

Is there a link between beef quality and animal welfare in traditional beef systems?

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1. Introduction

Farm animal welfare is a growing concern for many consumers in Europe and is becoming increasingly recognised as an important attribute of food quality (Blokhuis *et al.*, 2008; Quintili and Grifoni, 2004; Blandford *et al.*, 2002). In spite of different interpretations within different parties, there has been a profound evolution in animal welfare perception in Europe. Specifically considering beef products, Veissier *et al.* (2007) report that consumers have relevant concern levels for animal welfare. In Portugal, Aguiar Fontes *et al.* (2008) in a study looking at consumers' attitudes and preferences towards beef, when analysing the level of agreement with a series of statements, and using a 5 point Likert Scale (1 = total disagreement, 5 = total agreement), found an average score of 3.78 for the statement «I don't mind paying more for beef that ensures animal welfare».

These concerns are in some cases strong enough for the market to respond by developing farm assurance schemes guarantying animal welfare friendly products, such as UK's so called "Freedom Food" (Burgess *et al.*, 2003). Nevertheless, it is important to re-

Abstract

There has been a profound evolution concerning farm animal welfare perception in Europe. This together with growing evidence that animal welfare has an impact on food safety and quality led to new legislation for an animal friendlier production sector. Also, new support measures aid those who supply cost increased animal friendlier products with differentiated quality. This article unveils connections between traditional systems and animal welfare. Two beef production systems in Portugal are described. A descriptive analysis is relevant for understanding why local breeds are preferred by producers, and why "semi-extensive" systems are better adapted to the country. Portuguese beef systems are also described in terms of their animal welfare status and probable control points. A link between Portuguese native breeds and beef quality is proposed, namely through increased animal welfare that may be translated into beef intrinsic quality. Nevertheless, as animal welfare is a credence quality attribute, consumers must rely on information, that is, on quality cues, to infer upon it on the product. This might give marketers the option to develop quality differentiated strategies based on that attribute, within their broader marketing strategies.

Keywords: Beef Quality; Animal Welfare; Control Point; consumer preferences

Résumé

En Europe, la perception du bien-être animal a subi une évolution bien profonde. L'évidence de plus en plus croissante que le bien-être animal a un impact sur la sécurité et sur la qualité des aliments a permis de formuler une nouvelle législation pour un secteur animal plus écocompatibles. Des mesures soutiennent tous ceux qui fournissent des produits animaux écocompatibles dont les coûts sont plus importants. Cet article décrit les relations entre les systèmes traditionnels et le bien-être animal en décrivant deux systèmes de production au Portugal. Une analyse descriptive explique pourquoi les producteurs préfèrent les races locales tout comme la raison pour laquelle les systèmes semi-extensifs s'adaptent davantage au pays. Les systèmes d'élevage sont aussi décrits en termes de bien-être animal et de points de contrôle. On propose un lien entre les races locales portugaises et la qualité de la viande surtout à travers un bien-être animal accru qui peut se traduire en qualité intrinsèque de la viande. Cependant, vu que le bien-être animal est un attribut de qualité de confiance, les consommateurs doivent se fier des informations et des indices de qualité. Les marchés pourraient mettre au point des stratégies de qualité différenciées qui se base sur cet attribut.

Mots clé: Qualité de la viande, bien-être animal, Point de contrôle, préférences des consommateurs.

member that it may be possible that the consumption of animal friendlier products is motivated by the perceived link between the improvement of animal wellbeing and the quality of the food product, rather than concerns about the animal's quality of life (Harper and Makatouni, 2002).

This idea of consumers' motivations derives from the fact that food product's characteristics are its real attributes as perceived by consumers (Bech *et al.*, 2001). If attributes such as animal welfare are considered food attributes as perceived by consumers, then they will influence the product quality.

Animal welfare should thus be included in the so called credence quality attributes, *i.e.*, a quality attribute that cannot be evaluated, under normal circumstances, by the average consumer, becoming a question of faith and trust in the information provided (Grunert *et al.*, 2004).

All this means that the welfare quality of food

products can be considered a relevant issue within the food chain, additionally supported by the growing evidence that animal welfare has direct and indirect impacts on food safety and quality (Blokhuis *et al.*, 2008; Wyss *et al.*, 2004).

This evolution in society, together with pressure from different associations (Quintili and Grifoni, 2004; Wyss *et al.*, 2004; Blandford *et al.*, 2002) has had significant policy consequences, and once the food security issues were overcome in Europe, the Common Agricultural Policy (CAP) evolved

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through a series of reforms in this direction (Blokhuis *et al.*, 2008; Blandford *et al.*, 2002). These eventually led to considerable changes in the relationship between citizens and the agricultural sector, and also to new criteria for financial support to farm. Farmed animals are no longer viewed as just a means for food production, but also as an integrant piece of other social concerns such as food safety and quality, environmental protection and sustainability (Blokhuis *et al.*, 2002). It is in this context that animal welfare is now included in a concept of multifunctionality of farming, justifying new policies, regulations and support measures (Arfini, 2006).

Within this environment, the White Paper on Food Safety, adopted by the European Commission in 2000 “makes proposals specifically designed to promote the health and welfare of animals, once it is recognized that animal welfare questions need to be integrated more fully with regard to food policy, in particular their impact on the quality and safety of products of animal origin intended for human consumption” (Blokhuis *et al.*, 2008; European Commission, 2000).

Current research shows that well-treated livestock free from distress and able to express their natural behaviour, is healthier (Horgan and Gavinelli, 2006), thus more productive, both in quantity and quality terms. However, as Webster (2001) states, even though farmers are responsible for providing animal welfare, there are costs associated with implementing higher animal welfare standards, such as those related with training the farm staff, and adapting farm activities to appropriate standards. Moreover, certification costs can be very high.

Even though there are support measures for farmers complying with standards above those legally imposed and quality differentiated products may be sold with premium prices (as is the case with some animal friendlier products), if consumers want more animal welfare, they must convert that expressed desire into effective demand for welfare friendly products (WFP). Then, the increased costs may be compensated (Schnettler *et al.*, 2009) and welfare-based quality differentiated products may be able to find a market share large enough to compensate higher production costs (Vanhonacker *et al.*, 2001).

Nevertheless, most consumers still show a tendency to buy the cheapest meat, thus not reflecting the attitude towards animal welfare in their buying behaviour (Vanhonacker *et al.*, 2008). This means that choices made by the majority of consumers may not match the demand expressed by society (Vanhonacker *et al.*, 2007; Webster, 2001), which provides grounds for proper investigation about consumers’ preferences and willingness to pay for WFP.

Included in a broader research project investigating Portuguese consumers’ willingness to pay for beef products with

credence quality attributes related with safer, cleaner and animal friendlier production methods, this article’s objectives are:

- To define the current status quo and legal framework for beef cattle welfare in the EU and in Portugal.
- To unveil connections between “semi-extensive” production systems and beef cattle welfare in Portugal.
- To analyse whether welfare friendly products can be included in quality differentiating strategies for the Portuguese beef market.

2. Animal welfare – definition and legislative framework

Probably, one of the major problems associated with farm animal welfare certification is the definition of welfare (Quintili and Grifoni, 2004). This definition problem starts with different interpretations from different parties (Blokhuis *et al.*, 2008; Quintili and Grifoni; Vanhonacker *et al.*, 2007), because conflicting aspects such as economics, feasibility and environmental concerns have to be considered (Wyss *et al.*, 2004). Farmers and consumers disagree on the perception of farm animal welfare current status (Vanhonacker *et al.*, 2008). Moreover, the latter authors found that, although both farmers and consumers have some common ideas about animal welfare, consumers include additional values to it, such as freedom to move and fulfil natural behaviour.

With the globalization of information, consumers have also undertaken an active role in animal health and welfare. The requirements of European consumers, in addition to price, safety and quality, include the compliance with environmental and animal welfare norms. Requirements in niche markets (such as Protected Designation of Origin (PDO)¹ beef) include labelling and information on origin and production methods (Zjalić *et al.*, 2006).

At the same time retailers and producers increasingly recognize that efforts to meet consumer concerns and requirements in the animal welfare area actually represent a business opportunity and may thereby be profitably incorporated in production strategies of any agri-food company or chain (Blokhuis *et al.*, 2008).

Moreover, there is a growing appreciation that conditions negatively affecting animal welfare can also damage other quality aspects, interfering with the products’ intrinsic quality [(i.e. physical characteristics of the product that can be measured objectively, related to the product’s technical specification (Grunert *et al.*, 2004)]. Indeed, improving an animal’s welfare can positively affect numerous aspects of product quality (e.g. reducing the occurrence of tough or watery meat as well as the incidence of bruising, bone breakage and blood spots), and disease resistance (decreasing the immunosuppressive effect of chronic stress and the need for antibiotics). All these have direct relevance on food quality and safety (Blokhuis *et al.*, 2008), namely by diminishing potential for drug residues.

Increasingly research is being directed towards farmers’ willingness to change to more welfare friendly practices and how this varies according to the cost of implementing these changes (Blokhuis *et al.*, 2008).

¹ The PDO is a quality differentiated label regulated in the European Union since 1992 and it was established to “encourage diverse agricultural production, protect product names from misuse and imitation and help consumers by giving them information concerning the specific character of the products”. PDO products are certified and thus labelled with the PDO European symbol. Producers benefit from the exclusive right to use that PDO product name.

Farms are therefore exploring the application of animal friendly husbandry systems, management practices and breeding strategies, the implementation of monitoring and certification schemes and the communication of the associated information to the consumer (through branding and labelling, for example) (Blokhuis *et al.*, 2008).

From the scientific point of view, animal welfare, particularly farm animal welfare, emerged as a particular field of research in the 1960's. Since then there has been an increasing distinction between animal protection (what people do to animals) and animal welfare (the animal's own experience of its own situation) and it is now accepted that animal welfare science is about the animal.

The two most widely quoted definitions (Broom, 1996; Duncan, 1993) state that welfare is about an animal's ability to cope with its environment and, since the concept is only applied to sentient animals, animal welfare is about how animals feel. Thus basic research in this area usually reflects the need to get 'inside the head' of the animal (Blokhuis *et al.*, 2008)

Nowadays, one of the most widely recognized and most useful approaches to animal welfare is the definition of "The Five Freedoms and Provisions" (FFP), as defined by the Farm Animal Welfare Council (FAWC), for whom the welfare of an animal includes its physical and mental state. These freedoms identify the elements that determine the animals' own perception of their welfare state and define the provisions necessary to promote that state (Webster, 2001).

The guarantee of animal welfare according to these freedoms can only be accomplished by proper production practices, specific not only to the animal species, but also to production systems and husbandry, climatic and farming conditions, housing and management methods, feeding, etc. However, whatever specific conditions are present, animal welfare assessment should be a scientific procedure and should include health, physiology, performance and behaviour measures (European Commission, 2001).

Having in mind such animal welfare definitions, it is clear that the mindset of policy makers, producers and consumers has evolved from just preventing animal cruelty and suffering, to promoting their wellbeing and meeting their needs (Horgan and Gavinelli, 2006). The link between animal welfare, animal health and food safety has been highlighted since 1999 in the White Paper on Food Safety (European Commission, 2000), integrating animal welfare into the food chain policy. More recently, the new Animal Health Strategy 2007-2013 (European Commission, 2007b) further stresses this link (Blokhuis *et al.*, 2008).

Although it is not this article's goal to exhaustively analyse and describe the European and Portuguese legislation concerning animal welfare protection, an overview is relevant. The body of the European Union (EU) legislation has significantly changed and increased since 2000 (Schnettler *et al.*, 2009), and this trend is expected to go on, in light of growing evidence that animal welfare standards have both direct and indirect impacts on food safety and quality (Blokhuis *et al.*, 2008; Horgan and Gavinelli, 2006).

As it can be seen in table 1, many of the legal documents con-

cerning animal welfare protection are general, in the sense that they apply to all animal species, or at least to all farm animal species (Veissier *et al.*, 2008). EU's recommendations lay down minimal requirements to guarantee that the animals' needs are fulfilled in matters of nutrition, health, freedom of movement, physical comfort, social contacts, normal behaviour and protection against physical and psychological stressors (Veissier *et al.*, 2008).

Table 1 - Distribution of animals by the different Portuguese geographical regions by NUTS II in 2008, (Unit - 1.000 heads) (adapted from INE, 2009).

Cattle	Total	Less than 1 year				Between 1 and 2 years		
		Total	Veal calves	Males	Females	Males	Reproductive Females	Other females
Portugal	1439	371	89	131	151	73	143	22
Continent	1191	304	76	109	116	62	114	18
North	332	92	42	19	31	17	34	5
Center	214	60	19	20	21	15	23	4
Lisbon	51	16	3	7	5	7	5	1
Alentejo	584	134	11	62	60	22	51	8
Algarve	10	3	2	1	1	1	1	*
Azores	242	65	12	21	31	11	29	3
Madeira	6	2	*	1	1	1	*	*

Cattle	2 years and more					
	Males	Heifers		Cows		
		For Breeding	Others	Total	Dairy	Other
Portugal	31	67	6	726	301	425
Continent	27	57	5	603	203	400
North	6	11	2	185	110	55
Center	3	14	1	94	59	34
Lisbon	1	5	*	16	9	7
Alentejo	16	27	2	325	24	301
Algarve	*	1	*	4	*	4
Azores	3	9	1	121	97	24
Madeira	*	*	*	2	1	1

* Less than half of unit used NUTS - Nomenclature of Units for Territorial Statistics

There is no specific EU legislation considering the welfare of cattle kept for beef production (Blandford *et al.*, 2002; European Commission, 2001). However, some animals' welfare, and some specific situations were considered sufficiently important to be subject of a specific legal document. In this sense, veal production has been a controversial welfare topic within Europe and led to the implementation first in 1991, and later in 2008, of legislation laying down minimum standards for calves' protection.

Also, animal transportation is a very relevant issue for animal welfare, not only because it can in fact be stressful and harmful for animals, but also because it is very much in the public eye, therefore being subject to specific legal requirements.

The current EU legislation should be considered as providing minimum standards for animal welfare in many European countries. It is unlikely to represent the final development of animal welfare legislation in Europe as a whole (Blandford *et al.*, 2002), as many of the European Food Safety Agency's documents suggest.

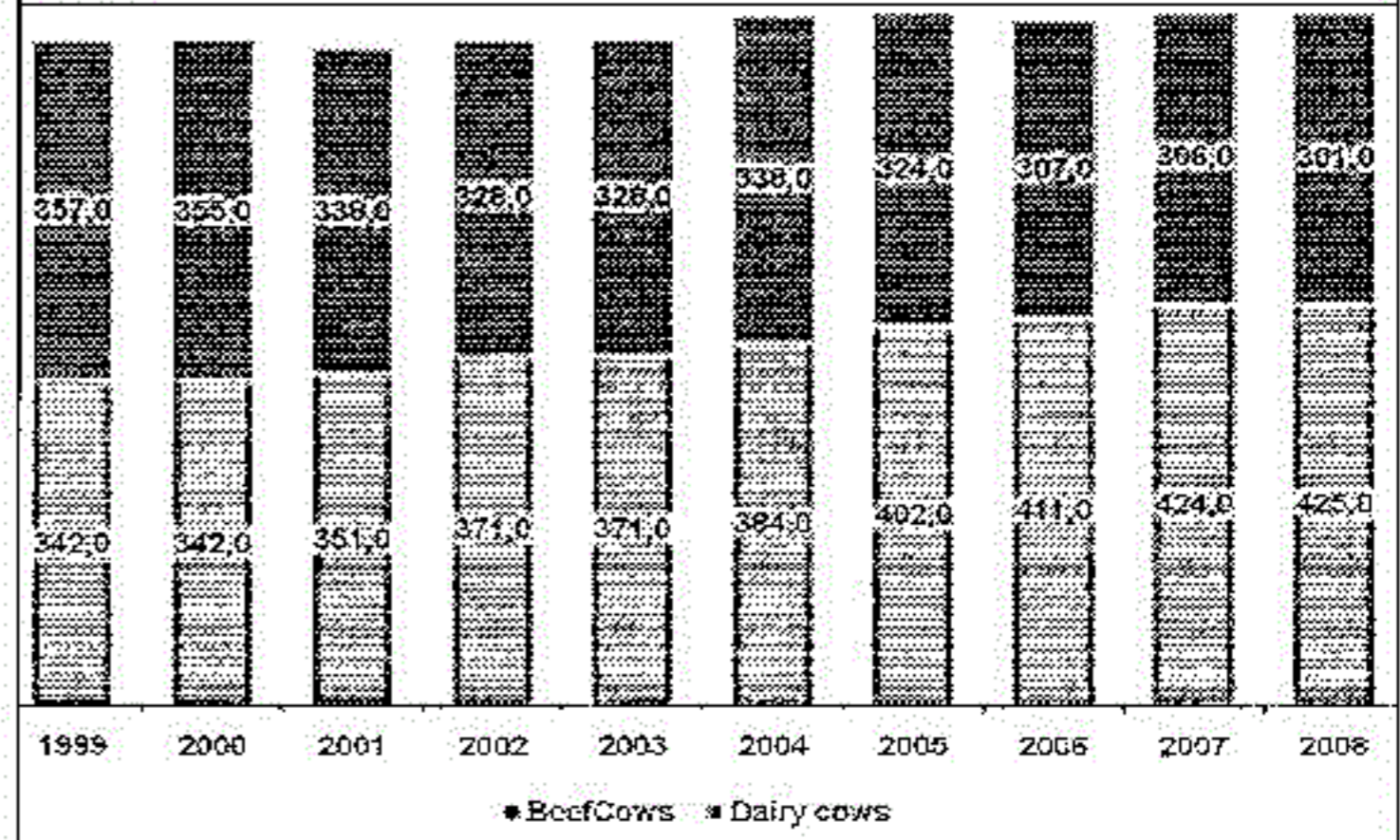
3. Beef production systems in Portugal – a descriptive analysis

Before describing the main Portuguese beef production systems, some very general data about EU's cattle herd and farms' evolution can be useful to act as a framework. The total bovine herd has been diminishing since 2001 in the EU15 at a -0.73% annual average growth rate. The dairy herd has followed the same trend, with a -1.43% annual average growth rate. However, the most striking figures concern the number of beef and dairy farms, which have had a -7.97% and a -12.90% annual average growth rates respectively since 2001, confirming that across Europe there is a trend for animal concentration in larger farms (Eurostat, 2009).

Considering the Portuguese reality, the main trends follow those of the EU. In 2008 there were 1439 thousand cattle, distributed by an area of 92072 km² (INE, 2009). By adding up the values in Table 2 corresponding to beef cattle (veal calves, males and non-reproductive females) the number of animals in beef farms is around 315 000 (although we have to assume that some of the males will be used for breeding instead). Alentejo is the region with more animals (in 2008 it accounted

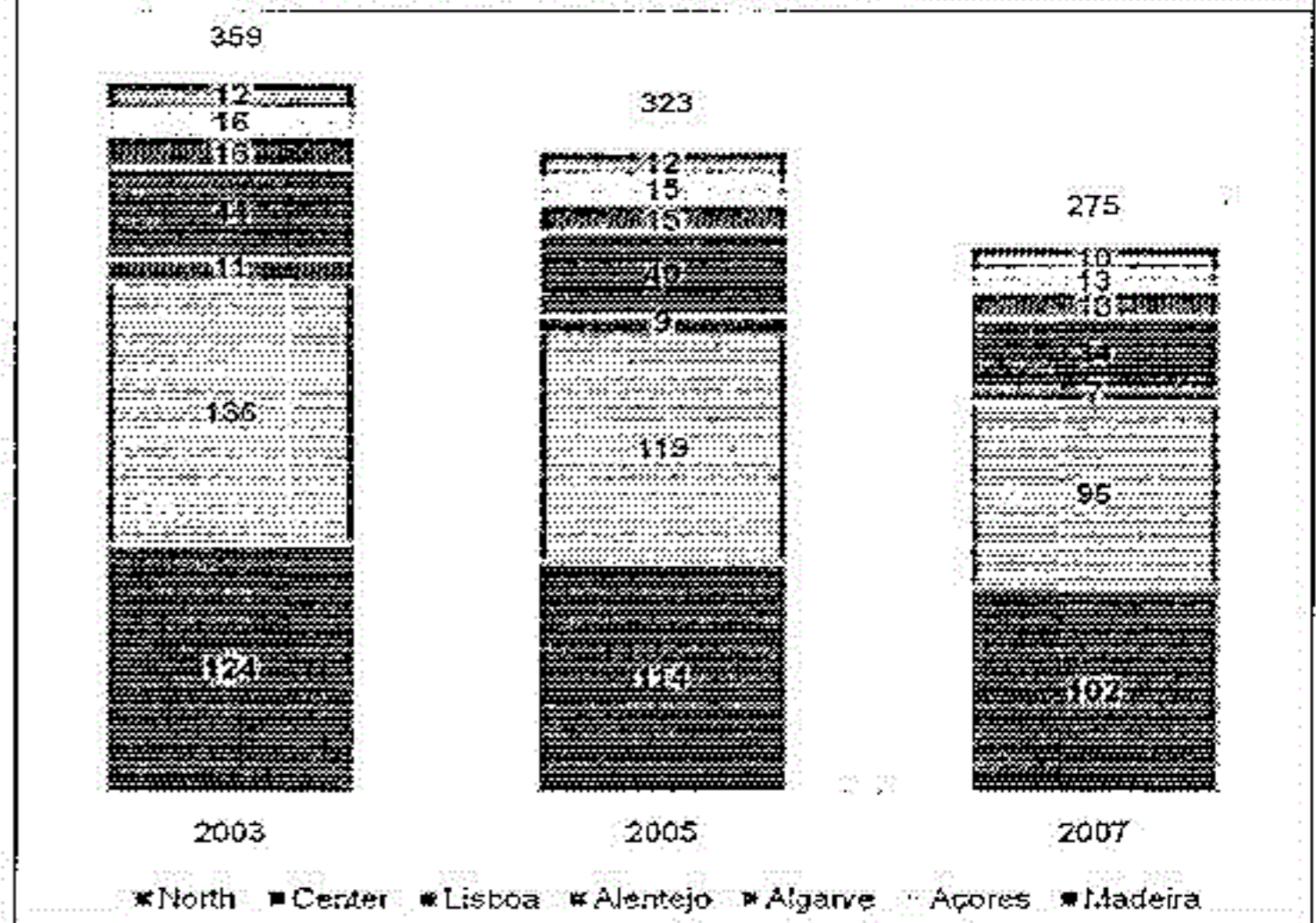
for 40% of the beef cattle) followed by the North region (23% of the beef cattle, in 2008). Another important feature is the growth in the number of beef cattle since 2001, while the number of dairy cows has been declining (figure 1).

Figure 1 - Evolution of dairy cows and beef cattle (adapted from INE, 2009).



The number of dairy farms has also declined (figure 2), and in the mainland these farms are mainly present in the North, Center and Alentejo regions.

Figure 2 - Evolution of the number of farms in the different Portuguese regions, by NUTSII (adapted from INE, 2009)



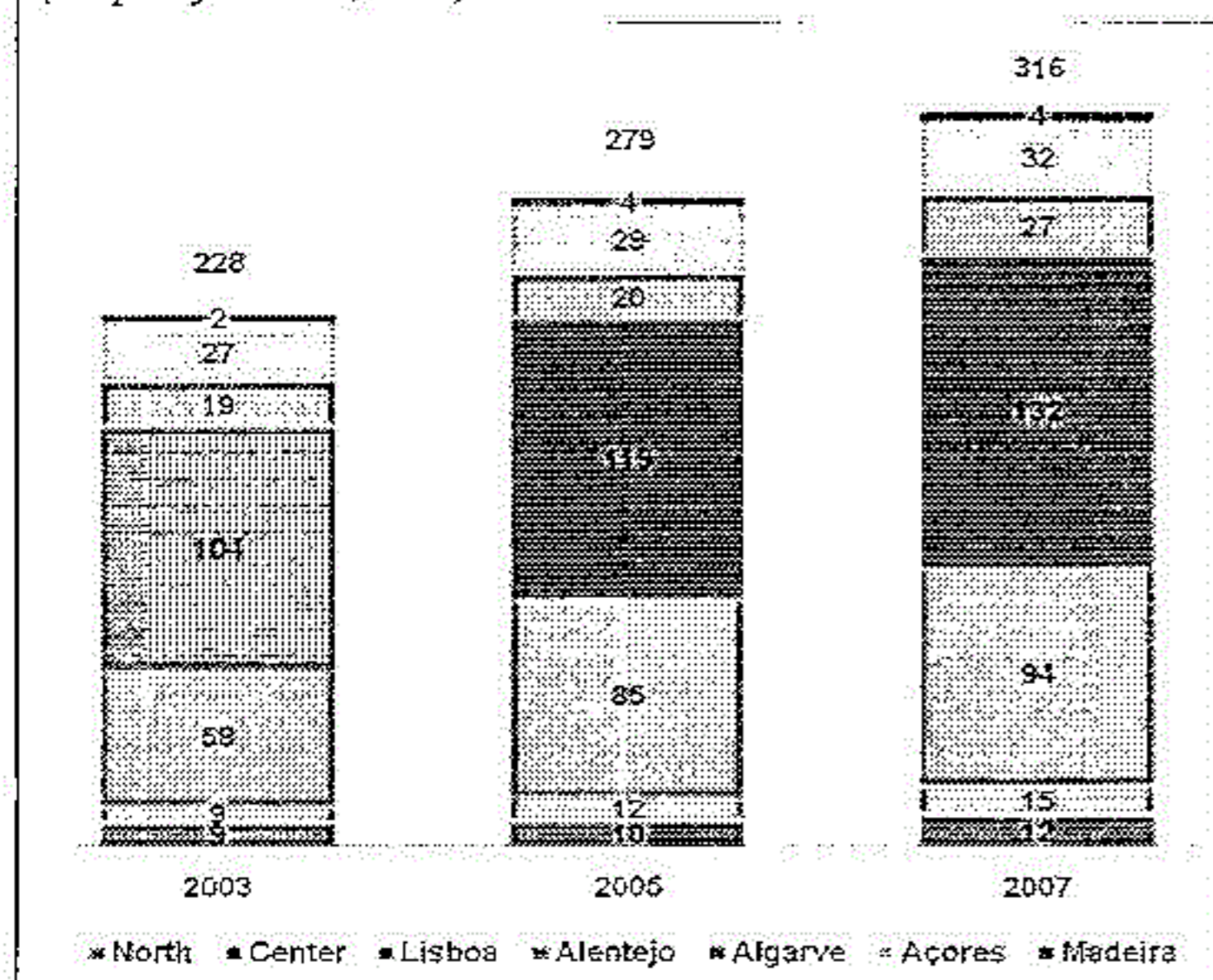
In 2005 Portugal had 10065 dairy farms, 10348 beef farms and 1041 classified as mixed dairy and beef (INE, 2006). The same report shows that the number of farms classified as beef grew 40% when compared with 1999 data.

The number of animals per farm has also been growing over the last years and in every region, mainly as a result of the above mentioned trends (figure 3) (INE, 2009).

The regions of Alentejo and the North (which have a higher number of farms) have a very distinct average number of animals per farm. This reflects the differences in beef production systems in the two regions and the differences in average farm size. In Alentejo (where farmers are usually larger) there are more animals per farm (an average of

Characteristics	North/Center	South (Alentejo)
Weather	Mediterranic with Continental and Atlantic influence	Mediterranic with Continental influence
Average temperature	15°C	> 15°C
Average rain	> 800mm	< 800mm
Soils	<ul style="list-style-type: none"> - Granite and schistose sandy soils, low pH - Low levels of exchangeable bases 	<ul style="list-style-type: none"> - Essentially flat land - Low fertility and productivity - High hydric erosion - Very low organic matter
Production Systems		
Farm size	Small farms 3 ha	Large farms 300 ha
Average herd size (animals)	3	75
Activity characteristics	Diversified and family type	Entrepreneurship
Aptitude of Indigenous breeds	Meat / Traction	Meat
Pasture	Natural irrigation + Dry land	Dry land
High digestibility and high forage production	April to July	March, April and May
High digestibility and low forage production	March and October	October and November
Null or low forage growth	August, September and November to February	June to September, December to February
Supplementary feeds	Hay, cereal straw, turnip, potatoes and fruits	Cereal straw, hay, grain and cereal culture residues
Calving	Along the year	Two periods (Summer and Winter)
Slaughter age	7 months	18 - 24 months

Figure 3 - Evolution of the number of animals per farm by NUTSII (adapted from INE, 2009).



132 in 2007), than in the North (where there is an average of 12 animals per farm).

Nevertheless, in spite of the marked tendency towards concentration (shown by a 54% increase in the number of animals per farm in Portugal between 1999 and 2005), in the North there is still a majority of small farms. More than 36% of these farms have 1 or 2 animals and around 70% have less than 10 animals (INE, 2006).

Overall, these characteristics lead to significant differences in the regional production systems, which can be divided into two main groups: "semi-extensive" (which has different characteristics in the north and south of the country), and intensive.

2.1. "Semi-extensive" beef production system

Considering the data described in the previous section, we can identify two "semi-extensive" beef cattle production systems, found in the two main regions of the country with beef production. Table 3 summarizes the different characteristics according to the geographical region described.

The Portuguese traditional "semi-extensive" production systems are considered sustainable and based on the use of local available resources (genetic basis of indigenous bovine breeds and spontaneous or seeded feedstuffs) (Rodrigues *et al.*, 1998).

In the small farms in the North and Center, farmers prefer to sell the animals at 4 to 8 months, instead of rearing them, avoiding additional feeding and housing needs. By selling the young animals, revenue indispensable for the family economy is obtained. In Alentejo the farm size allows an extensive livestock production system, which involves the late rearing of calves that are sold only at 18 to 24 months (Rodrigues *et al.*, 1998).

In addition to the sector's economic relevance, these extensive beef production systems play an important role in the protection and management of the environment (maintenance of countryside, control of weeds and bushes). Without this and other live-

Table 3 - Intensive production systems' characteristics in Portugal.

	Dairy calves	Suckler calves
Genetic resources ¹	Holstein-Frisian	Mainly crossbred: imported x Indigenous breeds
Feed ¹	Concentrate and straw (<i>ad libitum</i>). Sometimes maize silage. High energy and protein	
Produced quantity ¹	Mass supply. Standardized product	
Demand ¹	More generalized	
Weaning age (months)	2-3	6-8
Slaughter age (months)	9-12	12-15
Initial weight (kg)	100-120	250-350
Final weight	350-400	500-550
Carcass weight	170-200	300-325

stock production, many areas would suffer serious environmental degradation and desertification (Zjalic *et al.*, 2006).

A significant part of the "semi-extensive" beef cattle production systems is based on the use of animals with unique characteristics, different from region to region, with good maternal aptitude, high rusticity, slow growth performance (not very specialized in meat production) and exceptional adaptation to the environment as they live in and to the local naturally produced feed (Rodrigues *et al.*, 1998). Some of the animals belong to breeds associated with PDO beef, distributed along several Portuguese regions.

The differentiation trend can represent an important source of income to producers. Barreira *et al.* (2009) have shown that some PDO beef producers, namely in Alentejo region marketing "Carnalentejana" PDO, belong to a well established and very well organized producers association. These producers believe "this is the way to be in the market". The same authors also found that consumers think of PDO products as a good way to promote regional development.

2.2. Intensive beef production systems

There is no official record about the location of intensive feedlots in Portugal. The authors' experience suggests that these production units tend to be located near the large slaughterhouses. Traditionally they were located in the Center region. However, since November 2007 there have been severe restrictions in animal movements in Portugal because of a bluetongue outbreak. This scenario led to the rise of several feedlots in the South region, near the large farms that formerly produced animals in semi-extensive systems.

Still, in spite of the existence of these feedlots, and although there are no any official records on the average number of animals in this type of farm, the authors' experience suggests that Portugal is not a country where feedlots have a significant dimension or even tradition.

Also according to the authors' experience and through contact with many players in the sector, and given the current trends, there are mainly two types of feedlots in Portugal, classified here according to the type of animal entering the feedlot. Table 4 summarizes the description of the beef intensive production system.

These production systems mainly produce and commercialize undifferentiated beef. Of course this has important

implications, namely the need to compete mainly based on price facing tough competition in the market place.

Although there isn't any aggregated published data on this issue, our experience shows that many dairy calves that enter the intensive beef production systems come from Azores, an insular Portuguese region where dairy production is very important. There is a specific welfare problem related with the transportation of very young animals and the transfer conditions themselves. These often translate into very ill and weak animals upon arrival at the feedlot.

4. Portuguese beef production systems welfare status and possible control points

Within a framework that includes legislation, consumers' demands, producers' commitment and science the FFP mentioned above can be taken as a starting point into the assessment of animal welfare's relation with the production system. Each freedom will be then decomposed into several control points and attributes.

Based on the Hazard Analysis and Critical Control Point (HACCP)² methodology, and following Noordhuizen *et al.* (2008), we established control points for animal welfare assessment in Portuguese production systems as described below.

The critical control points (CCP) or control points (CP) are usually derived from the risk factors that have been identified during the strengths-and-weaknesses-assessment of a production system, representing points at different steps in the production process where risks should be controlled. They can be single points in the process, series of points, observations, procedures or test sites (adapted from Noordhuizen *et al.*, 2008).

A CCP has to meet several formal objective criteria before it can be considered as such. In living animals, due to biological variation, exact standards or absolute objective threshold values may not be available (as they are in physical processes). In such situations, if the critical control point is still considered of paramount importance, it must be defined as a control point (CP), which needs to be controlled, but is not objectively measurable (adapted from Noordhuizen *et al.*, 2008).

An exhaustive analysis of control points and attributes is not intended. However, there is a pressing need for credible on-farm assessment systems that help determining the animals' welfare status. Therefore, the attributes considered are already established as important by the existing body of science (e.g. RSP-CA, 2010, Blokhuis *et al.*, 2008, Vanhoneracker *et al.*, 2008, DEFRA, 2003).

On-farm assessment systems should provide a standard way of converting science-based welfare-related measures into information that is conveyable to and easily understood by all the parties involved, namely the consumer, thereby addressing specific concerns and allowing for the clear marketing and product

Table 4 - Overview of animal welfare main legislative references within the European Union (adapted from Veissier *et al.*, 2008; Blandford *et al.*, 2002; http://ec.europa.eu/food/animal/welfare/references_en.htm, last accessed May 19th, 2010).

Legal Act	Important features
All Animals	
Treaty of Amsterdam, Protocol annexed on protection and welfare of animals (1997).	Recognition that animals are sentient beings and should be protected for this reason. In formulating and implementing the Community's agriculture, transport, internal market and research policies, the Community and the Member States shall pay full regard to the welfare requirements of animals
Farm Animals	
European Convention for the protection of animals kept for farming purposes (ratified by all member states, 1976) and Council Directive 98/58/EC of 20 July 1998 concerning the protection of animals kept for farming purposes	General principles for the keeping, caring and housing of animals, and in particular to animals in modern intensive stock-farming systems. Reflects the FFP.
Calves	
Council Directive 2008/119/EC of 18 December 2008, laying down minimum standards for the protection of calves	Calves should benefit from an environment corresponding to their needs as a herd-living species, so they should be reared in groups, with sufficient space for exercise, for contact with other cattle and for normal movements.
Protection of animals at the time of slaughter and killing, and during transportation	
European Convention for the Protection of Animals for Slaughter (1979) and Council Directive 93/119/EC of 22 December 1993 on the protection of animals at the time of slaughter or killing	Aiming at improving handling, lairage, restraint, stunning and slaughter conditions.
European Convention for the Protection of Animals during International Transport (1968) and Council Regulation 1/2005 of 22 December 2004 on the protection of animals during transport and related operations	Rules concerning duration of transport, loading and unloading conditions, animal handling and caring, and transport means conditions.

positioning (Blokhuis *et al.*, 2008). Information should also be properly understood by producers, as a guarantee of successful adherence.

This method will allow an easier evaluation of whether different beef production systems have intrinsic characteristics that allow them to fulfil the FFP. At the same time, it will be possible to identify probable control points that need to be implemented in each system. Nevertheless, this analysis is undertaken with the previously described Portuguese "semi-extensive" and intensive production systems in mind, and according to the authors' experience. Other production systems, present in another countries or regions, may not fit this analysis.

The following tables try to identify and summarize the CP according to each freedom (from the FFP framework).

Looking at the "freedom from hunger and thirst" criteria, it can be suggested that in intensive systems it is easier to guarantee food and water supply, and to guarantee proper animal nutrition (regarding proper measures to avoid imbalances such as acidosis are taken).

Regarding the freedom from discomfort, no clear distinctions can be made between the two systems. However, the environmental conditions may favour "semi-extensive" systems.

² The Hazard Analysis and Critical Control Point (HACCP) methodology is a preventive food safety control system, based on a systematic, documented and verifiable approach. It intends to identify specific hazards and establish preventive measures at all production stages.

Table 5 - The Five Freedoms and Provisions (www.fawc.org.uk, accessed May 19th, 2010).

The Five Freedoms and Provisions (FFP)
1. Freedom from Hunger and Thirst - ready access to fresh water and a diet to maintain full health and vigour.
2. Freedom from Discomfort - provision of an appropriate environment including shelter and a comfortable resting area.
3. Freedom from Pain, Injury or Disease - prevention or rapid diagnosis and treatment.
4. Freedom to Express Normal Behaviour - provision of sufficient space, proper facilities and company of the animal's own kind.
5. Freedom from Fear and Distress - ensuring conditions and management which prevents mental suffering.

The freedom from pain, injury and disease may be easier to assure in intensive systems, as long as proper handling and procedures are implemented, once animal monitoring is more frequent and easier. Nevertheless diseases like lameness, ruminal acidosis and respiratory disease are much more common in the latter system.

Finally, when the freedom to express normal behaviour and the freedom from fear and distress are at stake, "semi-extensive" systems are clearly more animal friendlier, as beef cattle produced in such systems can be considered to have high quality of life, freedom to move and to fulfil natural behaviours, subjectively derived from above described objective criteria.

Table 6 - Freedom from Hunger and Thirst.

Criteria	"Semi-extensive"	Intensive
- Feeding and nutrition program appropriate to their age, weight, and behavioural and physiological needs. - <i>Ad libitum</i> feed and water. Avoid sudden changes in the type and quantity of food. - Adult cattle and calves must be provided with fiber to allow them to ruminate, which must be of such quality and length so as to help avoid acidosis. (RSPCA, 2010)	(+) Animals may not be dependent of hand feeding. (+) Amount of fiber is always guaranteed given the system's characteristics (-) Nutrition programs are more difficult to control as the animals are not observed as frequently and are dependent of local resources and flora. (-) Feed quality is dependent on the vegetative cycle and weather conditions.	(+) Concentrates have high energy and protein and most of the time constitute well designed feeding and nutrition programs. (-) Animals are dependent on the fiber that is provided with feed. (-) Animals are completely dependent on what is given to them, and feeding is completely controlled, which may prevent natural behaviour.
Drinking water with appropriate chemical and bacteriological quality	(-) Difficult to guarantee when water comes from natural sources	(+) Water quality is easier to control.
Feeding facilities and equipment cleaning and maintenance protocol	Non applicable	Depends on implemented procedures and protocols

5. Portuguese beef cattle welfare – objective quality and user-oriented quality

An overall analysis does not allow for immediate identification of the animals' friendlier system. Looking at each freedom as a whole, it is not always clear which system is more prone to promote animal welfare. Moreover, proper management must always be assured, whatever system is considered.

Having analyzed beef cattle welfare in Portugal according to the FFP, some relationships between animal welfare and beef

Table 7 - Freedom from discomfort

Control Point	"Semi-extensive"	Intensive
Genetics	(+) Native breeds are usually more adapted to local conditions, such as temperatures and insulation, thus being less affected by such stress factors (-) Imported animals have more difficulty in adapting to the new field conditions	(-) The production system does not make use of genetic characteristics for assuring increased comfort (-) Imported animals have more difficulty adapting to the new field conditions
Stocking density and available space (Vanhonacker et al., 2008)	(+) Easily guaranteed, given the system's characteristics	(-) Most farms tend to increase stocking density
Type of floor and bedding material (Vanhonacker et al., 2008); Comfortable resting area (DEFRA, 2003; Bickhuys et al., 2008)	Dependent on geographic conditions and soil characteristics in which the animals are kept	Dependent on facilities' characteristics and the kind of bedding used
Thermal comfort (Bickhuys et al., 2008, Vanhonacker et al., 2008)	(-) Difficult where no shelters are available. Heat stress can be one of the most important welfare problems in southern Europe	(+) Easily achieved in properly built farms
Air quality (Vanhonacker et al., 2008)	(+) Easily guaranteed, given the system's characteristics	(-) Noxious gas levels can be high
Animal waste and effluents (RSPCA, 2010)	(+) Fewer and more disperse environmental impacts	(-) Potentially bigger environmental impacts
Lighting (RSPCA, 2010)	(-) Difficult where no electrification is available	(+) Easily achieved in properly built farms

Table 8 - Freedom from pain, injury and disease.

Control Point	"Semi-extensive"	Intensive
Daily observation of the animals	(-) Difficult to guarantee as the animals are not observed as frequently	(+) Included in daily feedlot operation
Rapid diagnosis and treatment (DEFRA, 2003)	(-) Difficult to guarantee as the animals are not observed regularly	(+) Included in daily feedlot operation
Absence of injuries, disease and pain induced by management procedures (Bickhuys et al., 2008)	Depends on the implemented procedures and protocols	
Mutilations (castrating, dehorning and tail docking) (RSPCA, 2010)	Depends on the implemented procedures and protocols	
Prophylactic and therapeutic protocols (RSPCA, 2010)	Depends on the implemented procedures and protocols	
Biosecurity measures and rodent control plans (DEFRA, 2003)	(-) More difficult to achieve, as the production system is more open to external factors	(+) More closed production system: biosecurity measures can be more easily implemented
Carcass disposal according to current legislation (RSPCA, 2010)	Depends on the implemented procedures and protocols Sometimes difficult to comply with legally imposed timings	Varying procedures and protocols that comply with legal requirements
Animal transport protocol	Varying procedures and protocols that comply with legal requirements	

quality can be suggested, and, as discussed above, there are different ways of considering animal welfare in its relation to quality. Moreover, for consumers, concerns about animal welfare can also be multidimensional, once they often link it with the safety of the food product.

Whatever the reasoning behind consumers' motivations,

beef producers should take advantage of them. In this sense, Portuguese "semi-extensive" production systems may offer animal welfare characteristics consumers are interested in.

Therefore, consumers may value animals enjoying ease of movement, and being able to express natural and social behaviour, as well as not being dependent on hand feeding or subject to high stocking densities. Consumers may also consider the lower environmental impact to be important. Finally, the use of local native breeds may be considered positive through associations with cultural heritage and landscape preservation.

Table 9 - Freedom to express normal behaviour.

Control Point	"Semi-extensive"	Intensive
Facilities and equipment cleaning and maintenance protocol Characteristics of pens and equipments	Depends on the implemented procedures and protocols (+) Only Important when considering shelters	Depends on the implemented procedures and protocols (-) Extremely important. Sometimes problems with ventilation
- Expression of social behaviour. Animals should be allowed to express natural, non-harmful, social behaviour and natural behaviours, such as exploration and play (Blokhuis <i>et al.</i> , 2008) (Vanhonacker <i>et al.</i> , 2008)	(+) Naturally achieved	(-) Very difficult to achieve expression of natural behaviours. Expression of social behaviour, although always primary, can be enhanced by housing calves in group pens (Xlocato, Trocino, Queaque, Sartori & Carazzolo, 2002)
- Ease of movement - Foraging (Vanhonacker <i>et al.</i> , 2008)	(+) Naturally achieved	(-) Ease of movement is impossible to achieve as the animals are permanently housed. Can be compensated by adequate stocking density (-) Foraging is very difficult to achieve, as animals usually do not pasture.

Table 10 - Freedom from fear and distress.

Control Point	"Semi-extensive"	Intensive
Trained personnel (RSPCA, 2010) Implementation of codes of practice	Depends on the implemented procedures and protocols	
Good human - animal relationship. Absence of general fear, distress, frustration (Blokhuis <i>et al.</i> , 2008) (Vanhonacker <i>et al.</i> , 2008)	Depends on the implemented procedures and protocols	
Boredom (Vanhonacker <i>et al.</i> , 2008)	(+) As animal interacts more with its surroundings they tend not to be bored	(-) Associated with the intensive production
Mixing of animals Group size. Stable groups (Vanhonacker <i>et al.</i> , 2008)	(+) Uncommon. Groups are generally stable as they result from animals weaned at the same farm and at the same time	(-) Very common. One of the main factors leading to disease situations in feedlots.
Weaning	(-) At the farm, more often at 6 months age, usually represents a stressful event.	(+) Less stressful event as animals are younger. Dairy calves are less stressfully weaned
Transport protocols	Non applicable.	(-) The most stressful event after animal mixing
Handling facilities	Depends on the implemented procedures and protocols	

The use of local breeds in Portuguese "semi-extensive" production systems has advantages besides consumers' preferences. These native breeds are usually more adapted to local conditions, being more resistant to extreme temperature and insulation conditions, as well as to variations in pastures quality and availability. Moreover, the animals are usually reared in stable groups, in cow-calf operations, and mixing of animals of different ages and sources is unusual. This characteristic alone avoids many stressful events and reduces contact with pathogenic agents.

With the growing appreciation that conditions negatively affecting animal welfare can also damage other quality aspects, the positive welfare aspects of such production systems can be considered important, once it can be argued that more intensively raised and handled animals can be more prone to stress. Current research shows that well-treated livestock, which is able to behave naturally, is healthier (Horgan and Gavinelli, 2006).

Therefore, beef cattle welfare shows a close relation to production systems, and improving an animal's welfare can positively affect numerous aspects of product quality (Blokhuis *et al.*, 2008). This welfare may be translated into beef intrinsic quality resulting in an increased experienced quality by consumers (*i.e.*, the quality dimension experienced by consumers during and after consumption (Grunert *et al.*, 2004)) (Fernandez *et al.*, 1996).

6. Conclusions

Regarding animal welfare, consumers' quality perceptions and expectations seem to interweave with the requirements of legislators and scientists. Consumer preferences have not been disregarded within EU and its policy, as European legal welfare requirements have been growing, together with evidence that animal welfare standards have both direct and indirect impacts on food safety and quality. Also, some support measures within the CAP favour producers who set higher standards for animal welfare.

Regarding the beef production systems here analyzed, it is not possible to clearly state that any of the two described systems is the animal friendlier one. Nevertheless, Portuguese "semi-extensive" beef production systems methods may have characteristics that, within the consumers' perspective, should be explored.

A user-oriented quality differentiating strategy for Portuguese beef should focus on features such as low stocking densities, natural animal behaviour and low environmental impact, incorporating credence quality attributes into the final beef product, including rural environment and ecosystem preservation and sustainability. Consumers relate these attributes with safer, more genuine and of higher quality beef.

Additionally, the animal rearing conditions in these systems reduce stressful events, which in turn can positively affect numerous intrinsic aspects of final product quality. This means there are potential intrinsic quality characteristics that can be translated into increased experience quality for consumers.

The market for such products is attractive because it provides a mechanism through which the implied value of animal welfare can be derived. Nevertheless, it cannot be ig-

nored that animal friendly products very often have higher costs (namely because of certification), translating into higher prices for consumers. Moreover, it is not possible to minimize price and income effects on such products' demand and market, which will always be a niche market.

However there are already, in Portugal and across Europe, certification schemes that include objective animal welfare standards. Moreover, some certification strategies, although not specifically related with animal welfare, can be perceived as animal friendlier by consumers, translating into increased benefit for producers.

Keeping in mind that certification costs could represent higher consumer prices, when compared to undifferentiated beef prices, and that consumers income always plays a very important role in their willingness to pay for differentiated products, some consumers may be willing to pay more for quality beef, helping support through their demand specific production sectors.

That is the case of organic farming and PDO beef, which represents a small but consistent niche market in Portugal, representing interesting market opportunities for producers and considerable sustainability value for the regions where they are located. Still, differentiation through marketing of animal friendlier products may still be insufficiently explored.

Therefore, there may be business opportunities in the Portuguese beef market for different product variants associated with higher levels of animal welfare, such as products explicitly labelled as animal friendly, or products for which the consumer perceives this to be the case.

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