than half of the respondents. Furthermore, respondents evaluated PDO beef as better than the other beef types for almost all the sensory attributes, particularly taste, tenderness and juiciness and in terms of global appreciation.

In terms of objective quality results, the three types of beef showed highly similar physicochemical characteristics and that there were no differences, on average, in terms of the aspects mostly considered by the consumers - tenderness, colour and fat content. However, tenderness revealed a positive asymmetry showing a higher probability to find a tender beef in PDO than in the other beef. Hence, it was not possible to show that physicochemical characteristics are good predictors of consumer preferences. This should constitute an area worth further research.

Major limitations in this work to make these two sources of information compatible, that is subjective quality (consumers' appreciation) and objective analysis data comparable, can be mentioned:

- the unavailability of beef samples for laboratory analysis in all and the same days that trials at the supermarket took place;
- the need to use large samples of beef for lab analysis implies that these can be different from the ones available for consumers, though coming from the same lot of animals, and

It should be highlighted that there is a natural restriction to this kind of research: the huge variability of intrinsic quality characteristics (objective) both in the same sample and between samples even from homogeneous animal lots.

Further research should be undertaken in order to try to overcome the above mentioned limitations, namely, enlarge the sample used to overcome some of the variability observed, and find out other methodologies that might contribute to a better explanation of the relationship between subjective and objective quality.

Aknowledgments

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