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"THESES OF PhD DISSERTATION"

EVALUATION OF THE PERFORMANCE OF THE HUNGARIAN RACKA SHEEP

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1. INTRODUCTION, RESEARCH PRELIMINARIES

Today in Hungary the almost only source of income within sheep husbandry is the export of live lamb. The sales revenue from wool would hardly cover the costs of shearing. The number of dairy sheep farms is insignificant, however the foodstuffs made out of quality sheep milk are merchantable at the EU markets as well.

Breeders of the Hungarian Racka Sheep have to face with similar challenges as the breeders of other breeds in the industry. The difference is that for centuries, the wool of the Racka has not been competitive to the Merino wool, this way the fact that the woollen industry of the domestic industry is collapsed brought no changes regarding the Hungarian Racka Sheep.

Authors of the former and present times describe the conformation of the Hungarian Racka Sheep uniformly, even if using a different wording, since the conformation of our ancient sheep breed has remained unchanged throughout the centuries. In publications about the body sizes, though, some differences can be found. The sizes measured by HANKÓ (1940) and by current researchers (DUNKA, 1986; BEDŐ, 1994) are differing.

All authors have identical findings on the thickness of the Racka sheep's top and bottom hair. It is commonly agreed that the fleece of the Hungarian Racka Sheep is not suitable for producing fine textiles. However, taking into account the current price of wool, practically this has no importance at all. Nevertheless, many of the researchers (DUNKA, 1978; BODÓ et al., 1991) call the attention to the fact that today the wool of Racka does not have to compete with the Merino wool, as there are plenty of Racka wool products that could be merchandised as Hungarian specialties, "Hungaricums.

During the history of the Racka it used to be registered as milk sheep. Today our indigenous sheep breed is not milked in any of the major breeding farms, in spite of the fact that the former references do acknowledge the milk production capabilities of the breed. Therefore the quantitative analysis of the milk production of the Hungarian Racka Sheep is not possible today, but changes in the milk

composition throughout the lactation period can be examined through experimental test milking.

Practically, the literature does not discuss the meat production capabilities of the Hungarian Racka Sheep, as the Racka has low significance in the meat production, as well. Experts think that the Racka is a breed with slow growth and lean body and it has therefore no reason to involve it in the advanced sheep breeding. As opposed to this, however, the opinion of the breeders dealing with this breed is that due to the good mothering skills of the Racka ewes when selling live lamb at the weight of ca. 20 kg the bodyweight growth of the lambs is not any worse than that of the wide spread Merino sheep.

It is expected that in the future the importance of selling live lamb would drop, therefore the importance of carcass qualification is to become more of a priority in the future. Today it is obligatory to qualify all sheep slaughtered in Hungary based on the S/EUROP system.

2. OBJECTIVES OF THE RESEARCH

Taking into account the above, in my thesis I was striving to get answers to the following questions:

1. Have the body sizes of the two colour types of the breed changed due to the impact of the taste of producers, related to the huge decline in the number of animals of this breed?

2. Has the quality of Racka fleece changed compared to recent results?

3. Is the Hungarian Racka Sheep suitable for growing under intensive and/or extensive conditions? What is the qualification of the breed in the cutting and boning tests and carcass qualification upon the different forms of growing?

4. Is there any statistically detectible difference in the milk composition of the two colour types of the Racka Sheep?

3. MATERIALS AND METHODS

3.1. Animals involved in the body size measuring, sizes taken

Body size tests were performed at two breeding farms. For the rams the basis of body size measuring was always the judgment of conformation at two-year age, while the body sizes of ewes were taken on animals that had lambed at least once.

For the body size data recording 100 Hungarian Racka Sheep were measured (20-20 rams and 30-30 ewes).

In each case the sizes were taken on unshorn animals. The **data recorded** in both genders and in both colour types were the following:

1. height at withers (measured with stick), 2. body length (measured with a stick), 3. chest depth (measured with stick), 4. chest width (measured with stick), 5. rump width II. (between the two greater trochanters) (measured with stick), 6. shank girth (measured with tape), 7. horn length (measured with tape), 8. turns of twists on the horn, 9. angle between the horns (measured with angle gauge), 10. bodyweight.

3.2. Animals involved in the wool analyses and the data analysed

Wool samples were taken from the breeding stock of Hortobágyi Természetvédelmi és Génmegőrző Kht. (Hortobágy Nature Protection and Gene Reserving Kft.) at 1-year-olds' qualification in 2003. 20 black and 20 white ewes were tested. All the rams judged at the age of 1 year were sampled. This involved 19 white and 9 black rams. Prior to cutting off the staple samples the staple length on shoulders was measured on all sheep.

From each animal two staple samples were cut, one from the rump and another from the shoulder. The **data recorded** in both genders and in both colour types were the following:

1. average fibre diameter (μ), 2. top hair (μ), 3. bottom hair (μ), 4. crimp (deg/mm), 5. transparency (%), 6. medulla contents (%), 6. spinnability .

The wool samples were evaluated in the Wool Quality Laboratory of the Natural Institute for Agricultural Quality Control using OFDA 100 type equipment.

3.3. Meat performance tests

In the meat performance tests the data of altogether 130 lambs were evaluated, out of which 105 animals belonged to either colour types of the Racka sheep. Altogether 4 test series were performed, out of which 2 were performed after intensive growing, 1 after extensive growing and 1 by slaughtering at small weight right after weaning.

3.3.1. Meat performance test after intensive growing

The intensive meat performance tests were performed in years 2003 and 2004. In both cases the location was the Atkár Animal Husbandry Performance Test Station of the National Institute for Agricultural Quality Control. The testing method was compiled on the basis of the regulations of the Code of Sheep Performance Testing (2002) related to central tests. The Hungarian Racka Sheep was compared with the German Mutton Merino, the Milking Tsigai, the British Milk Sheep and the Tsigai.

For test slaughters lambs of 28-32 kg bodyweight were selected. Slaughtering was performed on the day subsequent to finishing the growing of the animal, following a 24-h fasting time. The **data recorded** at slaughter were the following: *1. bodyweight before slaughter, 2. skin weight, 3. head weight, 4. weight of abdominal fat 5. weight of kidney fat, 6. warm carcass weight.*

After 24-hour chilling the carcasses were cut into two parts along the spine. The right side of each carcass was chopped according to the Australian cutting method. The following **data were recorded** after cutting and boning:
1. cold carcass weight, 2. right half weight, 3. left half weight, 4. weight of surface fat, 5. weight of short leg (meat + bone weight), 6. weight of sirloin (meat + bone

weight), 7. weight of short loin (meat + bone weight), 8. weight of long loin (meat + bone weight), 9. weight of rib (meat + bone weight), 10. weight of shoulder (meat + bone weight), 11. weight of shank (meat + bone weight), 12. weight of neck (meat + bone weight), 13. meat colour (%).

Qualification of the carcasses was performed in line with Annexes No. 1 and 2 of the Minister of Agriculture's Decree No. 78/2003. (VII.4.) on the qualification of slaughter sheep after slaughtering, in compliance with the regulations of the Carcass Qualification Policy (2003) issued by the National Institute for Agricultural Quality Control, which makes provisions about the S/EUROP qualification of the carcasses over 13 kg.

3.3.2. Meat performance test after extensive growing

The extensive meat performance tests were performed in year 2004. The lambs were grown at the Dévaványa site of the Körös-Maros National Park and the test slaughters were again performed at the Atkár Animal Husbandry Performance Test Station of the National Institute for Agricultural Quality Control. For the experiment wether lambs were grown. The Racka Sheep was compared with the Hungarian Merino, the German Mutton Merino, the Milking Tsigai and the Tsigai.

In the evening the wither lamb were accommodated in folds, while during the day they could graze freely at an area delimited by electric fence. No supplementary feeding was applied, only drinking water was provided to the animals in addition to the grass grazed.

The weighing was repeated in every 4 weeks starting from the 10th of May till mid-October, when the growing was finished. Slaughter upon extensive growing took place on a single day, therefore at differing weights. Slaughtering was performed on the day subsequent to finishing the growing, following a 24-h fasting time.

The data recorded at slaughter, the method of cutting an boning, and the procedure of carcass qualification were identical with the ones described under the section on intensive growing methods (please refer to section 3.3.1).

3.3.3. Small-weight slaughter tests

Also the small-weight slaughter tests were performed in year 2004. In this case no fattening or growing was applied. The lambs delivered were slaugthered at the Kaposvár slaughterhouse of Juhász Pál. The Hungarian Racka Sheep was compared with the German Mutton Merino, the Milking Tsigai and the Tsigai.

The small-weight slaughter tests were performed after 24-hour fasting, on the day subsequent to delivery. The data recorded at slaughter were identical with the ones described under the section on intensive growing methods (please refer to section 3.3.1).

The carcasses were cut after 24 hours of chilling. Due to financial pressure the cutting of small-weight lambs was not followed by boning.

The **data recorded** upon cutting were the following:

1. leg, 2. shoulder, 3. neck, 4. ribs with flanks, 5. loin.

Qualification of the carcasses was performed in line with Annex No. 3 of the Minister of Agriculture's Decree No. 78/2003. (VII.4.) on the qualification of slaughter sheep after slaughtering, in compliance with the regulations of the Carcass Qualification Policy (2003) issued by the National Institute for Agricultural Quality Control, which makes provisions about the small-weight (South European) qualification of the carcasses under 13 kg.

3.4. Milk composition analysis and the animals involved the analyses

I performed the milk composition analyses at the breeding stock of Hortobágyi Természetvédelmi és Génmegőrző Kht. (Hortobágy Nature Protection and Gene Reserving Kft.) in years 2003 and 2005. In both years the milk composition of 18 black Racka ewes and 18 white Racka ewes were analysed. In year 2003 3 samples were taken every second week from the 14th day of the lactation on, while in 2005 7 samples were taken weekly starting from the 7th day of the lactation. The **data recorded** were the following:

1. fat (g/100 cm^3), 2. protein (g/100 cm^3), 3. lactose (g/100 cm^3), 4. urea (g/100 cm^3), 5. somatic cell count (1000 / cm^3).

3.5. Statistic methods applied

Evaluation of the results was performed aided by SPSS for Windows 14.0 and EXCEL 2000 for Windows programs. For the statistic calculations variance analysis was applied, from which the results over or under the double deviation range were excluded, and the significance of the differences between the groups were analyzed using the LSD test. When investigating the key indicators, the breed and gender were considered as fixed impact. In the meat performance tests the live bodyweight prior to slaughter was considered as co-variant factor for the cold and warm carcass weight. In the analyses of the cutting data the cold carcass weight was taken as a co-variant.

4. MAJOR FINDINGS OF THE DISSERTATION

4.1. Body sizes of the Hungarian Racka Sheep

Body sizes of both colour types of the Hungarian Racka Sheep and the significant differences between the colour types are shown in Table No. 1.

The average height at withers was 76.45 cm at the black rams, while 74.95 at the white ones, showing a significant difference. ($P<1\%$). Significant difference ($P<5\%$) was found also between the ewes, the white colour type ewes were higher (68.20 cm), and the black one was lower (66.97 cm) when measured at withers.

For black ewes a 33.27 cm and for white ewes 34.87 cm of chest depth were recorded, showing a significant difference ($P<1\%$).

Chest width of black ewes was 29.40 cm while that of white ewes was 30.97 cm.

Rump width of black rams was 31.55 cm, while that of white rams was 32.90 cm, showing a significant difference. (P<5%).

The 27.50 cm horn length of black ewes showed a significant longer results than the 23.67 horn length of the white ewes (P<1%).

The angle between the horns was 108.30^{o} in black rams, while it was 111.15 ^{o} in white rams, which is correspondent with the widest possible acceptable angle between the horns. The angle between the horns prove to be smaller also in the black ewes (64.80^{o}), compared to that of the ewes of the white colour type (67.20 ^{o}), but the difference here was not significant, either. However, this record deviates from the ideal 45-60 ^{o}.

4.2. Results and evaluation of the wool analyses

The parameters of the Racka fleece and the significant differences in the colour types are shown in Table No. 2

When comparing the transparency and medulla content of the fleece of the two Racka colour types, in both genders significant difference was found (P<1%). Due to the black vs. white wool the difference in transparency was obvious, while most likely the difference in the medulla content was due to the fact that the OFDA 100 type tester was not capable of testing adequately the medulla content of the black wool. No other statistically proven differences were found between the fleece of black and white Racka sheep.

4.3. Meat performance test results and their evaluation

4.3.1. Results of the intensive meat performance tests, and the evaluation of the results

Under intensive growing both colour types of the Racka showed a significantly lower bodyweight gain compared to the other breeds (Table No. 3). The bodyweight gain of both the white (rams 252.94 g/day, ewes 185.99 g/day) and

the black colour types (rams 238.33 g/day, ewes 178.81 g/day) is lagging behind the currently demanded the bodyweight gain results achieved under intensive growing conditions.

At the slaughter the abdominal and kidney fat of both colour types of the Racka sheep weighed significantly more than the abdominal and kidney fat of the other breeds. This is explained with the ancient sheep breeds being prepared continuously for a nutrient deficient period. In all breeds ewes deposited more abdominal and kidney fat in their organization than rams.

In Racka rams, similarly to the abdominal and kidney fat, also the surface fat amount (white 0.53 kg, black 0.54 kg) was significantly higher than the surface fat of the other breeds. Surface fat of ewes exceeded that of rams. Also among the ewes the Racka sheep prove to be the most abundant in fat (white 0.77 kg and black 0.73 kg) and apart from the British Milk Sheep the difference was significant.

When evaluating the meat of the first quarter it was found that the white Racka rams were better compared to the German Mutton Merino and the Milking Tsigai, while black Racka rams were significantly better than all the breeds (white 2.13 kg and black 2.21 kg) (Table No. 4). The meat amount in the first quarter of Racka ewes of the black colour types (2.04 kg) was significantly higher than the Hungarian Merino and the Milking Tsigai, while the white type's meat amount (2.2 kg) was significantly better than Tsigai and the black Hungarian Racka, in addition to the two breeds mentioned before (Table No. 5).

Meat weight of the rear quarter of Racka rams (white 3.03 kg, black 3.03 kg) was significantly higher in both colour types when compared to the Milking Tsigai and the Tsigai, in addition, the meat weight of white rams was also significantly higher than that of the British Milk Sheep (Table No. 4). The meat weight of the rear quarter of Racka ewes in both the white (3.18 kg) and the black (3.08 kg) types prove to be statistically higher than the meat weight of the rear quarters of German Mutton Merino, Milking Tsigai and Tsigai breeds (Table No. 5).

Regarding the yield rate (48.23 %) white rams had a significantly poorer performance compared to the German Mutton Merino, and they performed better

than the Milking Tsigai. At the same time, black rams (48.85 %) performed significantly better than Milking Tsigai, the British Milk Sheep and the Tsigai as well. Both Racka ewe groups showed significantly better yield rates (white 50.94 % and black 49.86 %) compared to the Milking Tsigai and the Tsigai groups, and the performance of the white ewes prove to be significantly better than that of the British Milk Sheep (Table No. 6).

Regarding the meat and the bone ratios both colour types of the Hungarian Racka rams (white 77.62 % meat and 22.38 % bones and the black with 78.39 % meat and 21.61 % bones) were characterised by significantly lower ratio of bone, and accordingly, significantly higher ratio of meat compared to all the other breeds. In black ewes (78.79 % meat and 21.21 % bones) the proportion of meat was significantly higher compared to the Milking Tsigai and the Tsigai. As opposed to this the white Racka ewes (80.74 % meat and 19.6 % bones) represented a significantly better meat to bone ratio compared to all the groups, including the black Racka ewes (Table No. 6).

Applying the S/EUROP qualification both the Racka rams and ewes (white and black average O^+) were better only compared to the Milking Tsigai. The maximum difference between the Racka and the other groups was only 2-3 sub-classes in rams, and no more than 1-2 sub-classes in ewes.

Apart from the results of white ewes (average 3^-) the Racka showed ideal results in fat coverage, since it belonged to some sub-classes of the category No. 2.

4.3.2. Results of the extensive meat performance tests, and the evaluation of the results

The extensive meat performance test finished in October, following 148 days of growing. The Racka withers showed the two weakest results at the end of the test. Still the results of the white Racka withers (63.43 g/day) was significantly lower only compared to the Hungarian Merino. The bodyweight gain of black Racka withers (56.55 g/day) was even worse than this, since their results were significantly lower compared to the Hungarian Merino, German Mutton Merino the Milking Tsigai and the Tsigai, as well. As opposed to the Hungarian Merino

providing the best performance in the experiment (95.44 g/day) the lag of the weakest performing Racka was not reaching 39 g in daily bodyweight gain. For the 148 days of the entire experiment this added up to a lag of 5.75 kg.

After extensive growing significant differences between the Racka and other breeds were observed primarily in the amount of the abdominal and kidney fat. The evaluation found that in all of the cases the white Racka withers had the highest amount of fat (0.14 kg), which is still not too much, although, when compared to other breeds even this little amount was found significant.

Following boning a significant lower bone amount of Racka withers was found when compared to the Milking Tsigai.

In both colour types the meat amount of the first quarter (white 1.99 kg, black 1.53 kg) was significantly more compared to the meat amount of the Milking Tsigai.

Also the amount of meat in the rear quarters of both Racka groups (white 2.89 kg, black 2.33 kg) was significantly better than the Milking Tsigai.

In both groups the carcass yield rate was 6-8 % lower than upon intensive growing. From this perspective there was no great difference among the groups involved in the study, thus, compared to the other breeds the Racka sheep showed no significant difference in the carcass yield (black 41.92 %, white 42.73 %).

Regarding the meat and bone ratio the white (3.11, 75.69 % meat and 24.31 % bones) and black (3.07, 75.40 % meat and 24.60 % bones) Hungarian Racka withers were significantly better only when compared to the Milking Tsigai. Compared to the other groups no significant difference was observed.

Therefore, the cutting and boning experiments showed that when applying extensive growing based on grazing exclusively, there is no such difference in the amount of meat of the various breeds than what can be found upon intensive growing. In the experiment based on extensive growing the amount of meat produced was considerably less than upon intensive growing. The result of this was that the carcass yield rate as well as the meat to bone ratio were less favourable than in the intensive meat performance test.

In all breeds the muscularity was less pronounced than upon intensive growing. White Racka withers (average O^-) and black Racka withers (average P^+) were better only compared to the Milking Tsigai sheep.

Regarding the fat coverage both types of the Racka belonged to the ideal category No. 2, however, the fat coverage of white withers was significantly higher than that of the other breeds (and even that of the black Racka).

4.3.3. Results of the small-weight slaughter tests and their evaluation

In the small weight slaughter tests the lambs were delivered to the slaughter house straight from the breeders, this way, no growing experiment was performed on them. Regarding the bodyweight gain up to delivery both genders of the white Racka (rams 268.22 g/day, ewe 245.95 g/day) performed significantly worse results compared to the German Mutton Merino. In the black Racka sheep such significant difference could be detected only for the rams (rams 260.63 g/day, ewes 248.80 g/day).

Also in the small-weight slaughters the Racka sheep had significantly more fat. However, this was not a considerable amount, as at a slaughter weight under 20 kg the abdominal and kidney fat have not yet accumulated.

Considering the carcass yield rate both Racka rams (white 46.76 %, black 47.06 %) and Racka ewes (white 48.38 %, black 46.70 %) showed significantly better results compared to the Milking Tsigai.

Racka rams were significantly worse regarding the total weight of the leg, while they were significantly better regarding the rib and flank. At the ewes it was the rib and flank that was significantly bigger compared to all the other groups.

When qualifying the carcasses slaughtered in small weight 80 % of both the black and white rams of the Hungarian Racka sheep belonged to the category of 1st class meat. Compared to the Milking Tsigai this prove to be significant ($P<5\%$).

When qualifying Racka ewes there was significant difference compared to the Tsigai ($P<1\%$). 100 % of both the black and white Racka ewes represented 1st class category.

4.4. Analysis and results of the milk composition

In this dissertation I am publishing the test of the Hungarian Racka Sheep milk for its composition. However, these results do not include the quantitative changes in the milk production during the lactation period, but their scope involves only the analysis of the composition of the milk tested in ad-hoc test milking. Therefore the results achieved are only for information, and the exact values of lactation require further studies.

In year 2003 on the average throughout the lactation significant difference between the two Racka colour types was found only in the lactose content (black 5.42 %, white 5.26 %) and in the urea content (black 0.071 %, white 0.082 %). In black Racka ewes the lactose content was significantly higher when compared to the white Racka ewes, while the amount of urea was significantly higher in the milk of white ewes. There was no significant difference between the two colour types regarding the fat content (black 7.11 %, white 6.72 %), protein content (black 4.77 %, white 4.88 %) and somatic cell count (black 96 thousand/cm^3, 60 thousand/cm^3).

In 2005 throughout the lactation only one statistically verifiable difference could be shown between the two Racka colour types. Fat contents of the black Racka milk (7.49 %) were on the average significantly more than the fat content of the white Racka milk (6.83 %). Regarding the protein content (black 4.58 %, white 4.41 %), lactose content (black 4.98 %, white 4.93 %), the urea content (black 0.042 %, white 0.043 %) and the somatic cell count (black 158 thousand/cm^3, white 127 thousand/cm^3) there was no significant relation between the two colour types of the Racka ewes.

5. NOVEL SCIENTIFIC RESULTS

1. By today the black Racka Sheep, which was higher and had longer horns 50-60 years ago, has lost its previous advantage over the white colour type of Racka. Due to mixed breeding of the colour types in the recent decades today differences in the body sizes are hardly detectable between the two Racka types.

2. Up to the bodyweight of 20 kg the difference in bodyweight gain is negligible when comparing the Hungarian Racka Sheep with the other breeds studied, however, over this weight the difference becomes significant. Therefore the intensive growing of Racka over 20 kg is not suggested.

3. The data recorded during cutting and boning after intensive growing show that the meat to bone ratio of the Racka sheep is better than any of the breeds involved in the study, regarding both genders. Out of the valuable meat cuts the meat quantity of loin is especially favourable.

4. There is no significant difference between the bodyweight gain of the extensively grown Racka wethers and the other breeds studied, as it was only the Hungarian Merino that had a significantly better bodyweight gain than the white colour type Racka. Accordingly, the Hungarian Racka Sheep can be suggested for extensive growing. In this form of growing the yield rate is 6-8 % lower compared to the yield when slaughtering after intensive growing.

5. When slaughtering Racka Sheep in small weight of around 20 kg it was only the leg of rams that weighed less than that of the other breeds, while regarding the weight of the loin and the rib and flank cut the Racka outperforms the other breeds involved in the test. When qualifying the carcass in small weight slaughter (South European qualification) the Racka Sheep scored better than the other breeds tested.

6. In the slaughter tests after both the intensive and extensive growing the Racka Sheep prove to have the largest amount of abdominal and kidney fat compared to the other breeds involved in the test. As a result of intensive growing this amount increases considerably, but already in the small weights it is significantly more when compared to the other breeds studied. Especially large amount of deposited fat is typical of the Racka ewes.

6. RESULTS TO BE APPLIED IN PRACTICE

1. The wool of the Hungarian Racka Sheep may be suitable for the manufacturing of rough rugs, folk art products, shepherd clothing and the ornamental pieces. A side-product of extensively grown lambs slaughtered in the autumn is the most valuable fur, together with the first lamb wool, which an be a supplementary source of income.

2. Similarly to the Hungarian Grey Cattle and the Mangalica swine - it would be suggested to target with marketing activities a circle of customers who would appreciate the Hungaricum nature of the Racka sheep. The high meat ratio of the Racka could be highlighted when selling whole cuts, while when selling fillets – after boning – ready-to-cook products due to the low amount of bone lower losses are to be considered. Anyway, it is expected that the sales of live lamb would reduce in the future, this way the negative stereotypes of traders related to the Racka could be eliminated.

3. Due to the favourable meat to bone ratio of the Racka breeders of the Racka Sheep shall by all means make efforts to sell the meet at higher processing levels, which is much more favourable for the Hungarian sheep. Then these meat products could be sold in butcheries or restaurants that are already selling Hungaricums.

4. The Racka Sheep can be recommended for extensive growing. Also in this form of growing a higher level of processing is suggested instead of selling live or in carcasses. During the studies an especially humid weather prevailed, therefore it is suggested that further comparative test series be performed with the Racka Sheep, under weather conditions that are typical of Hungary, when in the summer the pasture burns out.

5. Due to the ideal, light rose-red meat colour and fat coverage of Racka meat it can be strongly recommended for selling at small weight. Due to prejudices, when selling to markets abroad, again it is not that reasonable to sell live, instead selling of carcasses or cuts shall be preferred. It is highly required to perform further studying on this subject, as also when slaughtering in small weight the meat-bone ratio – which prove to be favourable in Racka sheep based on the experiences of slaughtering in large weight – needs to be further tested.

Table No. 1

Major body sizes of the Hungarian Racka Sheep

Colour	Gender	Live bodyweight (kg)	Height at withers[aK] (cm)	Body length (cm)	Chest depth[A] (cm)	Chest width[A] (cm)
		Average ± SE	Average ± SE	Average ± SE	Average ± SE	Average ± SE
black	ram	63.90 ± 3.11	76.45 ± 1.85	76.50 ± 2.44	40.90 ± 1.94	37.60 ± 2.16
white	ram	63.50 ± 2.50	74.95 ± 1.50	75.55 ± 1.93	41.15 ± 1.69	37.55 ± 1.67
black	ewe	43.27 ± 3.80	66.97 ± 2.28	67.83 ± 2.29	33.27 ± 1.53	29.40 ± 1.59
white	ewe	42.40 ± 4.31	68.20 ± 2.34	68.57 ± 2.40	34.87 ± 2.84	30.97 ± 1.52

Colour	Gender	Rump width[k] (cm)	Shank girth (cm)	Horn length[A] (cm)	Angle between the horns (degree)	Twists on the horn (turns)
		Average ± SE	Average ± SE	Average ± SE	Average ± SE	Average ± SE
black	ram	31.55 ± 1.93	9.12 ± 0.70	42.25 ± 2.84	108.3 ± 12.32	3.50 ± 0.49
white	ram	32.90 ± 1.71	8.93 ± 0.70	42.20 ± 2.89	111.1 ± 13.69	3.35 ± 0.37
black	ewe	29.27 ± 2.23	7.44 ± 0.60	27.50 ± 3.38	64.80 ± 8.79	2.92 ± 0.46
white	ewe	29.10 ± 1.24	7.65 ± 0.60	23.67 ± 2.68	67.20 ± 9.54	2.80 ± 0.53

k: the trait studied is significantly different between the two colour types of Racka rams at P<5% level,
K: the trait studied is significantly different between the two colour types of Racka rams at P<1% level,
a: the trait studied is significantly different between the two colour types of Racka ewes at P<5% level,
A: the trait studied is significantly different between the two colour types of Racka ewes sat P<1% level.

Table No. 2

Major data of Hungarian Racka Sheep fleece

Colour	**Gender**	**Staple length (cm)**	**Average fibre diameter (μ)**	**Top hair thickness (μ)**	**Bottom hair thickness (μ)**	**Crimp (deg/mm)**	**Transpa-rency (%)**	**Medulla contents (%)**	**Spin-nability (μ)**
		Average ± SE	Average ± SE	Average ± SE	Average ± SE	Average ± SE	Average ± SE	Average ± SE	Average ± SE
Black	ram[1]	20.78 ± 1.52	38.10 ± 3.50	58.10 ± 4.75	28.10 ± 2.65	35.82 ± 6.14	93.23 ± 1.11	38.33 ± 3.81	47.41 ± 4.67
Black	ram[2]	-	41.62 ± 5.21	61.62 ± 5.21	31.62 ± 5.21	31.99 ± 5.28	93.51 ± 1.18	42.00 ± 5.48	51.52 ± 5.78
White	ram[1]	21.32 ± 1.88	37.89 ± 3.24	57.89 ± 3.82	27.89 ± 3.12	36.24 ± 6.18	64.27 ± 1.74	56.74 ± 4.46	45.12 ± 2.92
White	ram[2]	-	40.54 ± 3.78	60.54 ± 3.78	30.54 ± 3.78	35.59 ± 6.91	66.54 ± 2.76	58.95 ± 4.53	48.53 ± 4.07
Black	ewe[1]	21.90 ± 2.16	36.86 ± 2.42	56.86 ± 3.21	26.86 ± 2.07	31.86 ± 5.03	93.41 ± 1.25	37.10 ± 2.36	44.16 ± 2.63
Black	ewe[2]	-	40.09 ± 3.80	60.09 ± 3.80	30.09 ± 3.80	30.40 ± 4.59	93.38 ± 1.29	40.50 ± 3.89	48.94 ± 3.81
White	ewe[1]	21.38 ± 2.10	38.15 ± 2.40	58.15 ± 3.50	28.15 ± 2.38	31.17 ± 4.82	63.87 ± 2.04	56.40 ± 3.44	44.99 ± 3.02
White	ewe[2]	-	39.18 ± 3.05	59.18 ± 3.05	29.18 ± 3.05	31.45 ± 3.53	65.13 ± 2.27	59.95 ± 3.44	47.40 ± 3.95

1: shoulder, 2: rump.

Table No. 3

Results of the intensive meat performance tests in rams

Breed	**Gender**	**Initial weight (kg)**	**Number of growing days (days)**	**Final weight after growing (kg)**	**Bodyweight gain during growing (g/day)**		**Gender**	**Initial weight (kg)**	**Number of growing days (days)**	**Final weight after growing (kg)**	**Body-weight gain during growing (g/day)**
		Average ± SE	Average ± SE	Average ± SE	Average ± SE			Average ± SE	Average ± SE	Average ± SE	Average ± SE
Black (1)	Ram	19.99 ± 4.04	46.55 ± 11.42	31.21 ± 1.89	238.33 ± 35.77		ewe	17.86 ± 2.11	55.65 ± 17.66	27.97 ± 3.28	178.81 ± 28.80
White (2)	Ram	19.16 ± 3.71	48.30 ± 16.20	31.18 ± 2.59	252.94 ± 49.58		ewe	18.99 ± 2.96	51.80 ± 16.12	28.73 ± 2.02	185.99 ± 26.37
HM (3)	Ram	21.95 ± 1.92^{aB}	35.00 ± 5.08^{AB}	34.24 ± 3.53^{AB}	348.92 ± 53.11^{AB}		ewe	20.77 ± 1.68^{AB}	38.68 ± 5.41^{AB}	32.23 ± 2.31^{AB}	295.00 ± 38.43^{AB}
GMM (4)	Ram	21.11 ± 2.11	39.20 ± 3.61^{AB}	36.48 ± 4.54^{AB}	389.67 ± 42.35^{AB}		ewe	19.79 ± 1.75^{a}	39.20 ± 3.61^{AB}	33.04 ± 3.04^{AB}	334.57 ± 54.05^{AB}
MTS (5)	Ram	22.52 ± 2.65^{AB}	35.00 ± 5.08^{AB}	34.77 ± 4.22^{AB}	347.90 ± 73.01^{AB}		ewe	20.91 ± 1.88^{AB}	38.50 ± 5.33^{AB}	32.32 ± 3.31^{AB}	299.60 ± 54.89^{AB}
BMS (6)	Ram	21.06 ± 2.14	36.40 ± 7.23^{AB}	34.09 ± 3.62^{ab}	361.67 ± 48.29^{AB}		ewe	20.12 ± 1.07^{A}	38.50 ± 6.48^{AB}	30.80 ± 0.69^{a}	285.12 ± 36.30^{AB}
TSI (7)	Ram	19.93 ± 2.37	35.00 ± 0.00^{AB}	32.85 ± 2.43	369.14 ± 34.17^{AB}		ewe	20.97 ± 1.70^{Ab}	42.00 ± 0.00^{Ab}	32.98 ± 2.05^{AB}	285.95 ± 43.74^{AB}

(1) Black: Hungarian Racka Sheep black colour type, (2) White: Hungarian Racka Sheep white colour type, (3) HM: Hungarian Merino, (4) GMM: German Mutton Merino, (5) MTS: Milking Tsigai, (6) BMS: British Milk Sheep, (7) TSI: Tsigai.

a: the trait studied is significantly different when compared to the black Racka at P<5% level,

A: the trait studied is significantly different when compared to the black Racka at P<1% level,

b: the trait studied is significantly different when compared to the white Racka at P<5% level,

B: the trait studied is significantly different when compared to the white Racka at P<1% level.

Table No. 4

Boning tests of rams upon intensive growing experiments

Breed	Gender	Shoulders		Front quarter		Short leg		Short loin		Long loin		Rear quarter	
		bone Average ± SE	**meat** Average ± SE	**bone** Average ± SE	**meat** Average ± SE	**bone** Average ± SE	**meat** Average ± SE	**bone** Average ± SE	**meat** Average ± SE	**bone** Average ± SE	**meat** Average ± SE	**bone** Average ± SE	**meat** Average ± SE
Black (1)	ram	1.20 ± 0.08	0.27 ± 0.04	1.17 ± 0.07	0.30 ± 0.02	0.60 ± 0.07	0.12 ± 0.04	1.17 ± 0.07	0.30 ± 0.02	0.60 ± 0.07	0.12 ± 0.04	3.03 ± 0.11	0.74 ± 0.07
White (2)	ram	1.15 ± 0.08	0.27 ± 0.03	1.19 ± 0.10	0.30 ± 0.03	0.57 ± 0.06	0.12 ± 0.02	1.19 ± 0.10	0.30 ± 0.03	0.57 ± 0.06	0.12 ± 0.02	3.02 ± 0.27	0.75 ± 0.05
HM (3)	ram	1.21 ± 0.13	0.31 ± 0.03	1.24 ± 0.09	0.33 ± 0.04^{a}	0.61 ± 0.04	0.14 ± 0.03	1.24 ± 0.09	0.33 ± 0.04^{a}	0.61 ± 0.04	0.14 ± 0.03	3.12 ± 0.14	0.86 ± 0.09^{AB}
GMM (4)	ram	1.25 ± 0.08	0.34 ± 0.04	1.36 ± 0.10^{a}	0.37 ± 0.05^{AB}	0.59 ± 0.09^{a}	0.14 ± 0.02	1.36 ± 0.10^{a}	0.37 ± 0.05^{AB}	0.59 ± 0.09^{a}	0.14 ± 0.02	3.29 ± 0.32	0.95 ± 0.07^{AB}
MTS (5)	ram	1.08 ± 0.08^{A}	0.37 ± 0.04^{AB}	1.13 ± 0.09	0.40 ± 0.03^{AB}	0.49 ± 0.05^{AB}	0.16 ± 0.02^{AB}	1.13 ± 0.09	0.40 ± 0.03^{AB}	0.49 ± 0.05^{AB}	0.16 ± 0.02^{AB}	2.59 ± 0.22^{AB}	0.99 ± 0.08^{AB}
BMS (6)	ram	1.12 ± 0.09	0.33 ± 0.03^{AB}	1.14 ± 0.06	0.34 ± 0.02^{Ab}	0.52 ± 0.05^{a}	0.14 ± 0.03	1.14 ± 0.06	0.34 ± 0.02^{Ab}	0.52 ± 0.05^{a}	0.14 ± 0.03	2.82 ± 0.13^{b}	0.87 ± 0.06^{AB}
TSI (7)	ram	1.10 ± 0.05	0.33 ± 0.07^{AB}	1.16 ± 0.06	0.35 ± 0.01^{AB}	0.51 ± 0.05^{a}	0.12 ± 0.01	1.16 ± 0.06	0.35 ± 0.01^{AB}	0.51 ± 0.05^{a}	0.12 ± 0.01	2.76 ± 0.07^{ab}	0.84 ± 0.02^{AB}

(1) Black: Hungarian Racka Sheep black colour type, (2) White: Hungarian Racka Sheep white colour type, (3) HM: Hungarian Merino, (4) GMM: German Mutton Merino, (5) MTS: Milking Tsigai, (6) BMS: British Milk Sheep, (7) TSI: Tsigai.
a: the trait studied is significantly different when compared to the black Racka at P<5% level,
A: the trait studied is significantly different when compared to the black Racka at P<1% level,
b: the trait studied is significantly different when compared to the white Racka at P<5% level,
B: the trait studied is significantly different when compared to the white Racka at P<1% level.

Table No. 5

Results of the intensive meat performance tests in ewes

Breed	Gender	Shoulders		Front quarter		Short leg		Short loin		Long loin		Rear quarter	
		bone Average ± SE	**meat** Average ± SE	**bone** Average ± SE	**meat** Average ± SE	**bone** Average ± SE	**meat** Average ± SE	**bone** Average ± SE	**meat** Average ± SE	**bone** Average ± SE	**meat** Average ± SE	**bone** Average ± SE	**meat** Average ± SE
Black (1)	ewe	1.06 ± 0.15	0.24 ± 0.03	2.05 ± 0.26^{B}	0.58 ± 0.06	1.12 ± 0.12	0.26 ± 0.03	0.62 ± 0.08^{B}	0.10 ± 0.02	0.65 ± 0.10	0.19 ± 0.02	3.08 ± 0.32	0.69 ± 0.05
White (2)	ewe	1.11 ± 0.09	0.24 ± 0.02	2.21 ± 0.17^{A}	0.57 ± 0.05	1.14 ± 0.08	0.27 ± 0.02	0.68 ± 0.05^{A}	0.11 ± 0.02	0.67 ± 0.07	0.18 ± 0.03	3.18 ± 0.15	0.68 ± 0.04
HM (3)	ewe	1.19 ± 0.07^{a}	0.29 ± 0.03^{AB}	2.10 ± 0.14^{aB}	0.65 ± 0.06^{aB}	1.21 ± 0.05	0.30 ± 0.03^{a}	0.63 ± 0.06^{B}	0.13 ± 0.03	0.71 ± 0.08	0.23 ± 0.03^{AB}	3.27 ± 0.20	0.78 ± 0.04^{AB}
GMM (4)	ewe	1.25 ± 0.08^{AB}	0.32 ± 0.03^{AB}	2.19 ± 0.13	0.70 ± 0.05^{AB}	1.26 ± 0.06^{aB}	0.31 ± 0.02^{AB}	0.60 ± 0.05^{aB}	0.14 ± 0.03^{a}	0.62 ± 0.06^{Ab}	0.24 ± 0.03^{AB}	3.15 ± 0.18^{aB}	0.85 ± 0.05^{AB}
MTS (5)	ewe	1.07 ± 0.07	0.31 ± 0.04^{AB}	1.92 ± 0.15^{aB}	0.71 ± 0.08^{AB}	1.15 ± 0.08^{b}	0.34 ± 0.03^{AB}	0.51 ± 0.05^{AB}	0.14 ± 0.03^{Ab}	0.55 ± 0.07^{AB}	0.24 ± 0.03^{AB}	2.84 ± 0.22^{AB}	0.86 ± 0.09^{AB}
BMS (6)	ewe	1.12 ± 0.05	0.25 ± 0.06	2.09 ± 0.13	0.61 ± 0.09	1.16 ± 0.07	0.30 ± 0.01^{ab}	0.59 ± 0.10^{B}	0.11 ± 0.02	0.64 ± 0.13	0.20 ± 0.03^{b}	3.08 ± 0.33	0.76 ± 0.08^{aB}
TSI (7)	ewe	1.15 ± 0.06^{a}	0.32 ± 0.04^{aB}	2.01 ± 0.13^{B}	0.72 ± 0.05^{AB}	1.26 ± 0.08^{AB}	0.35 ± 0.05^{AB}	0.49 ± 0.03^{AB}	0.11 ± 0.02	0.57 ± 0.03^{AB}	0.22 ± 0.02^{aB}	2.96 ± 0.18^{AB}	0.84 ± 0.10^{AB}

(1) Black: Hungarian Racka Sheep black colour type, (2) White: Hungarian Racka Sheep white colour type, (3) HM: Hungarian Merino, (4) GMM: German Mutton Merino, (5) MTS: Milking Tsigai, (6) BMS: British Milk Sheep, (7) TSI: Tsigai.
a: the trait studied is significantly different when compared to the black Racka at P<5% level,
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b: the trait studied is significantly different when compared to the white Racka at P<5% level,
B: the trait studied is significantly different when compared to the white Racka at P<1% level.

Table No. 6

Slaughter and boning indexes the intensive growing test

Breed	Gender	Meat ratio (%)	Bone ratio (%)	Yield rate (%)		Gender	Meat ratio (%)	Bone ratio (%)	Yield rate (%)
		Average ± SE	Average ± SE	Average ± SE			Average ± SE	Average ± SE	Average ± SE
Black (1)	ram	78.39 ± 1.61	21.61 ± 1.61	48.85 ± 1.48		ewe	78.79 ± 1.76^{b}	21.21 ± 1.76^{b}	49.86 ± 1.22
White (2)	ram	77.62 ± 2.23	22.38 ± 2.23	48.23 ± 1.06		ewe	80.74 ± 1.66^{a}	19.26 ± 1.66^{a}	50.94 ± 1.29
HM (3)	ram	76.12 ± 2.64 ^{Ab}	23.88 ± 2.64 ^{Ab}	48.24 ± 1.19		ewe	77.99 ± 2.06^{B}	22.01 ± 2.06^{B}	49.83 ± 1.03
GMM (4)	ram	74.55 ± 1.56 ^{AB}	25.45 ± 1.56 ^{AB}	49.83 ± 0.63^{b}		ewe	77.45 ± 2.56^{B}	22.55 ± 2.56^{B}	51.27 ± 1.62
MTS (5)	ram	70.14 ± 1.84 ^{AB}	29.86 ± 1.84 ^{AB}	45.53 ± 1.44 ^{AB}		ewe	74.47 ± 2.41 ^{AB}	25.53 ± 2.41 ^{AB}	47.34 ± 1.76 ^{AB}
BMS (6)	ram	74.50 ± 1.45 ^{AB}	25.50 ± 1.45 ^{AB}	46.93 ± 1.34^{A}		ewe	78.54 ± 1.96^{b}	21.46 ± 1.96^{b}	48.63 ± 2.32^{B}
TSI (7)	ram	74.34 ± 2.62 ^{AB}	25.66 ± 2.62 ^{AB}	47.28 ± 1.82 ^{a}		ewe	75.34 ± 0.81 ^{AB}	24.66 ± 0.81 ^{AB}	47.92 ± 1.84^{aB}

(1) Black: Hungarian Racka Sheep black colour type, (2) White: Hungarian Racka Sheep white colour type, (3) HM: Hungarian Merino, (4) GMM: German Mutton Merino, (5) MTS: Milking Tsigai, (6) BMS: British Milk Sheep, (7) TSI: Tsigai.
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b: the trait studied is significantly different when compared to the white Racka at P<5% level,
B: the trait studied is significantly different when compared to the white Racka at P<1% level.

7. PUBLICATIONS ON THE SUBJECT OF THE DISSERTATION

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