Body Measurements on the Aubrac Cattle Breed: a review

Bianca-Maria Mădescu[1,2], Roxana Lazăr[1], Andra-Sabina Neculai-Văleanu[2], Ioana Poroșnicu[2,3], Paul Corneliu Boișteanu[1]

[1] *"Ion Ionescu de la Brad" University of Life Sciences, Faculty of Food and Animal Sciences, 700490, Mihail Sadoveanu Alley, no. 3, Iasi, Romania*
[2] *Research and Development Station for Cattle Breeding, no.9, 707252, Iasi-Ungheni, no.9, Iasi, Romania*
[3] *The Stefan S. Nicolau Institute of Virusology, Romanian Academy, 030304, Street Mihai Bravu, no. 285, Bucharest, Romania*

Abstract
The Aubrac is a French breed of domestic beef cattle, becoming a major interest for cattle breeders in our country. Being a large breed of cattle, cows weigh is between 650-800 kilograms and bulls between 1,000-1200 kg. Body conformation is one of the main criteria for assessing bovine animals from a zootechnical and economic point of view. The notion of body conformation in cattle means the overall external appearance of the examined bovine, with reference to the development of each body region separately. The method of body measurements consists in the direct measurement, on the animal, of the different body and mass dimensions. With the help of these measurements, we can appreciate the development and connection of different body regions or segments that make up the whole body and the general development of the animal.

Keywords: body, cattle, measurements, regions.

1. Introduction

Beef products are among the most consumed animal proteins, and the beef cattle industry is essential for many rural communities. Numerous challenges face the beef industry including the needs to improve nutrition and production efficiency to feed a growing human the population [1-3].

The Aubrac is a domestic beef cattle breed native from France. Originating in the heart of the Aubrac mountains (south of the Massif Central), the Aubrac cattle breed is a very old breed from France, bred especially in the departments of Aveyron, Cantal, Lozere and Haute-Loire, and over time this breed has spread especially in areas where access is difficult, the conditions being unsuitable for other breeds: the mountain area (Aude, Puy-de-Dôme, Pyrenees Orientales, etc.) and the high calcareous plateaus (Gard, Hérault, Landes, etc.). Initially, it was bred as a mixed breed (the milk is used to obtain Laguiole cheese), and later, starting from the post-war period, it was bred mainly for meat production. At the beginning of the 20th century, the Aubrac breed was widespread in the southern and eastern areas of the central massif and even in some Mediterranean regions [4]. Aubrac cattle provided milk for cheese making, and draft bulls were trained to work the land in those hilly areas, but at the end of World War II, the Aubrac breed was severely affected by competition from mechanized machinery (which replaced oxen Aubrac) and also by the popularity of highly productive dairy cattle breeds, which increased greatly after the 1950s, and milk was produced more cheaply by new cattle breeds such as the Holstein. Now the cows of the Aubrac breed are mainly used for meat production [5].

Aubrac cattle are medium-sized animals. Usually, they are brown-reddish in colour, the face structure

* Corresponding author: Bianca-Maria Mădescu
Email: biancamadescu@yahoo.com

is very well developed, darker around the eyes and the muzzle that continues with the white colour. The skin is black, the horns are lyre-shaped with a robust, well-muscled body, short neck, broad chest, very well-developed rump with also strong legs of short to medium length [6]. In general, the representatives of this breed are of medium height (adult cows: height at the withers 130cm, weight 550 – 800kg, bulls: height at the withers 140cm, weight 900 – 1200kg). They are rustic animals that show special biological characteristics, increased resistance and adaptability to diseases and severe environmental conditions, having a very long life, being recognized for easy calving. They are very easy-to-maintain cattle, they make good use of all categories of fodder, they adapt quickly to feeding on vast, poor pastures, without significantly influencing their productive level [4]. They are well adapted to harsh local climates and can thrive very well when fed on poor quality pastures. Also, their body is very well adapted to store energy during times of abundant food and then they can reserve energy for less favourable times**.** The Aubrac breed is famous for the flavour and the special tenderness of the meat, with a high degree of marbling, a special taste and a very good bone/meat ratio. This meat to bone ratio results in good, consistent carcass weight with superior meat quality.

Along with meat production, the breed is still used for milk production. Cows can produce on average up to 2,180 kg of milk per lactation. Aubrac cow's milk is of fairly good quality, with a fat content of around 4.13% [7].

In cattle, the body conformation is different depending on the direction of improvement (meat, milk or mixed production). The appearance of the body conformation of bulls depends mainly on the bone structure, which provides insertion points for muscles, ligaments and tendons. Bone tissue is the lever arm on which muscle tissue acts, thus ensuring body movements, but it can also have a protective role on vital organs.

It is recommended that cattle have a strong skeleton, with wide joints, and are closely related to their robust constitution. This type of constitution is desirable regardless of the specialization of the cattle, because such animals have a good vitality and a strong organic resistance.

The assessment of body conformation in cattle consists of two stages.

The analytical examination, which is based on the assessment of each body region, in correlation with the development and functioning of the whole body.

The synthesis test, which is based on the assessment of the animal as a whole, in correlation with its general development, harmony and proportionality of the whole organism.

It is indicated that in each conformity assessment, the analytical examination must be supplemented by the synthesis examination, which consists in assessing the proportional development of all body regions but also the way in which they merge with each other, depending on the morpho-productive type.

The synthesis exam can be done by: free method; points method; body measurement method (biometric measurements).

By performing the synthesis test, it is possible to follow the way in which the animal develops in a certain time interval (for example from calving to maturity) and comparisons can be made between the characteristics of the breed.

Body dimensions can be determined with various measuring instruments, data are recorded, then processed and interpreted.

2. Classical methods

The position of the animal during the measurements must be in a forced quadrupedal position, with the head and neck oriented in the normal position. Measurements may be made when the animal is outside or in the shelter.

Tools used

As measuring instruments are used: the zoometer for large body dimensions, the compass for small body dimensions, the metric tape for perimeters, the weighing scale for body mass.

Figure 1. Body measurements with zoometer

The rod (zoometer) is the most commonly used, with it measuring the large dimensions (lengths and heights). It generally consists of two parts: a round, sheath-shaped outer body 111 cm long, marked in cm, and a 106 cm long metal rod

(rectangular prismatic) that slides into a wooden sheath [8].
Its side faces are also marked in cm. In order to fix the size reference points, the cane has two metal branches, 1 cm wide, articulated movably and which can be fixed in a position perpendicular to the end, respectively on the wooden sheath.
A branch is located at the top of the metal rod, on a 6 cm long metal body; the second is attached to a metal slider that slides on the wooden sheath. If we consider the zoometer oriented with the metal branches forward, the gradations are arranged as follows: on the bottom left up from 0 to 116 cm, continuing on the rod from top to bottom from 116 to 217 cm when the rod is completely removed from the sheath; on the right side the gradations start from the upper end of the rod, with 0 to 101 cm and continue on the stick up to 211 cm i.e., in the upper part of the sliding metal slider [9].
Heights are measured on the animal in a four-legged forced station placed on a horizontal and straight ground in a four-legged forced station. The stick is fixed perpendicular to the stationary plane and the height is taken at the highest point, by removing the central rod from the wooden sheath. The size can be read on the left side, on the stem, directly at the point where it comes out of the sheath.
The gradations on the right side are used for lengths and widths. (To set the right or left side of the zoometer, it must be oriented with the metal branches in front of the examiner).
If the size is less than 101 cm, the side branch is fixed to the upper end of the shaft cover and includes the landmarks by moving the central rod; if it exceeds 101 cm, remove the stem completely from the sheath and move the lower side branch on the sheath of the cane.
Measuring compass (Wilkens). It is used to measure widths and shorter lengths. It consists of two arms in the shape of an arc of a circle, which rotate around an axis or the screw fixing them, the dimension is read on an arch on which the centimetres have been stamped (opening of the arms is indicated on the spring) or degrees - their equivalent being entered in a table. When measuring the size, the branches of the compass will be fixed on the external points with the help of a screw.

Figure 2. Animeter cattle tape measure

The goniometer is used to measure the angles formed by different bone rays. It is most often used to determine the mechanical ratios i.e., the angles of the musculoskeletal system and less to take the front-nasal angle in pigs or the costal angle in cattle [8]. There are various types of goniometers: Schmaltz, Duerst etc. The scale is used to determine body weight. To perform the measurements are required: an operator and two assistants (one records the data).

Figure 3. Weighing Aubrac cattle with the scale

Height measurements - This type of measurement is performed vertically and allows the appreciation of the proportional development of different body regions.

The main height measurements are:
Height at the withers (waist) - represents the distance from the ground level to the highest point of the withers;
Spine height - is the distance from the ground to the upper edge of the spinous process of the last dorsal vertebra.
Height at the croup - represents the distance from the ground level to the highest point of the sacral line;
Height at the base of the tail - represents the distance from the ground level to the insertion point of the tail;

Height (depth) of the thorax - represents the distance from the lower level of the sternum, immediately behind the shoulders, to the highest point of the rash;
Height at the sternum (substantive vacuum) - measured immediately behind the shoulders, is the distance from the ground to the lower level of the sternum [8].
All height dimensions are measured using a zoometer.

Length measurements
Oblique trunk length - measured from the anterior part of the scapulohumeral joint (point of the back) to the posterior prominence of the ischial tuberosity (point of the buttocks), on which occasion it can provide information on body development and body shape;
Horizontal length of the torso - represents the distance, in the horizontal plane, between the tangent verticals at the point of the back and the point of the buttocks;
Chest length (depth) - represents the distance between the point of the back and the maximum convexity of the last rib, gives us indications on the development of the thorax and body capacity.
All these dimensions can be determined with the zoometer or compass [8, 9].

Width measurements:
Chest width - is the distance between the most prominent points of the ribs, measured immediately behind the shoulders. This measurement provides data on chest development and is determined by the zoometer;
Chest width - is the distance between the scapulo-humeral joints, taking as landmarks the lateral protrusions of the upper humeral extremities; gives indications on the development of the previous train;
The width of the croup - provides information on the development of this region, the degree of muscular dressing and is determined in three points:
- At the hips and represents the distance between the external angles of the iliac bones;
- In the hip-femoral joints and represents the distance between the most prominent points of the hip-femoral joints;
- In the ischium and represents the distance between the two sciatic protuberances.

The width of the head (forehead) is the distance between the external points of the orbits and gives us indications on the morpho-productive type.
All these measurements are determined with the zoometer or compass.

Perimeter measurements
The perimeter of the thorax is determined with the ribbon, immediately behind the shoulders and gives us indications on the development of the thorax, body capacity and the body as a whole;
The perimeter of the whistle is determined with the ribbon, on the left front limb, in the area where the whistle is thinner; it correlates with the degree of skeletal development.

Figure 4. Perimeter measurements

Interpretation and use of data
This is done by expressing the results of the measurements in absolute values, in relative values and in body indices.
Absolute values represent the actual value of size and body mass, expressed in physical units (cm or kg). These values give us indications on the general development of animals and on the uniformity or variability of different characters within a population and on the appreciation of the productive skills of an animal.
Relative values are the expression of the absolute values of some dimensions, as a percentage of one of the main dimensions which is considered to be more closely related to the general development of the animal.
In practice, the term comparison is represented by the height at the withers (waist), using the formula:
This expression allows the proportionality of the regional and overall dimensions to be assessed in the examination of the animal.

$$Vr = (Va \times 100) / (trunk\ height)$$

Where:
Vr = relative value of the dimensions pursued;
Va = absolute value of the dimensions sought.

Body indices represent the relative values, obtained by relating some dimensions to others, with which they are closely related anatomically and physiologically [8]. These relationships of interdependence between different body sizes, serve to a greater extent to the overall assessment, to characterize the type of co-formation and production of animals.

The value of the same body index varies depending on the morpho-productive type, race, sex and age. In some cases, the value of some indices allows us to assess whether an animal developed normally or not during the breeding period.

A greater number of indices are used in the assessment of bulls, the most important of which are:

Body format index - It illustrates the general development of the body, as well as the format in which it falls; the value of this index increases from birth to adulthood and is higher in meat breeds than in milk breeds and respectively higher in early breeds than in late breeds.

Chest Depth Index - It changes with age, is higher in meat breeds than milk breeds and intermediate in mixed breeds; it is higher in bulls than in cows.

Mass index - It is an index that illustrates the ratio of body weight to animal size, the value being higher in meat breeds and also increases from birth to adulthood.

Height difference index - It is an index that shows no obvious differences between morpho-productive types. In general, the value of less than 100 of this index is found in primitive breeds, which have a less developed posterior train and in bulls. The difference in height is typical of young animals, but it disappears with age.

Head size index - Indicates, as a percentage, the length of the head at the waist, which is a characteristic of each morpho-productive type; the value of this index is higher in milk breeds compared to meat breeds [8].

Cephalic index - It illustrates the shape of the head, the ratio of these dimensions being higher for meat breeds compared to milk breeds; it is also higher in early than late animals. It changes with age, being higher in milk breeds compared to meat breeds; also higher in cows compared to bulls.

Pelvic-thoracic index - It varies according to age, sex and morpho-productive type. Increases with age, is higher in meat breeds compared to dairy breeds and in bulls compared to cows.

Pelvic-pectoral index - It shrinks from birth to adulthood and is higher in meat breeds than in dairy and bull breeds over cows.

Compactness or robustness index - Indicates the general development of the body (its length and depth in relation to the length). Its value generally increases from birth to adulthood, being higher in meat breeds.

Whistle loading index - The value of these two indices is higher in milk and mixed breeds compared to meat breeds.

3. Modern methods

The innovative system used to perform three-dimensional (3D) biometric measurements in cattle

Body size, weight and body condition score parameters are key indicators for monitoring cattle growth and these parameters can be monitored to predict beef cattle yield and evaluate economic traits. Frequent checks on animal growth can also help reduce animal welfare problems and recognize health problems [10].

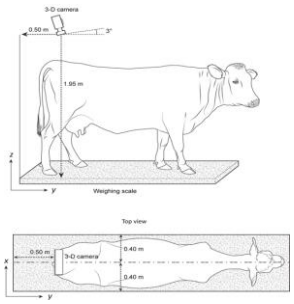

Figure 5. Innovative system for biometric measurements

For the past fifty years, the best way to measure the live body weight of individual animals, as well as their physical development, has been through the use of traditional or electronic weighing systems. Manually measuring the body size of animals can induce intense stress on them, with negative effects on their feeding and weight gain. However, such techniques are time-consuming and involve considerable costs, which are borne by the manufacturers. As a result, visual inspections are often preferred and biometric analyses are only done on visibly suffering animals, when preventive measures are not possible and curative interventions would be less appropriate and expensive. An alternative approach, which allows overcoming the limitations associated with the use

of direct manual measurements, is the introduction of techniques based on optical detection [11].

In recent years, many research efforts have focused on the use of image analysis for automatic animal weighing or estimated body parameters combining one or more two-dimensional (2D) views to obtain the required measurements. However, 2D images only provide two-dimensional projection of the animal, and the lack of the third dimension in vision-limiting applications using depth information. In addition, two-dimensional detection is highly influenced by perspective, distance and specific wavelength or applied filters, which can introduce relevant distortions in the collected data, therefore attention is currently focused on three-dimensional reconstructions, obtained by two-dimensional sensors or on instruments with true three-dimensional [12].

In order to solve this problem, the design of a system for collecting the main reference points for making real-time biometric measurements (lengths, depths, perimeters) for beef cattle with five measuring chambers was carried out. Algorithms perform reference point processing, registration, segmentation, sampling and 3D reconstruction of them, enabling target recognition. The maximum uncertainty of the calculated body in terms of width and length is 20 mm, and the image processing time is 0.08 s. This real-time 3D system for cattle allows the collection of data on biometric parameters, the animals are not subject to any factors of stress during the measurement [13].

The working method is as simple as possible, this being exemplified in Figure 6, when the cattle pass directly under the device, the traversing grid sensor and RFID reader is triggered to read the cattle tag number. Once the necessary information has been obtained, the five Kinect DK cameras begin to collect image data on the analysis of the main reference points in the determination of body indices in cattle, these images are followed by a computer conversion [14].

The system allows body measurements for active cattle on the farm. It can achieve cattle entry perception, tag tag reading and instant collection of key reference points from multiple angles with 5 Kinect cameras without stress and interference to cattle [14].

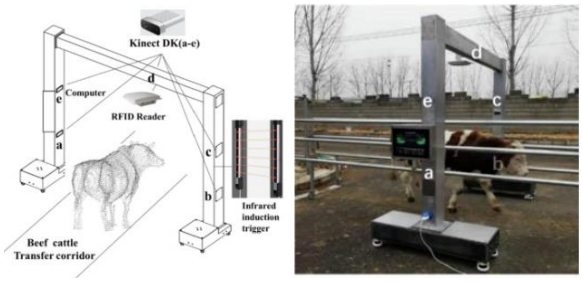

Figure 6. Kinect DK cameras (3 D system)

Weighing animals using smartphone applications

The "Beefie" application was recently launched and allows you to find out on the spot the weight of cattle on the farm or even in the pasture by simply photographing them. The agroninja beefie™ mobile application developed by the Agroninja company, is also available for cattle breeders in Romania.

The main function of the beefie™ app is to measure the weight of cattle using a mobile phone. Unlike all traditional weighing methods, the beefie™ app, developed by Agroninja, performs the actual weighing of the animal remotely, stores this data and allows you to use it later [15].

By means of a single photo of the animal either in motion or partially covered, taking into account its breed, sex, age and condition, the weighing is done with an accuracy of 95% without coming into contact with the animal. The quality of the image is of great importance, for their realization a distance of 4-6 meters from the cattle is recommended, but also its realization from a perpendicular angle. Without special training, the weighing is done in less than a minute and can be recorded based on the animal's tagline.

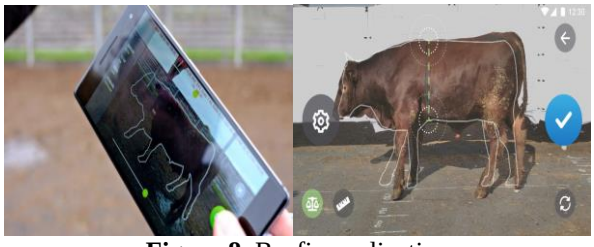

Figure 8. Beefie applications

Measurements can then be emailed. Compared to the classic weighing process, this application makes it possible to weigh without stress and hassle because the animal does not have to be moved.

The beefie™ digital scale works on Android 5.1+ systems, so it can be used on most Android smartphones (figure 15). In addition, the application does not require an Internet connection, measurement and recording of results can be done offline, so it can be used anywhere [15].

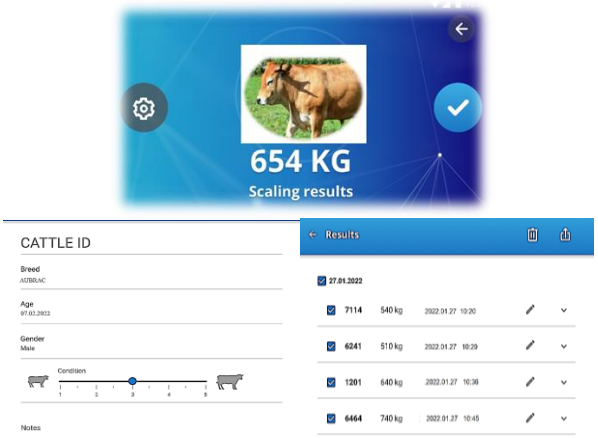

Figure 7. Weighing animals using Beefie application

The concept of "precision agriculture" is very popular nowadays, a methodology through which we can increase efficiency through careful management. This mainly requires as much information as possible about the animals. The information in this case is the weight of the cattle [12].

Conclusions

Weight and body condition score parameters are key indicators for monitoring cattle growth and can be used to predict beef cattle performance and evaluate economic traits. Modern biometric methods for measuring the body of animals (3D systems) represent an easier alternative compared to classical methods. The animals are not exposed to major stress and the personnel performing the measurements are not exposed to any risk. It is moving towards the digitization of the livestock sector.

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