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# RESEARCH ON THE QUALITY OF PIG CARCASSES BASED ON DIFFERENT INFLUENCE FACTORS

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***Abstract***

*Each pig breed has different characteristics and composition of meat and carcasses. After slaughter, the quality of animals for meat, respectively the assessment of carcass quality, is established by assessing elements such as conformation, fattening status, fineness, color and consistency of the muscles. All of these elements used to assess the quality of a carcass depend on invariable and variable factors. The invariable factors taken into account are species, breed, sex, age, these determining the "classes" for the carcass. The variable factors are the maintenance conditions, nutrition, section, etc. and participate in determining, for each class, the carcass qualities. The aptitudes of the animals for quality carcasses are established after cutting, summing up several essential criteria such as the conformation of the carcass, the weight of the carcass and the portions in the carcass, the yield, the characteristics of the muscle and adipose tissue that form the meat and define the quality of the meat, as well as their distribution according to the slaughtering region.*

***Key words****: carcass, influence factors, quality, pigs.*

## INTRODUCTION

According to the National Institute of Statistics, in 2023 pig slaughter decreased by 1.1%, but pig farming is a prosperous livestock industry, with over 100 species of pig breeds with different characteristics and meat composition. Both nationally and globally, pork consumption represents a significant share of daily human consumption (insse.ro).

The quality of animals for meat after slaughter, respectively the assessment of carcass quality, can be established by assessing the following elements such as conformation, fattening status, fineness, color and consistency of the muscles.

These elements of carcass quality depend on invariable and variable factors. (Song et al., 2023; Burtea et al., 2017; Caratus Stanciu et al., 2017).

Among the invariable factors, we mention species, breed, sex, age, which determine the "classes" for the carcass (Song et al., 2023).

Variable factors such as housing conditions, food, ward, etc. are involved in determining each class (Song et al., 2023).

The quality of animals for meat is determined after slaughter, based on the ratio of four essential elements, namely (Van den Broeke et al., 2020; Xia et al., 2023):

- carcass conformation;
- carcass weight and carcass portions;
- yield;
- characteristics of the muscle and adipose tissue that form the meat and define the quality of the meat.

Therefore, a meat animal will be appreciated and considered of quality to the extent that it satisfies the consumer's requirements from this point of view (Lebret & Čandek-Potokar, 2022; Maloș & Ianițchi, 2024).

That is why it is necessary to delimit these characteristics, because the classification of animals into categories must respond to common and simple definitions (Zomeño et al., 2023; Xia et al., 2023).

The objectives of the research are to determine how certain factors influence the quality of pork meat and carcasses, as well as its difference depending on the individual. The differences between individuals will be monitored depending on breed, sex, age, rearing system, as well as the weight at slaughter, weight after slaughter, organ weight, all of these by breed, age and sex (Xia et al., 2023; Maloș & Maloș, 2020).

## MATERIALS AND METHODS

The research was conducted in a slaughterhouse in northern Argeș County, which is equipped with slaughtering lines for pigs, but also for sheep, goats and cattle. It has been operating continuously since 1993, initially being recognized as a local slaughterhouse, later expanding its activity to the distribution of meat and meat products in its own warehouses. The slaughtered animals come from small and medium-sized farms, with a semi-intensive farming system, built from local materials, where feeding and watering are done manually. In the cold season, the shelter is heated based on the biological heat released by the animals, and in the warm season, ventilation is done through doors and windows. To ensure data confidentiality and remove any trace of subjectivity, the name of the slaughterhouse will not be disclosed.

In the slaughter unit, the actual research activity consisted of weighing animals before slaughter, determining the weight of the carcass after hot and cold slaughter, determining the weight of certain organs such as the heart, lungs, liver, kidneys and gastrointestinal tract.

Sensory analysis of meat, which is used to determine the quality of meat and carcass, was performed. The following determinations were made for sensory analysis: appearance, color, odor, fat characteristics, and consistency. The objectives of the research are to determine how certain factors influence the quality of pig carcasses, as well as its difference depending on the individual. The differences between individuals will be monitored according to breed, sex, age, rearing system, as well as the weight at the entrance to the slaughterhouse, the weight after slaughter, the weight of the organs, all of these per breed, age and sex. The average weights, both live and in the carcass, hot and cold, as well as the average weights of the organs in question, were calculated for 15 individuals, from each breed, respectively the mixed breeds in question, aged between 6-8 months. The data necessary to achieve the objectives proposed for this work were collected, analyzed and interpreted.

The pig breeds discussed were Mangalita, Duroc, and Great White x Landrace crosses.

In what is identified Duroc breed, it is characterized by medium to large hooves, pigmented skin and reddish hair. At the age of 6 months, they reach a weight of 105-110 kg., the average thickness of the bacon layer being 13-15 mm, with a meat content in the carcass of 55-56%. It is a resistant breed that is very suitable for growing in a household system, resistant to stress. It is recognized as a meat breed, adults having a meat content in the carcass of up to 80% (agrobiznes.ro).

Mangalita is a breed resistant to diseases and less favorable microclimate conditions, suitable for growing in semi-intensive and intensive systems. It is characterized by a mixed morpho-productive type, meat-fat. It has a slaughter yield of 75-85% and a relatively low growth rate, at 6 months the young reach 70-80 kg (agrobiznes.ro).

Regarding the Great White x Landrace crossbreeds, the young raised for meat reaches the slaughter weight of 115-125 kg at the age of 7-8 months. The slaughter yield is good, 75-76%. It is characterized by having a high capacity for acclimatization, making it very suitable for both home-based and semi-intensive farms (agrobiznes.ro).

The data recorded following the determinations carried out in the slaughterhouse were analyzed and interpreted statistically, obtaining the following statistical indicators:

- arithmetic mean $(\bar{X})$:

$$\bar{X} = \frac{\Sigma x}{n}$$

$\sum x$ - represents the sum of the performances;

n - the number of individuals.

- the variance ($S^2$):

$$S2 = \sum x^2/n - 1$$

x - the measured value of each individual;

n- the number of individuals.

- the standard deviation (S):

$$S = \sqrt{S^2}$$

- coefficient of variability (CV%):

$$\text{CV\%} = \frac{S\bar{X}}{\bar{X}} * 100$$

- error of the mean $S\bar{X}$:

$$S\bar{X} = \sqrt{\frac{S_{\bar{X}}^2}{n}}$$

The results obtained were compared with existing data in the specialized literature and with those obtained in similar research.

## RESULTS AND DISCUSSIONS

Sensory analysis of meat. Organoleptic characteristics are influenced by several factors such as age, sex, fattening status and anatomical regions. Sensory analysis of meat was performed similarly for all three breeds analyzed according to sex and age. Therefore, in terms of appearance and color analysis, these were carried out in as close to natural light as possible, observing both the surface and the section. They provide general information about the meat examined. The smell provides information about the state of freshness of the meat and is determined by directly smelling the meat both on the section and on the surface. In the case of boars, by directly smelling the meat, a possible urine smell can also be detected, specific to this category of pigs. The sensory analysis regarding the characteristics of the fat was carried out by observing its color and consistency when touched. The consistency of the meat was determined by touching it, by pressing with the finger in several areas, noting the characteristics of the fingerprint and the state of elasticity.

According to Tables 1, 2 and 3, regarding the organoleptic examination, the differences observed between the three categories of individuals under discussion were related to the color of the meat, in youth it was light pink, and in adults it was pink to dark red, consistency, soft meat in youth and hard, firm, in adult individuals.

Table 1. Organoleptic characteristics of fresh carcasses according to certain characteristics in young pigs, males of the Mangalita, Duroc and Great White x Landrace breeds

| CHARACTERISTICS | APPEARANCE | COLOR | SMELL | FAT CHARACTERISTICS | CONSISTENCY |
|---|---|---|---|---|---|
| YOUNG PIGS, MALEs | Glossy, clean surface, pearly white and elastic connective tissue. | Light pink color. In section, color characteristic of the anatomical portion. | Pleasant, characteristic. | The fat is soft, greasy, does not crumble, and is white in color. | It is soft and elastic both on the surface and in section. It leaves no imprint when pressed with a finger and quickly returns to its original shape. |

Table 2. Organoleptic characteristics of fresh carcasses according to certain characteristics in adult pigs Mangalita, Duroc and Great White x Landrace breeds

| CHARACTERISTICS | APPEARANCE | COLOR | SMELL | FAT CHARACTERISTICS | CONSISTENCY |
|---|---|---|---|---|---|
| ADULT SWINES, MALES | Glossy, clean surface, pearly white and elastic connective tissue. | Shades of red, to dark red depending on the body region. In section, the color is characteristic of the anatomical portion. | Pleasant, characteristic. | The fat is soft, greasy, does not crumble, and is white in color. | It is firm and elastic both on the surface and in section. It leaves no imprint when pressed with a finger and quickly returns to its original shape. |

Table 3. Organoleptic characteristics of fresh carcasses according to certain characteristics in adult pigs, females of the Mangalita, Duroc and Great White x Landrace breeds

| CHARACTERISTICS | APPEARANCE | COLOR | SMELL | FAT CHARACTERISTICS | CONSISTENCY |
|---|---|---|---|---|---|
| ADULT SWINES, FEMALES | Glossy, clean surface, pearly white and elastic connective tissue. | Shades of red, to dark red depending on the body region. In section, the color is characteristic of the anatomical portion. | Pleasant, characteristic. | The fat is soft, greasy, does not crumble, and is white in color. | It is firm and elastic both on the surface and in section. It leaves no imprint when pressed with a finger and quickly returns to its original shape. |

Table 4. Statistical parameters calculated according to organ mass weight

| Race | Statistical parameters | Organ weight analysis | | | | | |
|---|---|---|---|---|---|---|---|
| | | Heart | Lungs | Liver | Kidney | Stomach | Intestine |
| Duroc | n | 15 | 15 | 15 | 15 | 15 | 15 |
| | $X \pm S_X$ | 0.41±0.01 | 1.01±0.05 | 2.02±0.06 | 0.28±0.01 | 1.17±0.04 | 3.78±0.12 |
| | S | 0.05 | 0.22 | 0.24 | 0.05 | 0.17 | 0.44 |
| | CV (%) | 12.19 | 14.6 | 11.88 | 17.85 | 14 | 11.64 |
| Mangalita | n | 15 | 15 | 15 | 15 | 15 | 15 |
| | $X \pm S_X$ | 0.28±0.36 | 0.61±0.02 | 1.12±0.02 | 0.15±0.08 | 0.75±0.04 | 2.21±0.02 |
| | S | 0.04 | 0.13 | 0.07 | 0.04 | 0.14 | 0.06 |
| | CV (%) | 14.28 | 21.31 | 6.25 | 26.6 | 18.66 | 2.72 |
| Great White x Landrace | n | 15 | 15 | 15 | 15 | 15 | 15 |
| | $X \pm S_X$ | 0.44±0.01 | 0.87±0.02 | 1.65±0.02 | 0.23±0.01 | 1.10±0.04 | 3.25±0.02 |
| | S | 0.05 | 0.09 | 0.08 | 0.05 | 0.17 | 0.07 |
| | CV (%) | 11.36 | 10.34 | 4.85 | 21.73 | 15.45 | 2.15 |

Table 4 presents the data from the statistical analysis of the mass of the organs studied for the young of the three analyzed breeds. The heart had an average weight of 0.41 kg and a coefficient of variability of 12.19% in the Duroc breed, in the Mangalita breed its weight was lower, 0.28 kg, and a coefficient of variability of 14.28%, the highest weight being in the Great White x Landrace crossbreeds, of 0.44 kg and a coefficient of variability of 11.36%.

Analyzing the value of the coefficient of variability for this organ, in all three breeds taken into study it had a value less than 15%, which means that in the respective samples there is a small degree of variability, and the average established at the level of each sample is representative for the entire population of individuals taken into consideration.

Analyzing the data on the lungs, it is observed that the Duroc breed had the highest average weight, 1.01 kg, the Mangalita breed 0.61 kg - being the lowest weight of the three breeds, and in the Great White x Landrace crossbreeds, their weight was 0.87 kg. The coefficient of variability had a value of less than 15% for the Duroc breeds (14.6%) and for the Great White x Landrace crossbreeds (10.34%), resulting in a low degree of variability in the respective samples, and the average established at the level of each sample is representative of the entire population of individuals under discussion. The value of the coefficient of variability in the Mangalita breed was between 15-30% (21.31%) and considers that the variability is medium and the average is sufficiently representative.

The average liver weight was the highest in the Duroc breed, namely 2.02 kg, 1.12 kg in the Mangalita breed and 1.65 kg in the Great White x Landrace crossbreeds. For all three breeds, the value of the coefficient of variability resulting from the statistical analysis of the liver mass was less than 15%, which means that in the respective samples there is a small degree of variability, and the average

established at the level of each sample is representative of the entire population of individuals under discussion.

For kidneys, the average weights were: the highest in the Duroc breed - 0.28 kg, the lowest in the Mangalita breed - 0.16 kg, and in the Great White x Landrace crossbreeds 0.23 kg. For all three breeds analyzed, the value of the coefficient of variability was between 15-30% and it is considered that the variability is medium and the average is sufficiently representative.

The statistical data obtained from the analysis of the body mass of the stomach shows that the highest average weight of this organ was recorded in the Duroc breed - 1.17 kg, the lowest in the Mangalita breed - 0.75 kg, and in the Great White x Landrace crossbreeds 1.10 kg. Analyzing the value of the coefficient of variability for this organ, it is observed that its value was less than 15% in the Duroc breed, and between 15-30% for the Mangalita and the Great White x Landrace crossbreeds. In the latter, the variability is considered to be medium and the average is sufficiently representative.

The average weight of the intestine recorded values such as 3.78 kg for the Duroc breed - being the largest, 2.21 kg for the Mangalita breed - being the smallest, and 3.25 kg for the Great White x Landrace crossbreeds. For all three breeds, the coefficient of variability value resulting from the statistical analysis of the liver mass was less than 15%, which means that there is a small degree of variability in the respective samples, and the average established at the level of each sample is representative of the entire population of individuals analyzed.

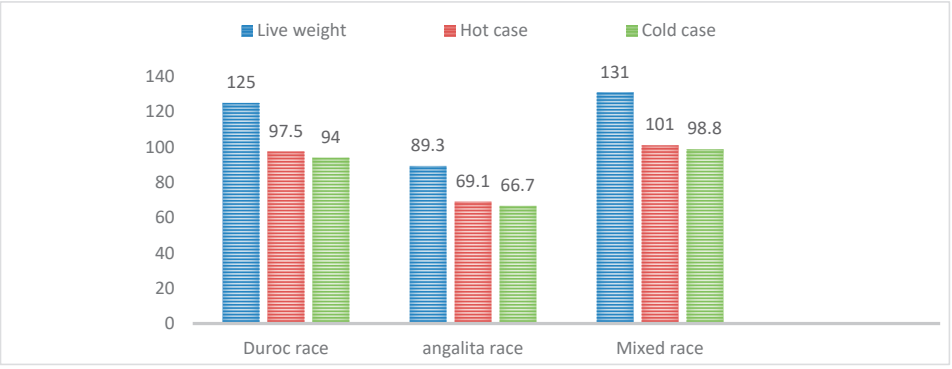


Figure 1. Evolution of carcass weights

In the Duroc breed, the hot carcass weight represents 78% of the total live weight, and the cold carcass weight represents 75.2% of the total live weight, a difference of 2.8%. In the Mangalita breed, the hot carcass weight represents 77.37% of the total live weight, while the cold carcass weight represents 74.69%, a difference of 2.68%. As for the Great White x Landrace crossbreeds, the hot carcass weight is 77.0% of the total live weight, and the cold carcass weight represents 75.41% of the total live weight, a difference of 1.58%.

Table 5 presents the statistical data calculated according to body weight, hot and cold carcass weight, of the 15 individuals in question. Regarding the live weight of the Duroc breed, with an average weight of 125 kg and a coefficient of variability of 0.21%. Analyzing the hot carcass weight with an average weight of 97.5 kg, a coefficient of variability of 0.75% was obtained. Statistical analysis of the cold carcass weight with an average weight of 94 kg, revealed a coefficient of variability of 0.80%. In all three situations, according to the coefficient of variability (<15%), it is considered that there is a small degree of variability in the respective sample, and the average established at the sample level is representative of the entire population of individuals in question.

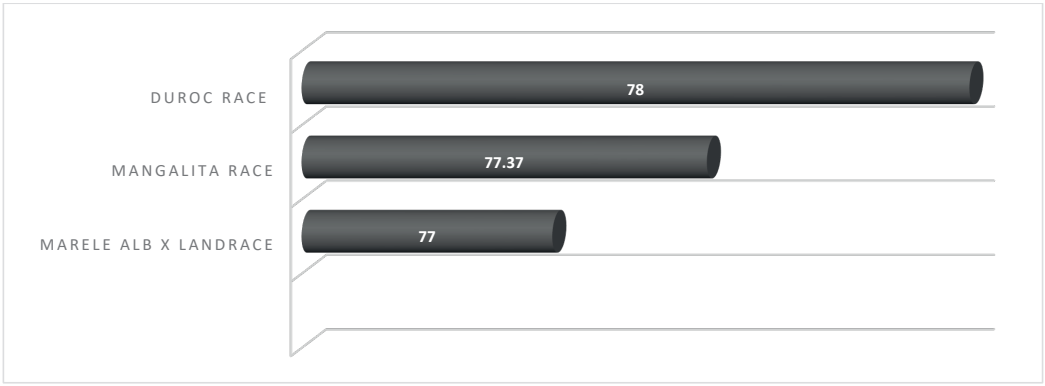


Figure 2. Difference in slaughter yield between the three breeds analyzed

Regarding the Mangalita breed, the average weight of the 15 individuals was 89.3 kg, obtaining a coefficient of variability of 1.67%. Statistical data obtained from the analysis of the cold carcass weight, with an average weight of 69.1 kg and a coefficient of variability of 1.42%. For the cold carcass weight with an average weight of 66.7 kg, the coefficient of variability was 1.15%. Considering that the value of the coefficient of variability is less than 15% in the case of the three parameters of the body analysis taken into consideration, it is considered that in the respective sample there is a small degree of variability, and the average established at the sample level is representative for the entire population of individuals taken into consideration.

In the case of the Great White x Landrace crossbreeds, the average live weight of the sample of individuals under consideration was 131 kg and a coefficient of variability of 0.49%. Regarding the hot carcass weight, it has an average weight of 101 kg and a coefficient of variability of 0.80%. The average cold carcass weight was 98.8 kg, and the coefficient of variability was 0.76%. According to the value of the coefficient of variability for all three categories of body mass analysis analyzed (<15%), it appears that there is a low degree of variability in the respective sample, and the average established at the sample level is representative of the entire population of individuals under consideration.

Table 5. Statistical parameters calculated according to the weight of the pigs.

| Race | Statistical parameters | Body weight analysis | | |
|---|---|---|---|---|
| | | Live weight (kg) | Hot carcass weight (kg) | Cold carcass weight (kg) |
| Duroc | n | 15 | 15 | 15 |
| | $X \pm S_X$ | 125 ±0.07 | 97.5±0.19 | 94±0.21 |
| | S | 0.27 | 0.73 | 0.80 |
| | CV (%) | 0.21 | 0.75 | 0.85 |
| Mangalita | n | 15 | 15 | 15 |
| | $X \pm S_X$ | 89.3 ±0.38 | 69.1±0.25 | 66.7±0.20 |
| | S | 1.49 | 0.98 | 0.77 |
| | CV (%) | 1.67 | 1.42 | 1.15 |
| | n | 15 | 15 | 15 |
| Great White | $X \pm S_X$ | 131 ±0.17 | 101±0.21 | 98.8±0.19 |
| x | S | 0.65 | 0.80 | 0.72 |
| Landrace | CV (%) | 0.49 | 0.80 | 0.76 |

## CONCLUSIONS

The organoleptic characteristics of carcasses are influenced by factors such as age, sex, fatness and anatomical regions. The organoleptic examination provides essential information about the appearance, colour, consistency, smell of meat and fat and helps to evaluate quality. Differences in the organoleptic examination were observed in the

color and consistency of meat between young and adults.

All pigs slaughtered in the slaughter unit come from farms that deal with raising pigs in a semi-intensive system. The differences in average weight were not significant in the slaughter unit under consideration.

Individuals with higher body weight also had higher organ weights, compared to individuals in the same weight categories, valid for all two slaughter units. In all individuals studied, the heaviest organ was the intestine, and the lightest was the kidney.

Observing the value of the coefficient of variability of body weights, in all three breeds being less than 15%, it appears that in the respective samples there is a small degree of variability, and the average established at the level of each sample is representative of the entire population of individuals under discussion.

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