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A CT-based examination of first-class meat parts in different sheep genotypes

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ABSTRACT

The tissue components of first-class meat parts of ram and ewe lambs of four genotypes (Ile de France, Hungarian Merino, Suffolk and Pannon Meat Sheep) in 30±3 kg live weight were compared (10 animals per categories, altogether 80 animals). We demarcated the area of the tissue of first-class meats on that images, which are included these meat parts. The examinations were carried out with the help of statistical tests that were made on the basis of CT images. Concerning the fat deposition of each first class meat part, the order of the breeds was the same (Merino, Ile de France, Pannon Meat Sheep and Suffolk), which can be proven statistically. The Merino deposed three times more fat than the Suffolk. The fat deposition of the ewes is more intensive than that of the rams, however, there is a slim difference between the two sexes in meat types. We did not observe significant differences in meat area of the different breeds. The Suffolk was prominent among the others because of its small quantity of water-like materials. In order to use better the growth potential of the meat type sheeps and their F1 lambs, the increased utilisation of the advantages provided by the slaughter weight over 30 kg is advisable.
(Keywords: CT, examination, first class meat parts, sheep genotypes)

INTRODUCTION

Nowadays, the natural conditions of the world's Great Powers in sheep breeding (Australia, New Zealand and China) favour the extensive way of animal husbandry, which gives the opportunity for producing cheap but high quality wool. Due to the facts mentioned before, the price of wool has fallen significantly for the last decade. As a consequence, the 85–90% of total income of sheep enterprises that do not deal with milking at the moment derives from meat production.

The domestic breed market consists of 25 genotypes (MJSZ – Hungarian Sheep Breeder's Association's offer) in which the Merino is still dominant. To improve the amount of production, two tendencies developed in the world, and this way in Hungarian sheep branch, too: improving reproductive capacity on the one hand and slaughter value and meat quality on the other. In the Association Agreement signed in October, 1991, the EU and Hungary agreed on the export quota of mutton and live sheep. According to this the introduction of S/EUROP system validated in the EU to qualify carcasses and the reaching of 1.5 million ewes (but minimum 1.3) is planned by the time of accession. To fulfil the latter requirement, the improvement of reproductive capacity can be a solution. To improve the S/EUROP qualification of lamb carcasses of domestic production, sheep breeding researches tend towards the examination of measure of such traits that are influential in meat production. The h^2 value of the proportion of daily weight gain, live weight, slaughtering percentage and certain body components can be regarded proper.

To improve the measure of traits of meat production, no other option has existed recently but test slaughtering. The great disadvantage of this method is that the genetic development, and this way the improvement of slaughter value, is slower than expected. For the last few decades, researchers have set out to develop such methods that give opportunity for the in vivo estimation of body composition. The common development of computer technology and X-ray imaging created the method of Computer Tomography. Researches of animal breeding have proven that this technology is suitable for the determination of tissue composition, for the quantity of them *(Vangen,* 1992*)* and for the more efficient and precise in vivo estimation of the meat-fat-bone ratio than before (eg., ultrasound) (*Parrat* and *Simm*, 1987). It was proven by Australian researchers that it is worth applying in breeding value estimations (*Jopson et al*., 1997). Since 1992, several CT experiments have been performed upon different kinds of animals at the University of Kaposvár.

These examinations also prove that the performance tests (STV) which are indispensable during the selecting process can be made more efficient and precise with the help of X-ray diagnostic procedure (*Vangen*, 1992).

There is a difference in quality and price between the different kinds of meat concerning lambs put on the market of heavier slaughter weight. As regards consuming preferences, costumers prefer roast meat. Thus we concentrated on the examination of first class meats (short and long loin, thighs) during the experiment. We settled our experimenting objectives accordingly, as follows:

- Classification of fat, meat and water dense materials - according to their quantity – in the first class meat of sheep of different genotypes in the same live weight,
- and how the same measures of traits are influenced by sexes.

MATERIALS AND METHODS

The ram and ewe lambs of four genotypes (Ile de France, Hungarian Merinó, Suffolk and Pannon Meat Sheep) were evaluated in 30±3 kg live weight in the examination. The keeping and feeding of lambs performed according to the regulations of the Sheep Performance Testing Code (OMMI, 1997).

The animals involved in the experiment were examined in the Diagnostic Institute of Kaposvár University with the help of an HRCT device by observing the CT examination protocol and the animal hygienic regulations (12-24 hours starvation of animals, narcotism, fixation, weighing, imaging, relaxation before transportation).

HRCT provides the possibility of a new testing methodology, namely, the new Australian procedure of imaging (that is: data are not recorded on determined anatomical points but images were taken of all over the body in normal mode with 10 mm slice thickness and 20 mm step, 1.4 zoom factor, kv: 120, mAs: 210). Depending on live weight, 50-60 images can be taken of an animal weighing 30-35 kg from the first cervical vertebra to the hock.

The images stored on CD were processed with CTPC (*Kövér*, 1994) software. From the measuring possibilities provided by this programme, we recorded the demarcated area and its tissue division according to the density measures of *Table 1*.

11 images of each animal were used during the examination: 4-4 images to determine the sectional surface of short and long loin – every second image from the meeting point of the last dorsal vertebra towards the head and tail and 3 serial images to determine the sectional surface of the thighs from the joint of the femur head. The shoulders were not examined.

Table 1

Hounsfield variables relating to certain tissues

Values relating to different tissue types	Hounsfield variables
Fatty tissue	-200 – -20
Water dense tissue	-20 – 20
Muscle tissue	20 – 200
Bony tissue	200 – 1500

Data gained after the examinations were evaluated with different statistic procedures and tests. First, the values of the certain parts of the body were averaged. (This way we gained 1-1 value for the data of tissue varieties of the 4-4 short and long loin images and of the 3 thigh images.) Data outside the double standard deviation distance were excluded from the statistical analysis. Then the basic statistic values (average, standard deviation, minimum, maximum) were accomplished with Excel software of Microsoft Office 97® programme package. Further analyses were performed with the help of SPSS® for Windows™ 9.0 software. To compare the four groups, we used a variance analysis of variable (oneway ANOVA). The statistic tests were carried out at $P \leq 0.05(*)$, $P \leq 0.01(**)$ and $P \leq 0.001(***)$ levels.

RESULTS

Examination of fatty tissue

During the examination of fat content of the long loin, it was stated that the order of genotypes (Merino, Ile de France, Pannon Meat Sheep, Suffolk) could be proven statistically, too. However there were not any considerable differences that could have been proven between Suffolk and Pannon Meat Sheep in the case of ewes and between Pannon Meat Sheep and Ile de France rams *(Figure 1).*

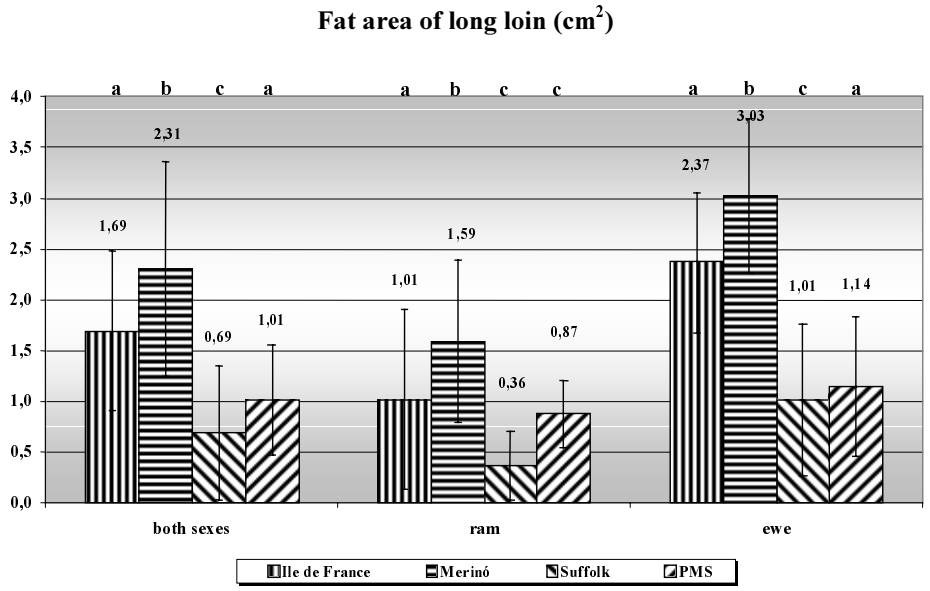
The results gained in the case of short loin can be evaluated similarly. As a result, Merino lambs depose more fat in this live weight, too, than the lambs of the other 3 breeds examined. We did not find any significant difference, either, between Suffolk and Pannon Meat Sheep in female sex and between Pannon Meat Sheep and Ile de France in male sex. The difference measured between the average fat content of the short loin of Suffolk and Pannon Meat Sheep rams is not significant.

It is worth observing the differences caused by sex: Merino ewes deposed much more fat around the meat of both loins than their breed brothers did. However there are not such differences between the meat types.

We got the same Merino, Ile de Frances, Pannon Meat Sheep and Suffolk order, when the thighs were examined. These are the only differences that are not so considerable in the group of rams, as we observed a significant differences only between Merino –Suffolk ($P \leq 0.001$) and Merino-Pannon Meat Sheep ($P \leq 0.01$).

As there are clear differences between meats, the result of the summed fat area evaluation was not surprising. As regards significance levels, the results are equal to those of the short loin in the case of the ewes and rams either. Without sexual distinction, the significant interdependencies that exist between the breeds are the same as those experienced in the case of ewes concerning the three first class meats examined, and their total fat area.

Figure 1



The letters can be seen in the graphs: variance at P≤0.05 significance level, they are different from each other.

Examination of muscle tissue

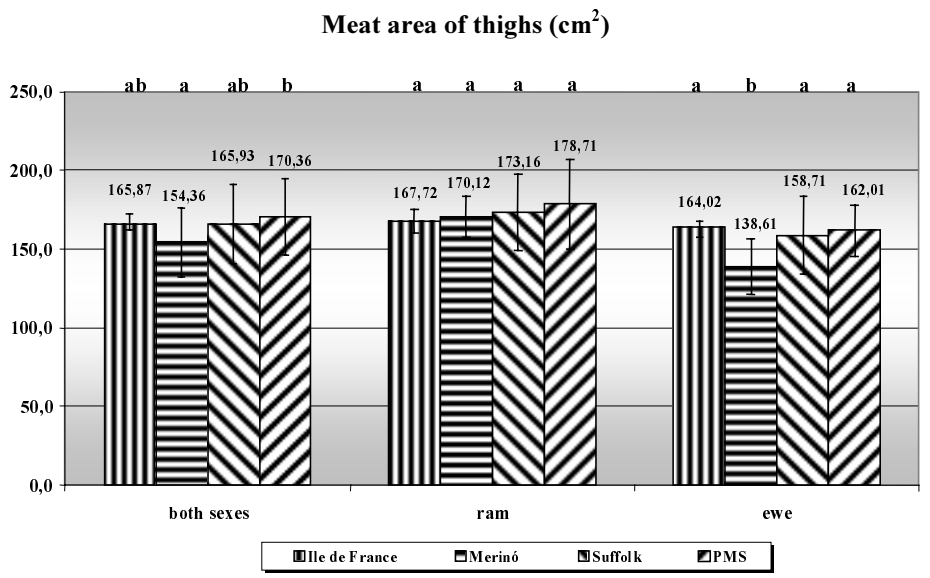
The differences observed in the quantity of muscle tissue of the long loin are rather small, they could not been proven statistically in male sex. In the case of ewes, we only found a significant difference between the highest (Ile de France) and the lowest (Suffolk) value. (P≤0.05). Examining the short loin, we found more prominent differences between the breeds though in the order of the ram group (Merino, Ile de France, Pannon Meat Sheep, Suffolk) only the advantage of the Merino over the others could be proven statistically. However, Ile de France ewes were superior to the other two meat types (Pannon Meat Sheep and Suffolk) than had smaller area.

The graph on meat area of thighs shows completely other order *(Figure 2).* Pannon Meat Sheep in male sex and Ile de France in female sex represented the highest value. The other three types just followed them closely. That is why we did not find significant difference in the case of rams. Though in the case of ewes it can be seen clearly that the meat deposition of Merino falls behind the meat types (at P≤0.01 significance level, between Merino-Pannon Meat Sheep and Merino-Ile de France; and P≤0.05 between Merino- Suffolk).

When comparing the total meat area of the three roast meats, we found a verifiable difference only in female sex with the totally same results described in connection with thighs. This can be explained with the fact that the area of thighs amounts to the biggest proportion of the sum.

If we consider both sexes, only the order observed at the short loin – except the differences of Ile de France-Merino and Pannon Meat Sheep-Suffolk – and the advantage of Pannon Meat Sheep that has the biggest meat area in thighs over Merino (at P≤0.05 level) can be proven statistically.

Figure 2



The letters can be seen in the graphs: variance at P≤0.05 significance level, they are different from each other.

Examination of water dense materials

During the evaluation of the images taken of water dense tissue-like materials, it was verified that the first class meats of Suffolk contain less interstitial tissue-like materials. It is demonstrated by the values observed in certain meats where the order was verifiable statistically in most cases of my research work (*Figure 3*).

In male sex, according to the results of water-like materials of both short and long loins, Suffolk contains significantly (P≤0.001) less interstitial tissue materials. On the contrary, there was not a significant difference between the breeds concerning water dense materials of thighs. Though there are clear differences in the case of ewes, only the difference between Ile de France and Suffolk can be proven statistically for sure in each meat.

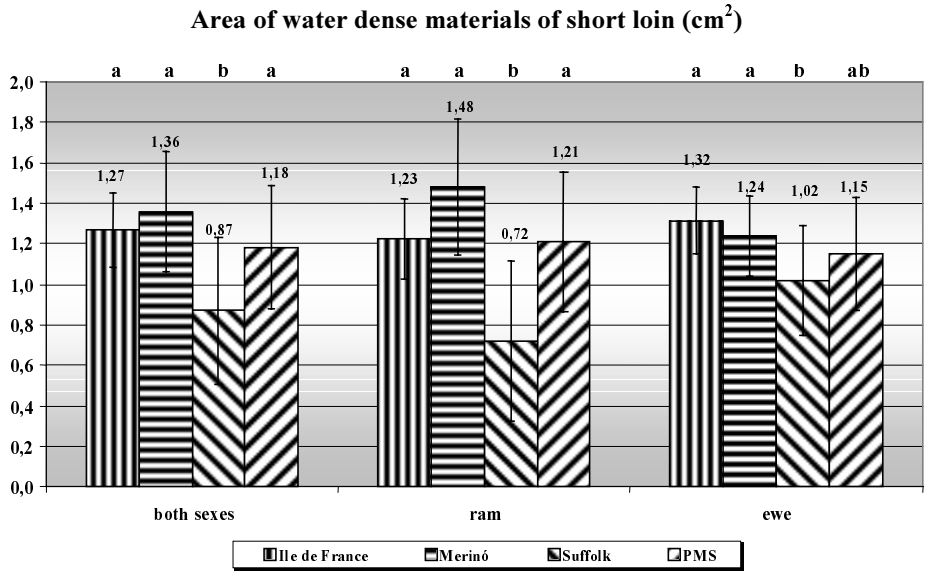
Concerning the total of water-like materials, it is Suffolk again which contains verifiably less as opposed to Ile de France being examined whether separately by sex or collectively.

CONCLUSIONS

As a summary, it can be stated that Merino deposed prominently more fat in this live weight (preceding Ile de France) than Suffolk and Pannon Meat Sheep if we take all three first-class meats into consideration (in the case of the two loins, nearly 3 cm^2 that is more than three times more, while in the case of thighs, 20 cm^2, approximately 1.5-2 times more). Our results are fortified by the fact that lambs reach their slaughtering maturity at the 50-55% of matured weight *(Veress* and *Jávor,* 1990*)*. Merino has reached this weight and hereby, beside the decline of meat deposition intensity, the increase of fat deposition has started. The low values relating to fat area in the case of Pannon Meat

Sheep can be traced back to the genetic background of the breed (influence of Suffolk and Texel). Comparing the lambs by sex, a prominent difference can be observed in the case of both Ile de France and Merino. The fat content of the ewes and rams of Pannon Meat Sheep and Suffolk differed slightly because of the endeavour to decrease sex dimorphism during their breeding. On the other hand, significant dimorphism is peculiar to Merino.

Figure 3



The letters can be seen in the graphs: variance at P≤0.05 significance level, they are different from each other.

Concerning the meat area of loins, we experienced the leading position of Merino in more cases, however, it is an advantage of approximately 1-2 cm^2, which – except the short loin of rams – can not be proven statistically. Though the method applied in my research represents an average loin and thigh area well. The weight of the loin and slaughtering capacity can not be estimated from the data relating to meat area. The reason for this is that we did not deal with the length of the spine and thighs. Thus we are not given a picture of the well-known facts that Suffolk has long trunk, Ile de France has long and wide back, and the legs of Pannon Meat Sheep are close to the four-ham type, due to the influence of Texel. Merino is mature for slaughtering in the examined 30±3 kg live weight but the growth capacity of the other breeds would not be utilised if their lambs were slaughtered at this stage or earlier. Several experiments have proven that (*Mucsi,* 1997) rams from the same breed show developed forms 20-30 days and 4-9 kg later than ewes. This is particularly true about Merino. However, it is worth observing how low standard deviation values are shown by Ile de France, and that the two sexes have nearly the same size of meat area. It can be traced back to the fact that this breed is quite a balanced one in character.

The major parts of water-like materials are interstitial tissues that give place to fat deposition in the farther stage of development. From the small amount of water-like

materials of Suffolk we can conclude to a lower level of fat deposition at an older age, too. The bigger area of interstitial tissue material at ewes fortifies the evidence that ewes depose fat earlier (at a younger age) and in a bigger amount than their breed brothers.

The different breeds and cross-breedings produce the most favourable meat-bone-fat ratio at different age and development stage. Texel and F1 lambs represent developed forms at earliest time. Then come Ile de France and meat merinos in order. As opposed to this, Suffolk and Pannon Meat sheep lambs can be fattened to a heavy weight *(Mucsi,* 1997*)*.

We settled the tissue type order of the slaughter value of the breeds examined. Furthermore, we referred to the influence of sex on the amount of fat, meat and water-dense materials. In support of a better exploitation of the potential growth of meat types and their F1 lambs, it is advisable to exploit the advantages provided by the slaughter weight over 30 kg in an increased degree.

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