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Le standard de qualité EBLEX: un exemple de démarche qualité en Angleterre

« EBLEX Quality Standard »: une démarche qualité basée sur la connaissance des facteurs impliqués dans le déterminisme de l'acceptabilité de la viande rouge par les consommateurs.

Mots-clés : démarche qualité, viande bovine

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La démarche du « EBLEX Quality Mark standard » est un exemple de démarche qualité en Angleterre dans l'intérêt commun des consommateurs et de la filière. Cet article décrit cette démarche de qualité. Il a été préalablement publié en 2013 dans l'ouvrage « Developments in beef meat quality » édité par JD Wood qui résume les travaux qui ont été présentés lors de la « Langford Food Industy Conference » en juin 2012.

Résumé :
De très nombreux facteurs sont impliqués dans le déterminisme de l'acceptabilité de la viande rouge par les consommateurs. Cet article passe en revue les facteurs qui influencent la qualité de la viande bovine et qui, de ce fait, pourraient faire partie d'un cahier des charges pour une viande de meilleure qualité. Les avantages et les inconvénients d'une démarche de qualité sont brièvement discutés. La démarche du « EBLEX Quality Standard Mark » est présentée comme un exemple de démarche qualité en Angleterre qui offre des avantages pour les consommateurs et la filière. Les changements dans les pratiques qui sont induits par cette démarche sont également décrits.

Abstract: The EBLEX Quality Standard Mark: an example of a beef specification in England
A wide range of factors influence the consumer acceptability of red meat. This paper reviews those factors that influence the eating quality of meat and could therefore form part of a specification for enhanced meat quality. The advantages and disadvantages of the specification approach are briefly discussed. The EBLEX Quality Standard Mark is used as an example of a specification which delivers benefits to consumers and the supply chain, and changes currently being made to the scheme are described.

INTRODUCTION

A wide range of factors influence consumer acceptability of red meat. A review undertaken for Defra in 2007 (MLC, 2007) concluded that many of the things of concern to consumers are related to perceptions which are addressed either by changes to the production system or communication. The important quality attributes that result from changes to meat's physical or biochemical properties are appearance (colour and fat content), nutritional properties (primarily fat content and type) and eating quality (texture and flavour). This paper is focused on eating quality, with some reference to visual characteristics.

There are three main approaches that can be applied to managing beef eating quality:

- Definition of the treatment (of animals, carcases and cuts) that delivers the required quality, defining a specification and monitoring to ensure that the specification is adhered to
- Understanding the effect of factors throughout the supply chain that impact on quality, recording them and then, based on models, predict the resulting eating quality of the carcase on average or the individual cuts
- Using tools to measure the quality attributes of interest at an appropriate stage on the supply chain to determine the most appropriate use of the meat

The specification approach has been that used in England (and across the UK) by beef supply chains for many years. This approach fits well with the structure of the industry (with large retail supermarket customers) and will be the main focus of this paper. The advantages and disadvantages of the specification approach will be considered later.

A key attempt to create a national specification for quality beef was the MLC (Meat and Livestock Commission) Blueprint for Improved Consistent Quality Beef, launched in 1990 (MLC, 1990). This document comprised recommendations for best practice related to eating quality. In defining these, a literature review was undertaken in order that the Blueprint was based on the available scientific literature, combined with results from MLC's own research programme (much of which is described by Fisher *et al.* (1994)). The review has been updated several times since. Most recently, in order to ensure the most relevant advice is being given to industry currently, an updated review was produced in 2011. This draws on these earlier documents as a basis, updated with evidence from the last 10 years from the available scientific literature, levy-funded research (both published and unpublished) and contacts within the global meat science community (Matthews, 2011). This paper draws heavily on that review. The full review is available on the EBLEX website and a summary of the recommendations has been published as a leaflet.

In this paper the main factors to include in specifications are considered, following by a discussion on the pros and cons of the specification approach and an update on the specification underpinning the EBLEX Quality Standard Mark.

I. ON FARM FACTORS AFFECTING MEAT QUALITY

I.1. Genetic effects

Overall breed effects on eating quality in beef are small. The most important "breed" effect on eating quality is the toughness observed by many researchers in beef from cattle of *Bos indicus* (Zebu or Brahmin) breeding. Within *Bos taurus* (European) breeds, it appears that if there is a breed effect it may arise from associated factors like fatness or rate of maturity, although there is some evidence for an effect mediated by differences in muscle fibre composition.

The USDA Meat Animal Research Center at Clay Center, Nebraska, has been conducting large scale evaluations of cattle breeds since the late 1970s. A wide range of breeds have been used as sires with common dams (either Hereford, Angus or the 'MARC III' composite). Each 'cycle' of the programme includes a different combination of breeds. The results have consistently shown that *Bos indicus* breeds, with the exception of the Tuli (a Sanga type), result in tougher meat. Among the *Bos taurus* breeds, the results have not been consistent between cycles of the programme, but taken overall there are small tenderness advantages for Aberdeen Angus and Hereford (Tatum, 2006). While these effects are small, these breeds are often favoured in the US, primarily because of their higher marbling levels and therefore USDA quality grades which, it must be noted, are not strong indicators of tenderness.

British research (Homer *et al.*, 1997) examined the effect of sire genotype and fatness on eating quality of progeny from dairy dams. In steaks, there was no difference across six sire breeds for eating quality. In roast topside, the Belgian Blue produced higher tenderness scores than the other five sire types. Overall, it was concluded that breed effects were unimportant. Interestingly, Polish researchers also found advantages for Belgian Blue x dairy bulls compared with Charolais and Aberdeen Angus crosses, although pure black and white bulls had equivalent tenderness to Belgian Blue! The authors cite other Polish workers finding that black and white cattle had superior eating quality to crosses! (Groth *et al.*, 1999).

Work in pure bred steers has shown a small tenderness advantage for the Aberdeen Angus when compared with the Holstein. Charolais was intermediate (Sinclair *et al.*, 2001). The Aberdeen Angus also gave higher flavour, juiciness and overall acceptability scores than both the other breeds.

It can therefore be concluded that, whilst breed effects are small, there is probably an eating quality advantage for purebred Aberdeen Angus, and possibly Hereford. In British cattle populations, there is very little evidence for a breed effect on eating quality where cross-breeds are used. The benefit of Belgian Blue genes on eating quality can probably be attributed to the single gene that imparts the double muscling characteristic.

Within breed, different lines of cattle exhibit differences in calpastatin activity. In particular selection for high growth rate or net feed efficiency can increase calpastatin activity and therefore reduce proteolysis post slaughter (Oddy *et al.*,

2001). Selection for more tender lines should be possible but measuring phenotypes is difficult unless progeny testing through commercial slaughter is an option (even genomic selection requires collection of phenotypes!). Selection for markers, QTL or specific genes for eating quality traits is theoretically possible and several commercial tests are available. The difficulty is ensuring that these are validated in the population of interest. It is also clear that unless strict attention is paid to post slaughter handling of carcases, the genetic differences are not apparent. For example (Allais *et al*., 2011) found relationships with SNPs in the calpastatin and micro-calpain genes with tenderness/toughness but the polymorphisms that the markers are associated with, and the effects, differed by breed. This illustrates the caution that needs to be exercised in transferring gene markers from one population to another.

I.2. Sex effects

There is little evidence of an eating quality difference between steers and heifers. The main issue for consideration with regard to sex of cattle is the treatment of bulls. There is considerable evidence in the literature concerning the eating quality of young bulls compared with steers. Studies have been reported from several countries on a variety of breeds and production systems. The balance of published evidence indicates that the eating quality of bull beef is poorer than that of steers of the same age, particularly in terms of tenderness.

However, the results of the Beef Blueprint trial referred to above have indicated ways in which young bulls can be included in a quality specification. Bull beef was generally tougher than that of steers and heifers. Closer examination of the results led to the conclusion that young bulls can produce quality beef provided they meet some additional requirements: an upper age limit for at slaughter and subjection of the meat to extended maturation.

I.3. Animal age

The literature is consistent in supporting the existence of an effect of age on tenderness (see the review by Harper (Harper, 1999)). From March 1996 to November 2005, the upper age for cattle slaughtered in the UK for human consumption was 30 months. This coincided with the upper age limit recommended in the MLC Beef Blueprint and would have given protection against potential eating quality problems from older and, perhaps, slower growing animals. Since 2005 there have been a number of cattle over thirty months of age slaughtered for prime beef, and therefore the eating quality of older cattle is once more an important consideration.

Overall, it is clear that increasing age is associated with decreasing tenderness. The conclusions of a review carried out in 1989 (Purchas, 1989) are probably still applicable: age effects on tenderness are unlikely to be of practical significance in commercial meat producing systems where cattle are well grown and reasonably young at slaughter (up to 30 months). With regard to bulls, it is generally considered prudent to impose a lower age limit because earlier maturity and hence toughness is likely.

I.4. Growth rate

There is a substantial body of evidence, almost exclusively from feedlot systems, of beneficial effects of finishing cattle on high energy rations. Recent evidence, however, suggests that this effect is not seen across all muscles, mainly benefitting the sirloin (Archile-Contreras *et al*., 2010).

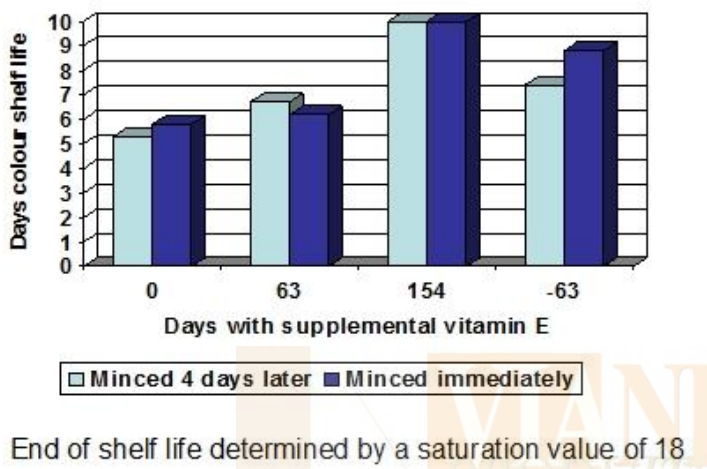
There is also Australian evidence of a positive effect of growth rate on tenderness (Perry *et al*., 2002; Perry and Thompson, 2005). This showed that growth rate was a minor but positive contributor to tenderness (with higher growth rate giving increased tenderness) within a group of cattle but did not account for differences between groups. This suggests that manipulation of growth paths is not a useful means of enhancing tenderness. On the other hand reducing variation in growth rate within a group might be an important means of reducing tenderness variation. This corresponds with the work of Sinclair *et al.* (2001) which showed no effect of growth rate, when deliberately manipulated, on tenderness. French work looking at the eating quality of animals finished on different commercial production systems found that those systems with the highest plane of nutrition resulting in younger animals at slaughter resulted in the most tender meat (Oury *et al*., 2007).

Maltin and colleagues, in their review (Maltin *et al*., 2003), cited several papers from the UK and Ireland that suggest no beneficial effect of pre-slaughter growth rate or compensatory growth on tenderness, and the authors suggest that the patterns of growth described by others are more extreme than those that would normally be observed in temperate climates. Nevertheless, it seems appropriate to try to standardise growth patterns as much as possible in order to reduce tenderness variation.

I.5. Diet

Colour and fat stability of beef can be enhanced by the use of vitamin E (see Figure 1). A large number of papers support the use of vitamin E in this respect for beef. In a review of the literature, Liu *et al.* (1995) concluded that 500IU/head for 126 days prior to slaughter would assure benefits in increased shelf life. A research project at the University of Bristol, with a range of partners including MLC, indicated that 1000IU/head for 100 days would deliver a benefit in terms of shelf life.

Figure 1: Colour shell life for fore-quarter mince in overwrap



End of shelf life determined by a saturation value of 18

Several studies have shown benefits of forage diets on colour and fat stability, presumably through antioxidants, including vitamin E, in the feedstuffs. The benefit of conserved grass (silage and dried grass) on the oxidative stability of beef steaks during retail packaging was shown by O'Sullivan *et al* (O'Sullivan *et al*., 2003; 2004). This work also showed that type of forage conservation influenced meat colour. Other work has also shown advantages of pasture or silage over concentrates in terms of colour stability (Gatellier *et al*., 2005; Warren *et al*., 2008). Wood *et al*. (2007) presented a summary of evidence for the role of oxidation in undesirable flavours in beef, with forage diets producing more desirable flavour, probably through the presence of antioxidants.

There is increasing evidence that the flavour characteristics of beef are influenced by dietary composition. North American evidence shows a clear difference between grain and grass finished beef with Americans preferring the flavour of grain finished animals (eg Sapp *et al* (1999)) and even preferring 'corn' (maize) fed cattle over barley fed. On the other hand, British and Irish consumers seem to prefer the stronger flavour of grass finished animals, which Americans find to be high in off-flavours. The review undertaken at the University of Bristol (Wood and Richardson, 2004) indicated that diet is a key component of beef flavour.

I.6. Carcase fatness and conformation

There is evidence that the leanest of animals tend to produce poorer eating quality, although this effect is not large. A widely used cut off is that of MLC fat class 3 with leaner animals excluded from quality specifications.

Published evidence indicates that at low levels of intramuscular (or marbling) fat, the tenderness and juiciness of beef is less satisfactory. There is also some evidence that beef flavour requires a minimum level of intramuscular fat. Denoyelle (1995) found that 4% was needed as a minimum in the *longissimus lumborum* but found no effect in two other muscles. Low levels of intramuscular fat are generally associated with low external fat cover. The Blueprint Trial confirmed the favourable effect of fatness on texture although, again, the effect was not large. MLC carried out a large review of the effect of fatness on the eating quality of meat and concluded that there is an effect of marbling fat, but this is generally small. On current evidence, a minimum fat level of 3 on the EUROP scale seems prudent to provide protection against very low intramuscular fat levels.

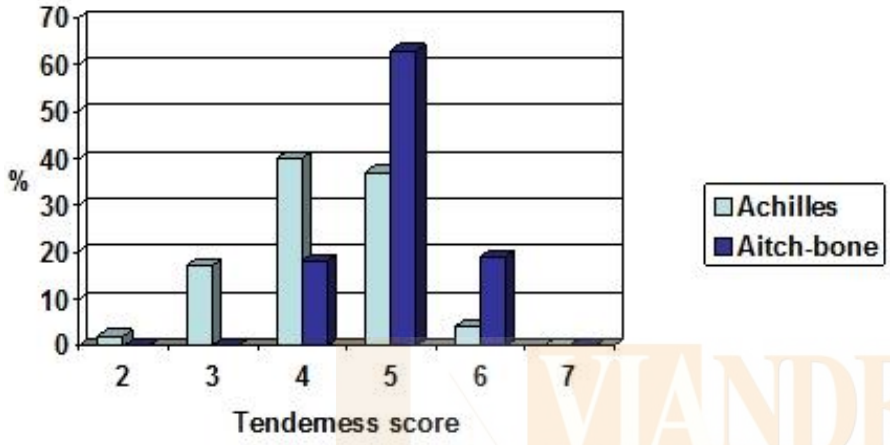
In terms of conformation, O+ is widely accepted as a minimum. The evidence to support this rests partly on the physical fact that the muscles from animals of good conformation are relatively thicker than those of poor conformation carcases. This makes them less likely to suffer from toughening due to cold shortening. A further factor is that good conformation carcases are likely to have a lower proportion of their muscle weight as collagen which is one of the contributors to toughness (Bouton *et al*., 1978). In addition, excluding very poor conformation carcases provides some protection against cattle which have had a chequered growth and nutritional history.

II. POST FARM GATE FACTORS

II.1. Carcase Suspension

Aitch bone (or hip) suspension is an important element of quality enhancing programmes in several countries. Several published papers report beneficial effects of suspension of hot carcases from the aitch bone during chilling (Ahnström *et al*., 2006; Ahnström *et al*., 2009; Joseph and Connolly, 1977; Lundesjo *et al*., 2001). Generally hip suspension improves consistency as well as increasing average tenderness (see Figure 2).

Figure 2: Distribution of beef loin tenderness by suspension method



Aitch bone suspension has its effect through holding the major muscles of the hindquarter and loin under tension. This prevents shortening of the muscles and may also accelerate the ageing process. In Britain the use of the aitch bone has largely been replaced by the ischium (an alternative position in the pelvic region) for safety reasons. In terms of the tension on the muscles this achieves essentially the same effect.

II.2. Chilling rate and electrical stimulation (ES)

Incorrect chilling can give rise to toughness through shortening. This has been demonstrated many times over the years. Recently, for example, Prado and de Felicio (2010) compared 'conventional' air chilling (air speed 2 m/s and temperature of 0ºC with slow air chilling (2m/s but temperature of 10ºC for the first 12 hours) and found marked difference in toughness of beef loin with the conventional chilling resulting in higher shear forces. Differences remained after even 60 days of aging.

A useful rule of thumb for beef where no electrical stimulation is applied is that no part of any muscle should fall below 10ºC within 10 hours of sticking (Bendall, 1972). If the temperature of muscles is reduced below about 10-14ºC while they are still in the early pre-rigor condition (pH about 6.0-6.4) there is a likelihood of shortening and, thereby, toughness (Locker and Hagyard, 1963). The only circumstances in which it is not a problem for the temperature of muscles to fall below 10ºC in 10 hours is where electrical stimulation (ES) is applied. This is because the stimulation depletes the energy reserves in the muscle prior to chilling so that there is insufficient energy for the muscle to contract.

There is a large volume of literature on the value of ES for avoiding the toughening effects of cold shortening. In addition there is evidence that ES improves tenderness over and above the effect of avoiding cold shortening (eg (Strydom *et al*., 2005)).

ES can be applied in high (normally 500-1000 V), low (less than 100V) or medium (100V) voltage forms. While all seem to be generally effective in causing a rapid reduction in pH in meat, such as is thought to avoid cold shortening, there is evidence that high voltage ES is more effective. This may be related to the timing of application. Hwang and Thompson (2001) found that stimulation at 3 minutes post mortem, whether high or low voltage, gave tougher meat than stimulation at 40 minutes

There are recent observations in the UK industry (Matthews, 2008) and in several research studies that high temperature in the deep muscles of the hind quarter can give a pale wet muscle rather like PSE in pig meat (De Boever *et al*., 2009; de Smet *et al*., 2010; Simmons *et al*., 2008). Others (Rosenvold *et al*., 2008), however, suggest that hot shortening does not occur after electrical stimulation in hot boned muscles. Nevertheless, it has been found that the deep *semimembranosus* muscle can have higher protein denaturation associated with a slower temperature decline during chilling, than the surface *semimembranosus*, resulting in lower levels of proteolysis and tougher meat (Huff-Lonergan *et al*., 2010; Kim *et al*., 2010a) so excessive stimulation without rapid chilling should be avoided.

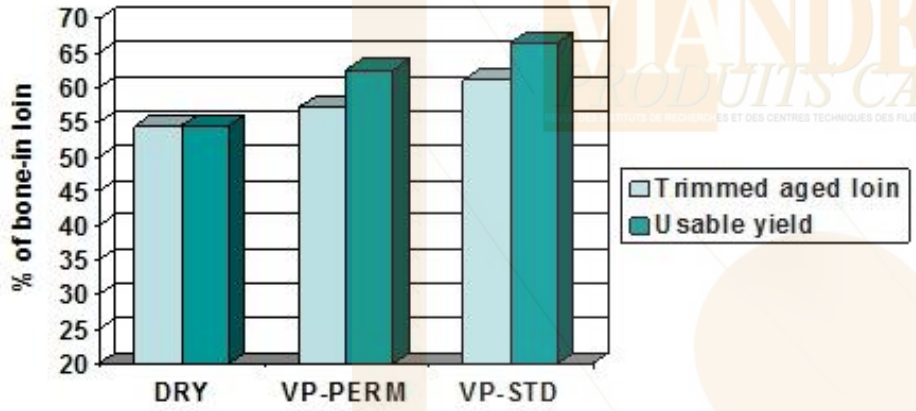
The rate of pH fall is probably best targeted at the pH/temperature window adopted by the Meat Standards Australia (MSA) scheme, implemented by Meat and Livestock Australia to address variation in the eating quality of Australian beef (Thompson, 2002). This requires the temperature to be below 35ºC and above 12ºC when pH 6 is reached.

II.3. Ageing

Ageing or conditioning of meat post-mortem has long been associated with an increase in tenderness and flavour. Improvements have been seen commonly in loin up to 14 or 21 days, benefits have been seen up to as long as 60 days (Prado and de Felicio, 2010). Ageing is also an important means of reducing tenderness variation - generally reducing or removing differences associated with animal type, eg breed (Ibrahim *et al*., 2008; Monsón *et al*., 2005). On the other hand, care should be taken to avoid ageing for excessive lengths of time to avoid a decline in beef flavour and the development of abnormal flavours (Spanier *et al*., 1997). It should also be noted that ageing effects differ by muscle.

"Wet" ageing is widely used in commercial beef production in England. This involves storage of the meat at chill temperatures (less than 3ºC) in vacuum packs, usually for 7 to 21 days. There is an industry view that ageing on the bone has flavour advantages over ageing in the pack. Prior to the development of vacuum packaging, meat was dry-aged. Dry aging consists of placing unpackaged meat in a chill under controlled temperature, humidity and airflow. There is increasing interest in the use of dry ageing to produce a premium product because the beef flavour, in particular, is reputed to be superior to that of wet-aged beef. A comprehensive summary of the effects of dry ageing beef has been published by the National Cattlemen's Beef Association (National Cattlemen's Beef Association Center for Research and Knowledge Management, 2008). EBLEX have compared dry ageing, and vacuum packed ageing using both permeable and impermeable bags. Permeable bags resulted in similar quality to traditional dry ageing but with reduced weight loss (see Figure 3).

Figure 3: Usable yield according to differing ageing methods



II.4. Retail packaging

Ageing (or maturation) of meat after slaughter is a widely used means of enhancing meat eating quality, particularly tenderness. It was generally been thought that ageing tenderisation occurs throughout the time under chill temperatures from slaughter to consumption. Tenderisation does not occur to any substantive degree during frozen storage or once the meat is cooked.

A significant proportion of high value meat cuts sold through the multiple retailers is packaged centrally in modified atmosphere packs (MAP, primarily 80% O2/20% CO2). Torngren (2003) reported that high oxygen (80% O2/20% CO2) packaging resulted in poorer eating quality (including reduced tenderness and lower flavour) of beef compared with vacuum packaging followed by overwrap. This has subsequently supported by a number of other studies others (Lagerstedt *et al*., 2010; Madsen and Claussen, 2006; Zakrys-Waliwander *et al*., 2010).

Following the publication of the work in 2003 EBLEX sponsored work to establish whether high oxygen packaging simply halted maturation or actually toughened the meat. The results conclusively demonstrated that the meat was toughened in high oxygen packs (MLC Technical Division, 2006). It has now been shown that oxidation is having a number of effects on the meat: proteolysis is prevented - ceasing any further ageing tenderisation (Maddock Carlin *et al*., 2006); protein is toughened directly through protein oxidation (Kim *et al*., 2010b); oxidation damages the flavour of beef (mainly through development of rancid fat notes (Campo *et al*., 2006).

III. ADVANTAGES AND DISADVANTAGES OF THE SPECIFICATION APPROACH

It can be seen that there is a substantial body of evidence that enables the construction of specifications to enhance meat quality. The use of such a specification is usually associated with supplying a specific customer or adding value to a brand. This means that the industry changes practices in order to increase the proportions of animals meeting that specification and therefore increases overall quality. It can be a science based approach, relying on experimental evidence to determine the practices to include in the specification. A specification is also a useful tool to underpin a brand and can be part of a marketing strategy.

On the other hand this approach, in common with the prediction-based approaches, cannot determine absolutely the meat quality of a given piece of meat. It does reduce the variation and increase the likelihood that a particular product will be of better eating quality. There is also the possibility that animals that fall outside the specification are reduced in value unnecessarily - actually being of good quality in at least some of the cuts.

In an ideal World a specification would be used alongside a measurement tool to improve overall quality and at the same time measure the actual quality on a carcase by carcase or cut by cut basis.

IV. THE EBLEX QUALITY STANDARD MARK

The EBLEX Quality Standard schemes for beef and lamb were launched in 2005 to give retailers assurance about the meat they buy. The concept of the schemes was to build on to existing approaches to farm assurance elements designed to enhance the eating quality of beef and lamb. This is an important part of the wider strategy of EBLEX to differentiate quality beef and lamb from commodity product, helping to build a long term, positive business environment for producers and the industry.

The Quality Standard Mark currently appears on more than a quarter of the English beef and lamb products sold at retail. Major multiple retailers are members of the scheme along with most of the major processors, wholesalers, catering butchers and approximately 1,800 independent retailers. There are more than 18,000 outlets stocking or serving Quality Standard Mark beef or lamb.

In 2011/2012 EBLEX reviewed the Scheme criteria and the role of the scheme and further requirements were built in to the standards. The new standards were formally introduced later in 2012. Given its success it would be reasonable to ask why it is being changed now. EBLEX is committed to working for the improvement of the beef and sheep industries in England and the changes to scheme bring it more in line with the messages of the farmer-facing Better Returns Programme, as well as responding to consumer demand for consistent, enhanced eating attributes. This should ultimately deliver better market prices for producers and add value and efficiency through the supply chain.

The new beef standards introduce the following additional criteria:

- An upper age limit of 36 months for steers and heifers
- Classification limits: a fat class of between 2-4H and a conformation of E – O+
- Minimum maturation for cattle 30 months or under: 7 days for primals used for frying, roasting and grilling
- Extended maturation for cattle aged between 30 and 36 months: Maturation of 14 days is required on primals used for frying, roasting and grilling. Alternatively one of the post-slaughter processes to enhance tenderness as outlined in 'EBLEX Guidance to Meat Quality' can be used i.e. Hip suspension or electrical stimulation in addition to the standard 7 day maturation
- A maximum age for bulls of 16 months at slaughter and a minimum ageing for primals from bulls used for frying, roasting and grilling of 14 days maturation

The new standards for lamb introduce the following additional criteria:

- Classification limits (or equivalent criteria where classification is not used: a fat class of between 2-3H and a conformation of E – O

These changes have been welcomed by the industry and scheme membership has remained extremely high with very few existing members not wishing to adopt the new standards.

CONCLUSION

Based on the scientific evidence available, a specification approach can be used to enhance the eating quality of beef and lamb. These specifications can be specific to individual supply chains or industry-wide. The EBLEX Quality Standard Scheme is an example of an industry-wide specification that is widely adopted and has evolved to further enhance the eating quality of English beef and lamb available to consumers.

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