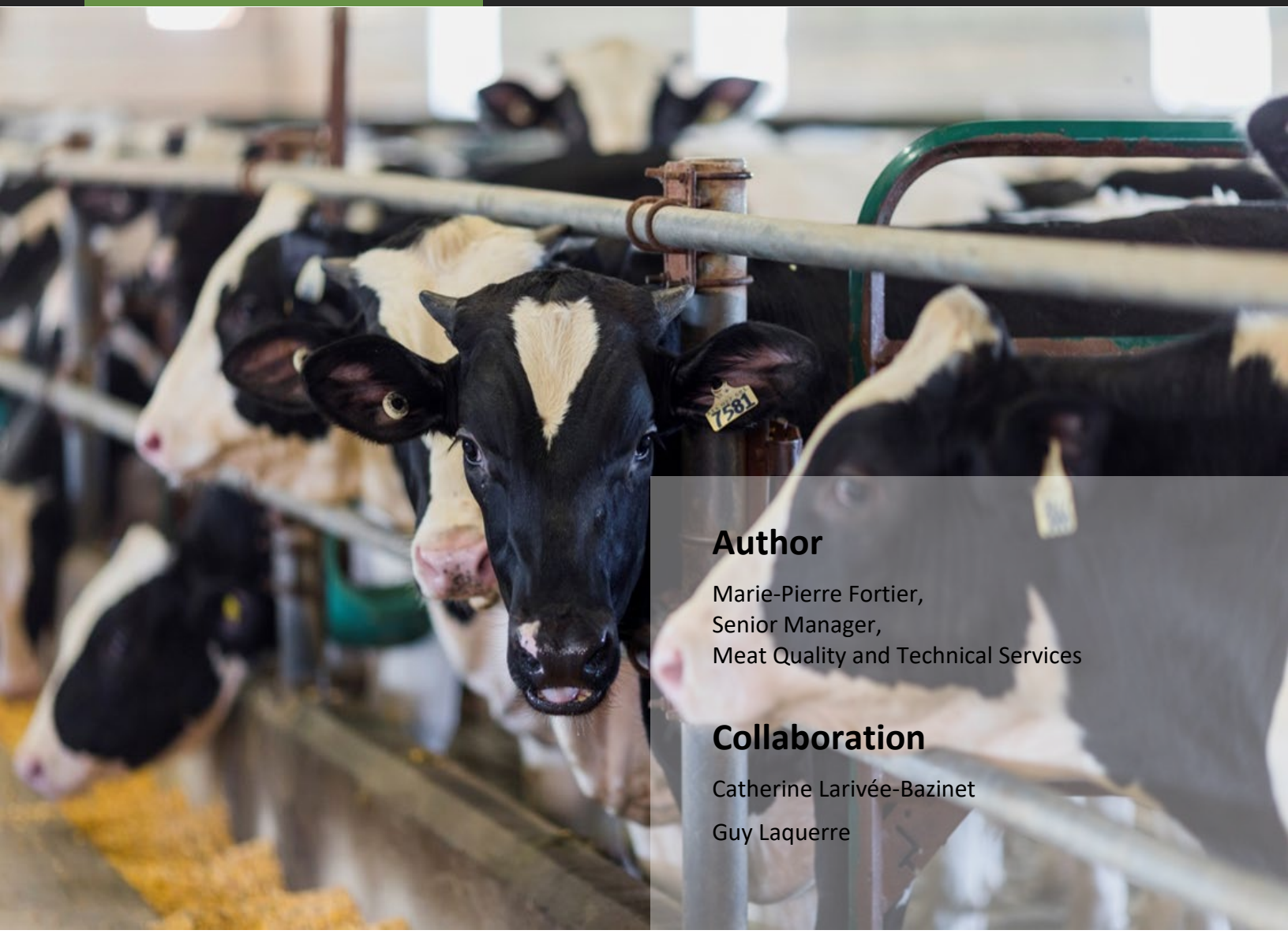
October 2020

Literature Review



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1 Veal Classification in Quebec and Canada

The main objective of establishing carcass grading systems is to establish their relative economic value in more precise terms for the meat industry. For this, the criteria used to define the quality and value of the carcass change depending on market conditions and the diversification of consumption patterns (Monaghan, 2002). The Canadian Beef Grading Agency has been accredited by the Canadian Food Inspection Agency to grade beef, veal and bison in Canada. The veal grading standards have been established by the federal government based on recommendations from the industry and the Government Advisory Committee on Veal Grading. These standards are published in the Livestock and Poultry Carcass Grading Regulations (Monaghan, 2002).

In Canada and Quebec, the veal grading system categorizes carcasses based on their conformation and meat coloring, under the Cattle and Poultry Carcass Grading Regulations (SOR/92-541) (Éditeur officiel du Québec, 2019). Classification, combined with a payment grid, therefore makes it possible to determine the settlement price between the slaughterhouse and the producer for the sale of its carcasses. Since payments and prices are based on these standards, they have a dual effect: they encourage producers to provide a high-quality product and promote rational marketing of products (PBQ, n.d.). Moreover, more specifically in grain-fed veal, the classification is also used to receive the class “Certified Quebec grain-fed veal”, the meat of which must be classified in the higher categories Canada A1 or A2 (Monaghan, 2002; PBQ, n.d.). On an annual basis for calves sold or delivered, the producer must achieve a classification of at least 80% in category A and 70% in category A1, A2, B1 and B2 as established under the Livestock and Poultry Carcass Grading (LPCG) Regulations (SOR/92-541) (Éditeur officiel du Québec, 2019)

2 Carcass Classification Factors

Grading of calf carcasses is done at slaughterhouses and processing plants that are under federal or provincial inspection within at least 48 hours of slaughter (Monaghan, 2002). The main factors considered are weight, musculature, fat distribution, fat color and flesh color.

2.1 Carcass weight

For a carcass to be considered that of a calf, its weight must not be less than 176 pounds. The Canadian Beef Grading Agency changed the maximum carcass weight for calves on January 15, 2020, from 397 pounds to 419 pounds (Canadian Beef Grading Agency, 2020).

2.2 Musculature

Musculature is defined by the proportional development of the different parts of the carcass as well as the percentage of bone in relation to meat (Monaghan, 2002). In the classification grid, it is represented by the letter A, B or C. Carcasses classified A are well muscled, B carcasses have medium musculature while carcasses classified C have little or no apparent musculature (Table 1). Carcass weight should be considered when evaluating musculature, knowing that light carcasses may not show as much muscle as a heavy carcass, but have the same bone to meat ratio (Canadian Beef Grading Agency, 2020; Monaghan, 2002; Riz Global Foods, n.d.; The BC Cook Articulation Committee, 2015).

2.3 Fat cover

The classification is also based on adipose deposits and their quantities on certain anatomical parts of the carcass (Table 1). It involves thickness, distribution on the carcass, uniformity, as well as the amount of fat on the kidneys. A minimum quantity of good quality fat must cover the carcass, without however being in excess, to be part of category A. In addition, it must be white or even tinged with pink, but it must never be yellow to be part of this class. The classifier also evaluates the amount of fat on the flank and on the kidneys. Carcasses with excess fat are graded B, while carcasses with little or very little fat are graded C (Canadian Beef Grading Agency, 2020; Monaghan, 2002; Riz Global Foods, n.d.; The BC Cook Articulation Committee, 2015).

Table 1 Muscle and Fat Cover Requirements (Canadian Beef Grading Agency, 2020; The BC Cook Articulation Committee, 2015)

Class	Fat Cover	Musculature
Canada A1 to A4	Carcass without excessive fat coverage, the coloring of which is creamy white or tinged with pink	Must meet **at least three** of the following characteristics: 1. A straight profile for the upper part of the leg; 2. Wide and thick loins; 3. A square with spinous processes well covered with flesh; 4. Covered shoulder tips.
Canada B1 to B4	Carcasses with low to high excess fat	Must meet **at least three** of the following characteristics: 1. Hip tips visible, but not prominent; 2. Loins showing depressions on either side of the processes of the dorsal vertebrae; 3. The spinous processes of the square slightly covered with flesh; 4. Shoulder points noticeable, but not prominent.
Canada C1 and C2	Carcass with very little kidney fat	Deficient to excellent

2.4 Meat color

All calf carcasses are graded according to the color of the meat. It is also one of the most important criteria in the grading of veal, greatly influencing the consumer, who seeks a meat color that is pale.

The color is determined using a colorimeter, a device measuring brightness, at the tip of the breast "brisket" (Figure 1). The device then provides a numerical value, based on the objective measurement of the color of the meat, which will then be used to distribute the calf carcasses into four categories. The lightest color range is given a score of 1, and scores of 2, 3, and 4 are assigned as the color of the meat becomes redder (Canadian Beef Grading Agency, 2020; Monaghan, 2002; The BC Cook Articulation Committee, 2015). Subsequently, a grade from A to C is assigned, according to the conditions of the category (Table 2).

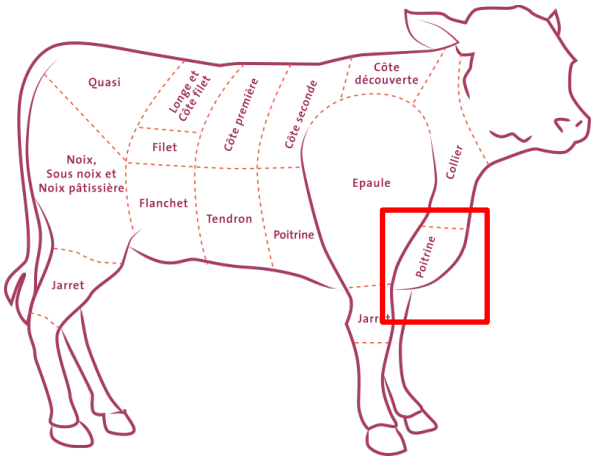

Figure 1 The color of the meat is determined on the tip of the breast (brisket)

Table 2 Classification category according to meat color

Class	Meat Color	Objective color (luminosity)
Canada A1	Bright pink or lighter color	50 or more
Canada A2	Pink	40 to 49
Canada A3	Light red	30 to 39
Canada A4	Red	0 to 29
Canada B1	Bright pink or lighter color	50 to plus
Canada B2	Pink	40 to 49
Canada B3	Light red	30 to 39
Canada B4	Red	0 to 29
Canada C1	Bright pink or lighter color	40 or more
Canada C2	Light red or dark red	39 and less

The color of veal meat plays a key role in the value of carcasses. In fact, consumers are looking for light meat, synonymous with an adequate supply of milk. However, according to numerous slaughterhouse testimonies reported by (Martineau, 2007), the color of veal continues to change within 24 to 48 hours after slaughter, without much more information being known on the subject. This development can pose problems at the commercial level, the buyer noting that the carcasses received do not correspond to the expected characteristics.

Combining the different criteria, there are therefore ten categories of calf carcasses bearing the names of the classes Canada A (1 to 4), Canada B (1 to 4) and Canada C (1 and 2). This grading process allows buyers of veal carcasses to specify their desired quality requirements (Canadian Beef Grading Agency, 2020; Monaghan, 2002; The BC Cook Articulation Committee, 2015).

3 Veal Classification Outside of Canada

3.1 Europe

Classification and marking are compulsory for all carcasses and in all slaughterhouses in France (FranceAgriMer, 2016). Like Canada, the weighing and grading of carcasses in Europe are determinants of the price per kilo of the carcass. They allow fair payment to producers based on the weight and quality of the carcasses.

Before 2008, animals were listed according to their weight. A calf could not exceed 200 kg, beyond which it was classified as an ox. This weight criterion has completely disappeared in the new regulations. Each of the countries of the European Union uses its own names, but applies the same European classification. In fact, on June 11, 2007, the 27 member states of the European Union reached an agreement, the term "veal" now being reserved for carcasses from animals less than or equal to 8 months old (Cartier and Moevi , 2007; FranceAgriMer, 2016). The rules for slaughtering, weighing and grading calves are very strict. This way, buyers know all the characteristics of the meat they are buying (Anonymous, n.d.; CIVAM Bio 09, 2015).

The calf must be slaughtered within four hours of arriving at the slaughterhouse.

Carcases presented whole or in half-carcasses must be weighed within one hour of stunning the animal. The weight used as the basis of payment for the breeder is that of the hot-weighed carcass reduced by 2% (FranceAgriMer, 2016).

Immediately after slaughter, the calf carcasses are evaluated according to three criteria: color, conformation and fatness, by a qualified classifier (FranceAgriMer, 2016).

The color of the meat is determined on the flank at the “Rectus abdominis” (Figure 2), using a color chart made up of the 5 color classes (FranceAgriMer, 2016), going from a white coloration for a score of 0, to a red coloration, for a score of 4 (Table 3). The color of the meat is an important component of the price of the veal carcass. In fact, the whiter the meat, the higher the commercial value of the carcass (FranceAgriMer, 2016).

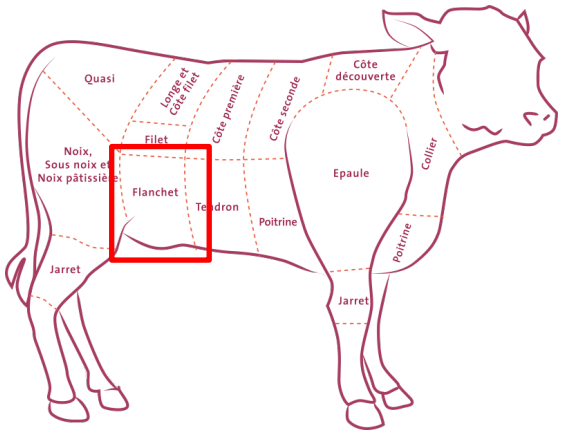

Figure 2 The color of the meat is determined on the flank

Table 3 Scale for the evaluation of coloring

Evaluation	Coloring
0	White
1	Very light pink
2	Light pink
3	Pink
4	Red

Conformation defines the profile and muscle development of the carcass. To determine the conformation of a carcass, it is visually cut into 3 parts (Figure 3) (CIVAM Bio 09, 2015; FranceAgriMer, 2016).

1. The back, which represents the leg;
2. The back, which includes the loin and the square;
3. The bass, which contains the bottom of the square and the shoulder.

For each of these 3 parts, we observe whether the muscle profile is concave, rectilinear or convex, the muscles plump or flat (elongated). The national grid provides for 5 classes of conformation corresponding to different muscle profiles, according to five EUROP classes (Table 4).

Fat cover is calculated based on the thickness of the fat under the skin and the amount of fat inside the chest cavity. The national grid provides for 5 fattening status classes (FranceAgriMer, 2016). Little or no fat corresponds to score 1 while a score of 5 defines a very strong fattening, the carcass being covered with a good layer of fat and the fatty deposits in the rib cage are considerable.

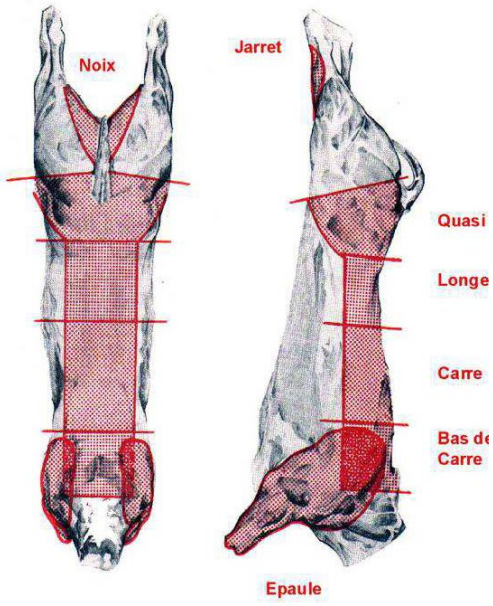

Figure 3 To determine the conformation of a calf carcass, it is visually cut into 3 parts (FranceAgriMer, 2016).

Table 4 Evaluation of the conformation of calf carcasses, according to the EUROP classification

Conformation	**E**	**Excellent**	• All profiles are convex • Compact and massive musculature of all parts
	U	**Very good**	• Profiles overall convex. Some, except those of the legs, can be rectilinear • Compact and massive muscles
	R	**Good**	• All profiles are at least straight • Thick musculature
	O	**Good enough**	• The profiles are rectilinear overall and sometimes subconcaves • Medium thickness musculature
	P	**Fair**	• The profiles are concave • Reduced musculature

Table 5 Evaluation of the status of calf carcasses, according to the European classification

Fat cover	**Lean**	No fat inside and outside the carcass
	Little coverage	The covering fat is insufficient. Muscle is visible almost everywhere: a thin layer of fat covers parts of the carcass
	Covered	Light layer of fat evenly distributed over the entire carcass. It can be very slightly more important at the level of the loin.
	Fat	The covering fat is slightly in excess, but covers the entire surface as a whole.
	Very fat	The covering fat is present in excess

Development

INTERBEV is the National Interprofessional Association of Cattle and Meat, a sector of FranceAgriMer, founded in 1979 on the initiative of organizations representing the cattle and meat sector. Within its strategic plan, published at the end of 2017, the calf sector has defined 4 main areas of work to face 2 essential challenges: maintain its production potential and defend the place of veal in the market. world of meats. One of the actions developed is "to assess the current rating system and consider an inter-professional agreement on the presentation, weighing, classification and marking of carcasses to enhance the transparency of the sector and its profitability". Among the planned activities, we note the objective assessment of the situation to formulate proposals for change (for example, review the frequency of quotations), the calibration of the chromameter, harmonization of the classification of the color, generalization of the increase of information to farmers, including the reasons for data enrty (including offal). The target is set for 2023.

3.2 United States

The inspection and grading of meat and poultry are two separate programs within the United States Department of Agriculture (USDA). The sanitation inspection is compulsory and financed by public funds. Rating for quality is voluntary and the service is requested and paid for by meat and poultry producers/processors (USDA, 2014).

The USDA Agricultural Marketing Service is the agency responsible for grading meat and poultry. Grading for quality means the evaluation of characteristics related to the tenderness, juiciness and flavor of the meat. Calf carcasses are classified according to two factors: conformation (proportion of lean, fat and bone in the carcass) and the quality of the lean. Staining of the muscle is also considered.

Once calf carcasses are graded, they can be labeled with one of the quality badges which provide a standardized way of describing the marketings of a particular food product. USDA grades are based on nationally consistent quality standards, ensuring that no matter where and when a consumer purchases meat, it meets the same criteria. The grade is stamped on the carcass or side of the beef and is generally not visible on retail cuts. However, beef retail packages will carry the American quality mark if they have been officially graded (USDA, n.d.). For the evaluation of calf carcasses, there are five categories, either grading or, "Prime, Choice, Good, Standard, and Utility" (USDA, 2014).

Table 6 Classification of calves according to USDA criteria (USDA, 2014)

Class	Description
Prime	Calf carcasses with minimal Prime quality conformation tend to be moderately wide and thick in relation to their length. They have a slightly thick flesh and a slightly plump appearance. The legs are slightly thick and rounded. The kidneys and back tend to be moderately full and plump. Shoulders and breasts tend to be moderately thick. The lean flesh is slightly firm, regardless of its color.
Choice	Calf carcasses with minimal Choice grade conformation tend to be slightly wide and thick in relation to their length. They tend to have a slightly thin flesh and have little or no signs of fullness. The kidneys, back and legs are slightly slender and almost flat. Shoulders and breasts tend to be slightly thin. The lean flesh is slightly soft, regardless of its color.
Good	Good quality minimum conformation calves are tidy, angular and narrow in relation to their length. They are fine-fleshed. The legs are thin and tapered and slightly concave. The kidneys and back are depressed. The shoulders and breasts are thin. Lean flesh is moderately soft, regardless of color.
Standard	Standard quality minimum conformation carcasses are very tidy and angular and very narrow in relation to their length. They have a very fine flesh. The legs are very thin and moderately concave. The kidneys and back are very depressed. The shoulders and breasts are very thin. Lean flesh is soft, regardless of its color.
Utility	Includes carcasses of calves whose characteristics are lower than those specified as minimum for the Standard category.

The Agricultural Marketing Department does not track the amount of ungraded veal, or how these carcasses are used. Again, the quality designation is simply a tool that is used between buyers and sellers to communicate an assured level of quality. There is no established use channel for the use of graded or ungraded veal or beef products (USDA, personal communication).

3.3 Australia

There is a basic category and four optional categories for grading veal carcasses, which are based on the individual characteristics of the carcass (Table 7). There are requirements for dentition, weight and color of muscle and fat, which must be met for the latter to be classified.

Assessment of dentition and weight is performed by trained operators on the slaughter floor while assessment of meat color and fat is performed by trained assessors (Matt Cooper, personal communication).

Table 7 Veal grading categories according to the Australian system

	Description	Category
Base	**Female or male** No evidence of permanent eruption on teeth Weight of the hot carcass must not exceed 150 kg No evidence of secondary sex characteristics in male calves The coloring of the meat must not exceed grade 5, standards established by the AUS-MEAT	V
Optional	**« Bobby »** Calf less than 3 months old Hot carcass weight must not exceed 40 kg	V
	Light veal Hot carcass weight must not exceed 70 kg Color must match AUS-MEAT standard dimensions	V
	Veal Hot carcass weight between 70 and 150 kg Color must match AUS-MEAT standard dimensions	V
	Rosé veal Slaughter at a minimum of 150 days of age Live weight 45 kg at 14 days of age Slaughter at a maximum of 240 days of age Hot carcass weight between 100 (minimum) and 200 kg (maximum) Muscle color should be between 1 and 3 (AUS-MEAT Standard) Fat color must be 1 or 2	RV

The meat color of calves is assessed on the chilled carcass at the level of the longissimus dorsi muscle (Figure 5) and is scored according to the AUS-MEAT reference standards (AUS-MEAT Limited, 2018) (Figure 4). Color can be assessed at any site from 4th to 13th rib. When the color observed is between two ribs, the higher is then retained. Color is assessed for any calf carcass with a maximum weight of 150 kg.

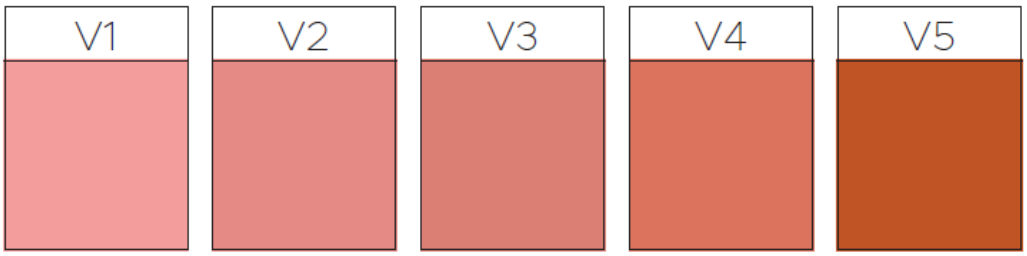

Figure 4 Standard for color evaluation of veal carcasses (AUS-MEAT Limited, 2018)

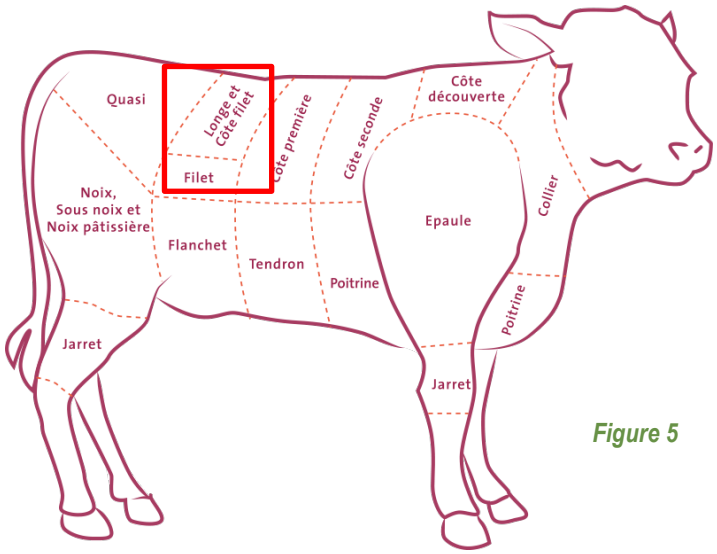

Figure 5 In Australia, the color of the meat of the veal is determined on the longissimus dorsi

4 Technologies available for grading bovine carcasses

In practice, the visual assessment of calf carcasses, required for the classification system, is carried out by one person and is therefore not a fully objective and accurate assessment. A study carried out in beef has shown that there are differences in the evaluation of carcasses between two evaluators. On average, one of the reviewers seemed to outclass type categories and underclass fat content (Karolina *et al.*, 2018). Knowing that producer remuneration is highly dependent on carcass evaluation, the process could be improved with an increase in grading accuracy, which would also lead to greater consumer satisfaction and increased supply for a calf. of good quality.

Classification systems have been around for decades in several species. However, the development of new technologies allows a better estimate of lean meat yield, covering fat and other traits of commercial value. The various devices used to classify carcasses are categorized according to their level of automation, either manual, semi-automated and fully automated. They provide different information (fat thickness, muscle thickness, etc.) and the choice of grading technology should be based on the specific needs of the user.

4.1 Manual equipment

"Manual" type equipment is entirely dependent on an operator since he takes the measurement on the carcass and then reads it. As a result, the operator is an important source of uncontrolled variations (eg: wrong angle of measurement, measurement taken at the wrong place, etc.), which can result in an increased risk of error, particularly with regard to the estimation of lean meat yield. In pigs, these devices can measure tissue depth, either where the carcass is split in half or laterally on the half-carcass (Pomar *et al.*, 2009).

Manual equipment is now seldom used for grading carcasses. Only slaughterhouses with low volumes still use this type of device. Considering that the veal industry is seeking to modernize its grading system, this type of device does not seem suited to the needs of the sector.

4.2 Semi-automated equipment

“Semi-automated” type equipment has been developed in order to reduce the “human” factor in taking measurements. However, this objective was not completely achieved, since these devices still need to be positioned correctly, at the correct measurement site on the carcass (Pomar *et al.*, 2009). The impact of the operator is therefore always present, which can contribute to increasing the risk of error. In order to minimize this risk, operators must be trained whether it is for the identification of the measurement site, the position of the transducers or the penetration angle of the probe. In addition, to limit the risk of fatigue-related errors, operators must be replaced frequently on the slaughter line. Moreover, if the device is not calibrated correctly or if it experiences technical problems, measurement errors may occur (Pomar *et al*., 2009).

Hennessy Probe

The Hennessy probe is an example of semi-automated equipment for grading carcasses in cattle. It uses optical technology (light reflectance) to automatically estimate carcass yield. This probe is mounted on a rigid handle with a sharp blade and a light emitting device, which provides the measurement when the tip of the blade pierces the tissue of the carcass (Hennessy technology, 2020; Pomar *et al.*, 2009). The data is then interpreted by software using prediction equations specific to each species and based on the recording of measurements from one or more preselected sites (Hennessy technology, 2020).

This probe is easy to use and the operator's training is relatively short. In addition, this system easily adapts to existing installations. The Hennessy probe can record up to 2,000 measurements per second and it takes less than a second to take a measurement at a specific site. In addition, in order to limit the risks of measurement error, these are performed using a Hennessy probe guide mechanism or a robotic device to ensure that the insertion and removal by the operator occur in the same coordinate plane (Hennessy technology, 2020).

In cattle, it can be configured to accurately grade carcasses for lean meat yield (%) and various objective quality traits such as color, water retention, intramuscular marbling, and tissue structure (Hennessy technology , 2020), in addition to being customizable so that the yield prediction analysis is suitable for different breeds of beef (Hennessy technology, 2020).

4.3 Fully automated equipment

"Fully automated" type equipment has been developed to completely eliminate the effect of the operator on taking measurements. However, in order to minimize the risk of errors related to the devices themselves, they must be tested periodically to ensure that they are properly calibrated and that they are functioning properly.

In cattle, the development of objective instrumental methods for grading carcasses has primarily focused on the use of video image analysis (vision) technology to mimic grader ratings. In Europe, the rules governing the grading of beef carcasses were amended in 2003 to allow mechanical grading. This has led to numerous installations in several countries of three different systems. Future developments in Europe could include the use of evaluations of the marketable performance of these systems as the basis for quality-based payments, and in the United States there is a move towards fully automated evaluation.

Video image analysis systems have therefore been developed and tested in different countries to predict percentage meat yield using data resulting from processing digital images of the entire side of a hot beef carcass or cross section of rib interface after carcass chilling, by a combination of data from the two digital images (Borggaard *et al.*, 1996; Cannell *et al.*, 2002; Jones *et al.*, 1995)

Video image analysis systems use cameras to capture images of a carcass and a computer to collect data: lengths, areas, volumes, angles, colors, etc. They then use this data to assess conformation, fat level and meat yield.

Beef Classification Center, BCC-3™

The Beef Classification Center (BCC-3) is now in its third generation. It is a classification system that uses advanced multi-view stereo imaging to create a full 3D reconstruction of the beef half-carcass.

Fully automatic, with a line speed of up to 620 half-carcasses/hour, it offers no possibility of interfering with the grading results. This technology therefore makes it possible to precisely and automatically quantify the commercial value of carcasses and, as it is "contactless", it does not damage the carcass and limits the risk of cross-contamination.

The fact of classifying each of the two halves of the carcass also brings precision and great reliability to the values obtained. Used in European slaughterhouses, it allows each primary and commercial cut to be defined and their weight to be predicted with high precision. This therefore allows the slaughterhouse to optimize the sorting of its products and to remunerate producers according to the true market value of the carcass. The system provides a classification of conformation and cover fat according to the EUROP classification system and similar standards (Frontmatec, 2019; Steinkuhler, 2019).

VIAScan carcass system (Australia)

This system uses video image analysis technology to objectively assess carcass quality and performance (Cedar Creek Company, 2020). It is a complete, non-invasive station where images of the outer surface of each carcass are taken in real time as it moves along the slaughter line. Fully automated, it can operate at high line speeds, up to 1200 carcasses per hour (Borggaard *et al.*, 1996; Cannell *et al.*, 2002; Cedar Creek Company, 2020; Jones *et al.*, 1995).

The resulting data can then be processed through software to predict lean meat yield (Cedar Creek Company, 2020). The device can be used to assess lean meat yield, percentage of primary cut weight, fat content, conformation (according to the EUROP classification) as well as percentage of total fat (Cedar Creek Company, 2020). The types of measurements can thus be customized to meet the requirements of the slaughterhouse and the needs of producers, with results available in real time.

Since 2017, this system has been used successfully to make commercial processing and carcass payment decisions for over 14 million sheep and over 500,000 oxen (Cedar Creek Company, 2020). Requiring minimal slaughter floor space, the Viascan system can be easily integrated into existing filing systems.

According to a test carried out by (Allen and Finnerty, 2000), the device's prediction error (in absolute value) for the yield of salable meat is 1.20 while the prediction error for the yield of cuts primary is 1.54.

BeefCam

It is a module used in conjunction with a computer vision system to predict the tenderness of meat. BeefCam is essentially a digital video camera that takes photos at the sirloin level and transfers the resulting images in real time to a computer. Images contain up to 250,000 pixels, allowing for separation and measurement of different colors. The BeefCam system quantifies the color of muscle and fat, known to be correlated with palatability, which is the product's appeal. Results obtained showed that 95 to 97% of carcasses identified as tender by the device were actually tender. The prototype, however, presents less precision in evaluating harder muscles whereas, of the carcasses identified as soft, 60% to 75% were just acceptable (Woerner and Belk, 2008). These limitations seem to prevent its use in a commercial setting (Vote *et al.*, 2003).

VBS 2000 (E + V technology, Germany)

VBS 2000 is another video image analysis based system developed for the EUROP beef carcass classification system. The system consists of a handling unit, cameras, lights, projectors and a computer system (BSAS, 2005). More recently, the technology was approved for use as a grading aid by the Canadian Food Inspection Agency and allows better grading accuracy, according to applicable regulations.

VBS 2000 is a fully automated device designed to assess hot half-carcasses suspended by Achilles tendons on mobile supports. It is equipped with high resolution digital cameras. The latter take two images of the exterior of each half-carcass, in a specific angle and analyze the area of the ribs between the 12th and 13th ribs on both sides of each carcass as it passes over a mobile rail (Delaloye, 2019; Duckworth, 2014; Karolina *et al.*, 2018). The technology is objective and evaluates marbling under the same light and at the same distance from the sirloin based on the red and white pixels in the traced muscle. This reduces the variability inherent in human assessment. The information captured can be stored, shared and analyzed more than before (Delaloye, 2019). In order to determine the volume, a weft of tape is projected onto the carcass. The first image taken by the device shows the two-dimensional view of the carcass and the second image shows the projected scratches. As the snapshots are taken, the computer software analyzes the scanned images and the handling unit moves back. The analyzed data is sent to the server which then estimates conformation and fat class, weight and yield. These values will then make it possible to determine the value of the parts and the selection criteria, i.e., length, width, angle, area and volume (Duckworth, 2014; E + V Technology GmbH, 2002; Karolina *et al.*, 2018).

Studies carried out by (Karolina *et al.*, 2018) have demonstrated that the VBS 2000 device allows a more objective evaluation of carcasses and offers a possibility to improve the precision of their evaluation. According to a test carried out by (Allen and Finnerty, 2000), the device's prediction error (in absolute value) for the yield of salable meat is 1.12 while the prediction error for the yield of cuts primary is 1.56.

Normaclass

The device was developed by the company Normaclass, in France, in order to automate the classification of beef carcasses, according to their conformation and their state of fattening in scores from 1 to 5 (Thomas, 2003). The technology, based on an image analysis system, uses six rotating cameras, set at different heights and viewing angles. The first half of the carcass, supported on a frame, is oriented outwards and is captured by two cameras (one for the rear and the other for the front). These first images obtained are used to determine the contour of the carcass and to evaluate the internal fat. The table then rotates 180 degrees, the first side is released and the frame is washed by an automatic system actuated by pneumatic pistons. The second half of the carcass then comes to rest against the other portion of the frame. This side is moved to three different positions and the six cameras take pictures with each change of orientation. 3D information is obtained from these different viewing angles (BSAS, 2005; Normaclass, 2011). The data obtained are paired with weight and thus make it possible to predict fat content and conformation. The grading machine operates continuously, without human intervention and allows grading approximately between 60 to 90 animals/hour (Thomas, 2003).

5 Conclusion

Weight, musculature, body fat and muscle color are the main criteria assessed when grading calf carcasses. Considering that the composition of the carcass changes with the age of the animal and that the maximum authorized weight for a calf carcass has constantly increased over the years, it is to be believed that the criteria are no longer necessarily the same.

In practice, the visual assessment of calf carcasses, required for the classification system, is carried out by one person and is therefore not a fully objective and accurate assessment. Knowing that producer remuneration is highly dependent on carcass evaluation, the process could be improved with an increase in grading accuracy, which would also lead to greater consumer satisfaction and increased supply for a calf. of good quality.

Classification systems have been around for decades in several species. Although developed and used mainly for grading large cattle, it appears possible that one of these technologies could be transposed to calves for better carcass evaluation. The technology should allow objective and accurate assessment of color, considering it to be the major quality criteria in the grading of carcasses.

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