

ABSTRACT

PhD thesis entitled *“Researches about the characterization of the meat quality indicators in equines”* it is structured in two parts: the bibliographic part and own researches part, completed with a chapter of conclusions and bibliography.

The bibliographical study consists of 4 chapters as follows:

- ✓ *chapter I* presents the production and consumption situation of horse meat with economic and social importance of horse raising for meat, and the need of horse meat consumption;
- ✓ *chapter II* describes the study of reference literature about the morphophysiological status of horses before slaughter, with the implications of the interpretation of haematological and biochemical parameters found in their blood;
- ✓ *chapter III* presents the literature study about the characterization of the technological parameters of obtaining the horse carcasses;
- ✓ *chapter IV* includes data from the specialty literature about the quality indicators of horse meat;

The cumulation of these four chapters contain a total of 17 figures and 10 tables, and the bibliographical study being represented by a number of 121 quotes.

The second part represented by own research is divided into 9 chapters, which lists a number of 50 tables and 52 figures.

In the first chapter, it mentions the meat derived from horses. Thus, it is consumed in many countries belonging to the European Union, the highest levels recorded in Italy, France and Belgium. European traditions tilt for fresh horse meat consumption, considering it a delicacy, without having in its composition promoters or growth additives, having high nutritional value and low content in fat.

World production of horse meat including donkey meat in some states in the world in 2009 is as follows: Mexico - 78 thousand tons, Argentina - 57 thousand tons, Kazakhstan - 55 thousand tons, Mongolia - 38 thousand tons, USA - 25 000 tons, Australia - 24 thousand tons, Italy - 16 thousand tons, Romania - 14 thousand tons, Spain - 5 thousand tons.

Production of horse meat has several advantages, with a high yield after slaughter of about $60 \div 70\%$, and the nutritional value is similar to beef, except that it has a lower fat content.

All over the world the need to ensure protein substances of animal origin in human nutrition is observed. Thus, increases and intensifies their efforts to raise livestock production. Consumers nowadays are increasingly interested in what they eat, wanting that the minimum level of fat to be the one that gives the meat flavor and juiciness.

Cellular blood components reflect specific changes in an organ or body system, or most often an animal's response to physiological or pathological certain conditions. Hematological profile provides important information about the severity of the disease, response to treatment, and helps to establish the diagnosis. Horses can have different hematological disorders, which makes hematology be an important branch in studying them.

Despite the widespread use of haematological analysis in equine medicine, their interpretation may be challenging in some cases because they may be significantly influenced by a high number of factors. Haematological parameters may vary according to race, sex, age, reproductive status, the lifelong work, of feeding, circadian variations, procedure of handling the animals during the collection of blood samples, the degree of arousal and health status.

To successfully respond to the increasing demands of meat consumption, increasingly intensifies husbandry systems, which however have limited resources in terms of food availability and environmental factors. Therefore, intervenes the role of technology of slaughter and obtaining of meat and meat by-products. The advantage of processing the carcasses is achieved through the use of certain animal tissues (remains from trimming the carcasses, remains of bones, remains of animal organs or even organs that are not sold in the fresh meat market) in the food chain, creating by-products that have high protein content.

In the study were pursued the following objectives: analysis of equine transport from the beneficiary to the slaughter unit and its influence on the animal; the appreciation of haematological and biochemical values for assessment of the morpho-physiologic status before slaughter and improve their welfare factors; presenting the phases of the slaughter technological flow, and depending on the species taken under study the features description and the role that they have to obtain conform carcasses for marketing; analyzing the differences in terms of meat quality harvested of various muscles from young and adult horses, of different sexes; analysis of nutritional-biological quality of horse meat, to meet the consumer demands of these products; analysis of physicochemical and sensory characteristics of horse meat through the main body regions; determination of microbial charge on the carcass surface, charge in limit due to hygiene

before slaughter, but also from the accuracy of which is performed throughout all stages of the slaughter flow.

Part of own research is divided into two chapters as follows:

✓ *in chapters V and VI* are presented the aim and objectives of this paper, the manner in which researches have been carried out, characterization of the institutional framework and the presentation of the experimental protocol, respectively the materials and working methods used in order to achieve the proposed goals;

✓ *in chapters VII, VIII, IX, X, XI, and XII, XIII* are analyzed the result of researches to which were performed statistical calculations and interpretations as follows:

- for the characterization of morpho-physiologic status of the horses was performed haematological and biochemical panel,
- the influence of slaughter technology on yield after slaughter, *the ratio meat / bones respectively meat / fat*;
- for physical indicators: *pH, color, texture, tenderness*;
- for chemical indicators: *gross chemical composition*;;
- for technological indicators: *losses by boiling*;
- for microbiological indicators: *Salmonella spp., Enterobacteriaceae, N.T.G*;
- for sensorial indicators: *taste, flavor, appearance and texture*.

In order to achieve these objectives was necessary to harvest tissue blood from live horses before slaughter, as well as muscle tissue from four different anatomical regions derived from carcasses after slaughter: *M. Longissimus dorsi, M. Semitendinosus, M. Trapezius thoracis, respectively M. Biceps brahial*. The experimental batches were in number 4 constituted in: L1 – young females, L2 – young males, L3 – adult females and L4 – adult males.

The researches undertaken for the characterization of horse meat were performed initially in order to identify the importance of pre - slaughter factors in the metabolism of the animal.

To avoid or prevent certain errors voluntary or involuntary multitude of stages pre - slaughter is respected without deviations, thereby offering greater attention to acquisition, transport, loading and unloading horses, but also their diet.

Embarking horses are done individually by trained personnel using a bridle which is also used to restrain the animal during transport.

The cars by which transportation of horses is realized are MAN with a capacity of 7.5 tons, length $L = 7.2$ m; $l = 2.6$ m width and height $H = 3$ m. The cars are equipped with additional electric fans are used during the summer to maintain a comfortable temperature during

transport, and during periods of moderate temperatures are used vents provided in the construction of the machine.

The processing unit is equipped with a paddock, divided, specially built for different categories of animals, ensuring comfort and relaxation necessary to physiological recovery after suffering discomfort during transport.

The paddock is equipped with installation of artificial light, but also by its construction ensures a natural lighting. The paddock is naturally ventilated through windows at the top of the walls, which provides a level of temperature, humidity and ammonia within the limits of admissibility.

Following the technological flow within the unit of slaughtering horses aimed to identify all technological parameters and particularities of each stage having a major influence on meat quality parameters results.

After slaughtering the animals for meat, to estimate and assess correctly the animal adaptation to different environmental conditions, their pre-slaughter welfare, the quality of ingested food was determined the slaughter yield. Among the categories of horses slaughtered are foals and adult animals with different body constitution according to feeding and maintenance. Within the study carried out on horse batches, calculated values for slaughter yield ranged between 47.63 and $50.65 \pm 1.00\% \pm 0.81\%$, the minimum being recorded in young females and the maximum in adult males.

The values of indicators resulted in the slaughter, depend greatly on the animals age, because adults towards the end of its lifetime activity do no more than convert energy into fat, unlike the youth who channel all their energy into muscle tissue activities.

pH is a result of biochemical changes postmortem, which continues during meat refrigeration. Averages founded and calculated for *Longissimus dorsi* muscles showed a curve that decreases slightly with increasing the refrigerating time.

Researches in the meat industry affirms that it is dependent on the quality of the pigments present, such as carotenes or heme pigment, which is synthesized antemortem and pigments produced postmortem through enzymatic reactions. The color intensity is reflected by the hemoglobin content present in the meat chemical composition and the brightness of the muscle, which in turn being influenced by the pH value and the rate of decay thereof.

Objective characterization of horse meat color for experimental L1, L2, L3, L4 was achieved by determining the five colorimetric parameters (L^* , a^* , b^* , C , h^0) system features CIEL * a^* b^* .

Average results calculated for brightness (L^*) at *Longissimus dorsi* muscle ranged between 23.42 ± 0.54 minimum units, determined at L1, and the maximum value 25.63 ± 0.59 units determined in group L4. Coordinate of complementary colors red - green (a^*) recorded values between 10.09 ± 0.29 $11.34 \pm 0.49 \div$ units.

Tenderness of horse meat by calculating the Warner Bratzler shear force to *Longissimus dorsi* muscle presented values between $46.91 \pm 1.40 \div \pm 8.54$ $70.43 \text{ N} / \text{cm}^2$ maximum value being found in the batch of adult males.

Regarded as an alternative to other meat, horse meat must capitalize on an important aspect to meet consumer, that being the meat tenderness. The complex process which forms the meat texture is influenced by the structure, integrity and other internal and external factors, factors that could negatively or positively influence this process. Analysis of the batches taken in study on *Longissimus dorsi* muscle showed values for hardness between 33.96 ± 2.41 (N) and 37.20 ± 2.65 (N) corresponding for L1 and L4 batch. Characterizing the Semitendinosus muscle, parameter values expressing muscle texture were lower than the results for *Longissimus dorsi* muscle, hardness indicator fluctuated between a minimum 23.14 ± 3.12 N and $1.36 \pm$ maximum 34.6 N.

The nutritional-biological value and chemical composition of meat generally varies greatly depending on the species from which the meat originates, thus the horse meat is generally preferred by consumers due to decreased caloric intake. Thus, higher lipid values were found in muscles derived from adult female and higher protein content in young males.

According to the analyzed samples from four batches of horses losses by boiling recorded different values not only because of the chemical composition, but also of the conditions and growth environments.

The proliferation of microorganisms in meat depends on several factors, among which: microflora composition, product temperature, previous treatments applied to the product, pH, available nutrients, redox potential, and environment of exposed product.

Concerning the presence of *Salmonella spp.* on the carcass surfaces taken in study, about those that are safe for consumption as it was not detected any colony of bacteria after microbiological examination. Thus, the obtained data fall within the limit of ISO6579: 2003.

The interval identified on the batches taken under study for *Enterobacteriaceae* ranged from $1.79 \pm 0.19 \log \text{cfu} / \text{cm}^2$ and $2.08 \pm 0.08 \log \text{CFU} / \text{cm}^2$, the highest value been found in young males. Given that ISO 21528-2 admissibility range is $1.5 - 2.5 \log \text{cfu} / \text{cm}^2$; all the 4 groups are in accordance.

The number of microorganisms (NTG) that may appear on the surface of meat varies greatly. The batch with the highest bacterial load on the surface of carcasses was L3 ($3.10 \pm 0.13 \times 10^3 \log \text{cfu} / \text{cm}^2$), at the opposite pole being placed L2 ($2.29 \pm 0.26 \times 10^3 \log \text{cfu} / \text{cm}^2$).

Trichinosis is a global zoonosis that is caused by the ingestion of raw or undercooked meat. Following the completion of analyzes for the 4 batches were determined negative results, which makes it good for consumption.

Analyzing *Longissimus dorsi* muscle in terms of sensory were observed very significant differences for analyzed L2-L4 batches regarding the hardness, and significant differences for L1-L3 batches, for the remaining batches the differences were insignificant.

From the conducted researches regarding the horse meat obtained through respecting the quality management within the technological slaughter flow were obtained very good quality carcasses, with commercial attractiveness for the final consumer.