THE PRODUCTIVITY OF KUIBYSHEVKAYA SHEEP BREED AND ITS CROSSBREEDS WITH RAMS OF ROMNEY MARSH AND NORTH CAUCASIAN-TEXEL BREEDS

A.I. Erochin[1], E.A. Karasyov[1], Yu.A. Yuldashbayev[1], T.A. Magomadov[1], M.V. Medvedyev[1], K.A.Razumeyev[2]

('- RSAU-MTAA;[2] - MSTU named in honour of A.N. Kosygin)

Abstract: The paper focuses on studies of productivity of Kuibvshevskava sheep breed and its crossbreeds with Romney Marsh and North Caucasian-Texel rams. Their height and build were studied, as well as the following parameters: fattening, slaughter and meat characteristics; fatty and amino acid composition of the meat; shearing and physical and mechanical properties of wool in both pure bred and crossbred youngster; P-lactoglobuline gene polymorphism.

Key words: meat productivity, sheep breeding, crossing, wool, amino acids.

Sheep breeding has always been and remains an essential branch of world's productive animal husbandry, and plays an important role in providing the world population with food and raw materials. Economic prosperity of sheep breeding has recently been based on wool production; its share usually constituting 70-80%. It was favoured by rather high prices of wool. The latter stimulated the increase in producing raw materials. Considerably less attention was paid to mutton production [1].

The rise in mutton production has been of great economic interest recently. The demand for early maturing mutton-woolen sheep breeds growing on a large scale. It results from the fact that the price of mutton is higher than that of wool. The profit obtained from annual sheep-shearing averages 200-250 rubles, and selling one head of offspring of 35-40 kg live-weight amounts to 3000 rubles and more [1].

A distinguishing characteristic of mutton-wool sheep is that they are fast- maturing— the live-weight of a 4-6-month-old lamb is 35 to 45 kg; they can be used for production purposes earlier than the sheep of other productive breeds [2].

Semifine wool-mutton and mutton types of sheep breeding should replace fine wool one wherever there are favorable conditions for that, and should not be set against each other. Meanwhile, it is necessary to use opportunities for increasing mutton productivity in the areas of breeding fine wool sheep. It is due to the fact that technological schemes, ensuring mutton production growth, require more advanced ways of organizing production processes, improvement of sheep feeding and keeping conditions, that explains the increase not only in mutton, but also in related wool and milk productivity [3].

The growth of sheep breeding production under modem conditions is connected not only to the increase in sheep number, but also with the transfer to the intensive ways of development based on more efficient use of genetic and biological potential.

In the context of market economy, the growth of mutton production is an important aspect for the survival of this branch in the majority of Russia's regions.

An effective method of increasing mutton productivity is industrial crossing of local-origin ewes with rams of specialized mutton breeds.

The aim of our research is to study the efficiency of crossing ewes of Kuibyshevkaya breed with pure-bred Romney Marsh (RM) and North Caucasian-texel (NC) rams.

Materials and methods

The experimental part of our research has been done on the pedigree farm «Friendship» in Koshkinsky district of Samara region. 3- to 4-year-old Kuibyshevskaya breed dams (n=360) were used in the experiment. Cross-bred North Caucasian- texel rams were brought from the experimental farm of the North Caucasian Research Institute of Animal Husbandry located in Krasnodar area. The Romney Marsh rams were brought from the pedigree farm «Vlast' Truda» in Oryol region. Kuibyshevskaya rams were a control group. The dams were artificially inseminated in August. Lambs were weaned at the age of 4 months. Three fattening young rams' groups were arranged after weaning. The first trial group consisted of young pure-bred Kuibyshevskaya rams (KR); n=40. The second one was cross-bred Kuibyshevskaya-North Caucasian-texel: 1/2 KR-1/4(NC-TK); n=42. The third group included Kuibyshevskaya-Romney Marsh - 1/2 (KB-RM), n=37. The fattening period lasted for three months. The ration was balanced according to VIS standards and consisted of 3.5 kg of green mixture (vetch-oat mix + bromegrass) and 0.5 kg concentrates for the first fattening portion; 4 kg green mixture (vetch-oat mix + com) for the second fattening portion. For the whole fattening period, the ration feeding value averaged 1.17 feeding units and 13.3 g of digestible protein. The experimental scheme is shown in Table 1.

Table 1

Experimental scheme

Group	Dams (n=120)	Rams		Breed, offspring's' blood pedigree
	Breed	Breed	n	
I (control)	KB	KB	5	KB
II	KB	NC-TK	5	$^1/_2$ KB-1/4 (NC-TK)
III	KB	RM	3	$^1/_2$ (KB-RM)

KB- Kuibyshevkaya, NC- North Caucasian, TK- texel, RM- Romney Marsh.

The live-weight was measured by means of individual weighing of all experimental newborn, 130, 147, 165, 187, 204, 221-day-old animals before the morning feeding (in kg) within the accuracy of 0.1 kg. The body scale points were evaluated by taking measures - height at withers and sacrum (hips); oblique body length, chest width behind shoulder-blades, chest depth, and width at hips, chest and metacarpus circumference. 130-day-old young rams at the beginning of fattening, and from 221-day-old young rams at the end of fattening were measured using a measuring stick, a caliper and a tape measure. Body built indices were calculated on the basis of body scale point measurements.

Young rams' fattening and mutton qualities were studied according to methods of All-Russian Institute of Animal Husbandry. Trial slaughtering of 5 young rams from each group was done at the end of fattening. Carcasses were analyzed for the morphological composition and graded. Chemical composition of resulting mutton was studied, the content of fatty and amino acids was investigated at samples of the longest spinal muscle.

Wool productivity was assessed through individual sheep-shearing methods in the entire heird of 14-month-olds. Physical and mechanical properties of wool (fineness, length and strength) were studied according to All-Union Academy of Agricultural Sciences (VASHNIL) techniques (1985). Wool samples were taken from 14-month-old young ewes' sides.

Sheep's lactoglobulin gene polymorphism was determined by the PCR-RFLP methods (V.V. Bochkaryov et al., 1998). The blood for the tests was taken from the lambs studied before the beginning of fattening.

The experimental data were processed by means of variation statistics (N. A. Plochinskyi, 1969).

Results

Rams and ewes' characteristics. The rams used in the experiment did not differ much in their live-weight (93-98 kg). Unwashed wool shearing from Kuibyshevkaya breed rams corresponded to 7.54 kg; 5.68 kg was obtained from Romney Marsh ones. Kuibyshevkaya rams excelled North Caucasian- texel ones of the same age by 1.2 cm and those of Romney Marsh breed - by 3.1 cm. The wool fineness in Romney Marsh and Kuibyshevkaya breeds was of 50-56 quality grade, and that of North Caucasian-texel was of 56-58 quality grade. The productive qualities of the ewes used in the experiment were typical for those of Kuibyshevkaya breed: live weight — 2.5 kg in pure fibre; the wool length —12,46 cm. The wool fineness was mainly of 50-56 quality grade.

Offspring characteristics. The live-weight dynamics for pure-bred and crossbred rams are displayed by the data of Table 2, from which one can see that newborn rams of different groups have almost the same weight.

Table 2

Young rams' live-weight dynamics with the age, kg

Age, days	Groups					
	n	I	n	II	n	III
Newborn	50	4.91±0.56	50	5.03 ±0.31	50	4.99±0.43
130	40	25.93±0.45	42	25.65±0.29	37	25.92±0.48
165	37	33.51±0.96	35	34.00±0.57	34	33.12±0.98
221	35	39.04±1.34	32	39.77±1.07	30	38.20±1.20

Young rams of all compared groups are not found to have any noticeable differences in the measurements of the main body scale points (Table 3).

Body built indices (Table 4) also confirm that pure-bred and crossbred rams do not really differ as per these indicators.

Table 3

Measurements of 221-day-old young rams' body scale points

Zoometrical parameters	Group		
	1	II	III
Wither height	62.2±0.45	62.3±0.47	61.7±1.48
Rump height	63.5±0.50	63.9±0.59	62.9±1.08
Oblique body length	62.4±0.57	62.7±0.61	62.0±0.92
Chest width behind shoulder-blades	20.0±0.24	20.4±0.33	19.8±0.62
Chest depth	27.4±0.37	27.4±0.23	27.8±0.95
Width at hips	15.5±0.17	15.8±0.21	15.1 ±0.33
Chest circumference	86.2±0.71	86.9±0.78	86.0±1.71
Metacarpus circumference	8.4±0.11	8.6±0.16	8.6±0.17

Table 4

Body built indices of 221-day-old rams, %

Index	Groups		
	I	II	III
Foreleg	55.9±0.89	56.0±0.81	55.6±1.61
Extension	100.3±1.39	100.6±1.19	100.5±1.69
Pelvic-pectoral	128.9±4.46	129.6±3.93	130.8±6.14
Pectoral	72.8±1.39	74.6±1.20	71.2±1.83
Blockiness	138.3±1.68	138.6±1.31	138.9±1.69
Over size	102.0±0.60	102.6±0.44	101.9±0.66
Bone	13.6±0.22	13.7±0.24	14.0±0.31
Robustness	138.6±2.51	139.5±1.94	139.3±2.73

130-day-old rams (weaning age) had practically the same live-weight. 165-day-old rams of the first and second groups excelled both pure-bred (by 1.9%) and crossbred (by 4.1 %) animals in live-weight, but the difference was negligible.

Fattening characteristics. During the fattening period (Table 5), the average daily live-weight gain of the first-group rams was 144.1 g; that of the second group equaled 155.2 g. and the one of the third group averaged 134.99 g. The feed expenditure for 1 kg weight gain corresponded to 7.4 feeding units in the first group; 6.9 — in the second group

Table 5

Young rams' fattening characteristics

Indications	Groups		
	I	II	III
Live-weight, kg: Start of fattening End of fattening	 25.9±0.45 39.0±1.34	 25.7±0.29 39.8±1.07	 25.9±1.18 38.2±1.19
Live-weight gain, g / day	144.1	155.2	134.9
Feeding expenditures for 1 kg of live-weight gain: Feeding units, pc. Digestible protein, g	 7.4 834	 6.9 768	 7.9 889

and 7.9 — in the third one. These data characterize higher feeding qualities of crossbred young rams from the second group.

Slaughter and mutton characteristics. The outcomes of slaughtering 7.5-month-old rams (Table 6) testify the fact that crossbred young rams of the second group exceeded their pure bred peers by 3.8% in the mass of: fresh (hot) carcass; by 29% in the inner fat content; by 4.5 %;in the weaight at slaughter and by 1.6 absolute percentage in the slaughter yield. Tberefore, they had better slaughter characteristics. Crossbred animals of the third group were intermediate between the first and second groups as per the parameters discussed above. However, one should notice that there were no consideable differences in both pre-slaughter and slaughter weight between the groups compared.

The morphological half-carcass composition (Table 7) shows that the second group crossbred animals exceeded both their pure bred peers from the first group and crossbred animals of the third group in the flesh mass by 0.58 kg (12.0%) and by 0.31 kg (5.5%)

Table 6

Slaughter characteristics for young rams of different origin

Indicator	Group		
	I	II	III
Live-weight, kg:			
pre-slaughter	37.60±0.92	37.89±0.74	37.81±1.84
fresh (hot) carcass	15. 73±0.73	16.33±0.54	16.06±0.94
inner fat	0.44±0.05	0.57±0.08	0.50±0.06
slaughter	16.17±0.70	16.90±0.57	16.56±0.82
Slaughter yield, %	43.0	44.6	43.8

Table 7

Half-carcass morphological composition

Indicator	Groups					
	1		II		III	
	Kg.	%	Kg.	%	Kg.	%
Weight, kg:						
cooled half-carcass	6.95±0.41	100	7.50±0.36	100	7.17±0.82	100
flesh	5.02±0.24	72.14	5.60±0.19	74.66	5.29±0.35	73.75
bones	1.79±0.11	25.78	1.77±0.11	23.60	1.74±0.15	24.26
tendons	0.14±0.03	2.08	0.13±0.02	1.74	0.14±0.04	1.99
Fleshing index	2.88	-	3.24	-	3.12	-

respectively. The fleshing coefficient for the second group animals constituted 3.24%. which is higher than for the peers of the first and third groups.

Cutting half-carcasses for grading purposes showed the differences between experimental and control animals. E.g., the weight of spinal-scapular, pelvic-femoral and lumber junctures was found to be higher in the crossbred animals of the second group by 5.3%, 11.0% and 6.3% respectively than that of pure bred rams; by 2.7%; 7.0% and 3.4% respectively as opposed to the third group crossbreeds.

Chemical composition, amino and fatty acid content of the longest spinal muscle. The mutton nutritional value is largely determined by its chemical composition and amino acids content.

According to the longest spinal muscle chemical composition, the preference should be given to the animals of the second group with the muscle containing less moisture while more fat and more tryptophane. Their mutton is characterized by higher protein-quality index and energy value. These data indicate earlier maturity of the second group crossbreeds compared to those of the first and third group (Table 8).

As far as the summary of essential and all other amino acids (Table 9) is concerned, the second group crossbreeds overperformed their peers of the first group by 7.0% and 3.9%. and those of the third group by 5.9% and 3.1% respectively. These indicators characterize higher biological value of mutton obtained from young rams of the second group. The third group young rams' fat contained the greatest amount of unsaturated fatty acids as well as such amino acids, as oleic and linolenic — 30.96% and 1.84% respectively. Meat obtained from animals of the first group appeared to have the least amount of unsaturated fatty acids — 15.8% and 0.73% respectively (Table 10).

The crossbred animals of the second group occupied an intermediate position as per these indicators. The pure-bred animals overperformed their peers of both the second and the third group by 29.5% and 64.0% respectively in term of stearic acid content. The difference between the studied groups is insignificant in the content of other fatty acids.

Table 8

Chemical composition of the longest spinal muscle

Indicator	Groups		
	1	II	III
Contents, %:			
moisture	72.94±0.62	71,52±0.98	72.01±1.30
fat	4.07±0.91	6.32±0.83	5.40±0.99
protein	22.09±0.61	21.14±0.70	21,59±0.98
ash	0.90±0.02	1.02±0.03	1.00±0.03
Tryptophan mass portion, mg/g of protein	15.85±0.67	16.10±0.86	15.96± 1.12
Oxyproline mass portion, mg/g of protein	6.80±0.86	6.45±0.38	6.63±0.86
Tryptophan to oxyproline ratio	2.33±0.25	2.50±0.16	2.41±0.34
Energy value, mg / kg.	6.89±0.56	7.56±0.38	7.30±0.61

Table 9

Amino acid composition of the longest spinal muscle

Amino acid	Group		
	I	II	III
Lysine	5.80±0.19	6.25±0.18	6.24±1.18
Histidine	3.02±0.11	3.28±0.13	2.84±0.84
Arginine	4.53±0.13	4.78±0.11	4.66±0.6
Threonine	2.80±0.14	3.13±0.14	2.90±0.78
Valine	3.34±0.14	3.69±0.15	3.49±0.90
Methionine	2.13±0. 1	2.19±0.09	2.09±0.65
Isoleucine	3.39±0.11	3.55±0.12	3.25±0.68
Leucine	4.83±0.14	5.09±0.15	4.76±0.89
Threonine	2.94±0.10	3.11±0.11	2.89±0.62
Summary of essential amino acids	32.78±0.61	35.07±0.53	33.12±0.82
Asparagine acid	5.66±0.16	5.85±0.19	6.01±0.95

Table 9 - ending

Amino acid	Group		
	1	II	III
Serine	2.39±0.12	2.61±0.12	2.27±0.35
Glutamic acid	10.46±0.23	10.53±0.23	10.30±1.4
Proline	3.36±0.09	3.08±0.09	3.22±0.27
Glycine	3.29±0.11	3.23±0.18	3.55±0.87
Alanine	4.11 ±0. 3	4.18±0.10	4.51±0.61
Cysteine	0.82±0.06	0.84±0.06	0.79±0.46
Tyrosine	2.89±0.10	2.95±0.11	2.54±0.39
Summary, replaceable amino acids	32.98±0.59	33.27±0.61	33.19±0.98
Summary, all amino acids	65.76±1.22	68.34±1.08	66.31±1.57
Biological value of meat	0.99±0.03	1.05±0.02	1.00±0.03

Table 10

Fatty acid composition of the longest spinal muscle
(The mass portion of fatty acid, % to fatty acid summary)

Fatty acid	Group		
	I	II	III
Myristic acid	2.42±0.19	2.15±0.16	2.07±0.52
Pentadecanoic acid	0.76±0.06	0.67±0.08	0.55±0.75
Palmic acid	22.29±0.29	21.13±0.29	17.85±0.90
Heptadecanoic acid	2.59±0.14	1.85±0.14	1.49±0.14
Palmitoleic acid	4.33±0.20	4.42±0.19	4.66±0.80
Heptadecenoic acid	2.01±0.14	1.31 ±0. 2	1.19±0.14
Stearic acid	46.76±0.34	36.11±0.53	28. 53±0.41
Oleic acid	15.8±0.24	25.22±0.52	30.96±0.37
Linolenic acid	0.73±0.09	0.99±0.11	1.84±0.2 8

Mutton and broth organoleptic estimation. The estimation of culinary and gustatory traits of mutton and broth performed by means of tasting revealed some inter-group differences in such indicators as colour, taste, smell (aroma), density and succulence (Table 11). The estimation was performed according to 5-grade scale.

Table 11

Mutton tasting results

Group	Taste	Aroma	Density	Succulence	Total estimation
1	4.3	4.4	4.2	4.1	4.2
II	4.5	4.6	4.5	4.5	4.5
III	4.4	4.3	4.3	4.3	4.3

According to a number of quality parameters, pure-bred animals' mutton was found to come short to the one obtained from the same age crossbreeds. The total estimation of mutton from crossbred animals turned out to be 0.3 and 0.1 grade higher. A similar grade has been obtained while tasting the broth for quality parameters (Table 12). According to the overall estimation, the broth of the second group young rams received higher grades. The broth of the first group crossbred animals' meat got lower points for the color, strength and richness.

Table 12

Broth tasting results

Group	Color	Taste	Smell	Strength	Richness	Total estimation
I	4.3	4.3	4.4	4.2	4.1	4.2
II	4.6	4.5	4.6	4.5	4.5	4.5
III	4.4	4.2	4.4	4.3	4.3	4.3

Wool shearing and quality. Pure-bred animals, that excelled the second group crossbreeds by 2.6% and the third group crossbreeds by 1.3% in unwashed wool shearing, showed better performance at the age of 14 months. However, this difference is unreliable.

The first and third group ewes' wool fineness constituted 27.5 mkm (56^{K}) and their peers of the second group had 26.85 mkm (58^{K}).These data characterize the second group ewes as having finer wool compared with those of the first and the third groups. Crossbred ewes overperformed their peers of the second and the third group in the number of crimps per 1 cm of staple by 22.2% and 15.8% respectively. The cockling power was higher in the second group crossbred ewes constituting 21.0% as opposed to 20.3% and 20.5% in the first and the third groups.

The results of wool length studies are presented in Table 13. Shorter wool length is correlated with finer wool in the second group ewes. The first group pure bred ewes are shown to overperform their peers of the second group by 1.62 cm (10%) in the natural length. Ewes of the first and the second groups are found to be similar in relation to this parameter. The same correlation has also been revealed while studying true length

Table 13

Unwashed wool shearing and 14-month ewes' physical and mechanical wool properties

Indicator	Groups		
	1	II	III
Unwashed wool shearing (cut), kg	5.48±0.18	5.34±0.23	5.41±0.21
Wool fineness, mkm	27.53±0.43	26.85±0.47	27.51±0.59
Natural length, cm	17.85±0.64	16.23±0.67	17.80±0.58
True length of stretched fiber, cm	22.41±0.49	20.55±0.76	22.40±0.64
Degree of crimp,%	20.3	21.0	20.5
Breaking load, sN/tex	8.72±0.21	8.34±0.24	8.44±0.24

Table 14

Polymorphism of the sheep studied in relation to p-lacto globulin

Groups	n	Genotype frequency						Allel frequency	
		n	AA	n	AB	n	BB	A	B
I	25	6	0.24	15	0.60	4	0.16	0.54	0.46
II	30	6	0.20	24	0.80	0	0	0.60	0.40
III	11	11	0.44	13	0.52	1	0.04	0.70	0.30

of stretched fiber. The wool density of the experimental animals of all groups is within scientific and technological requirements — 8.1-8.5 sN/tex for this kind of raw material.

As the selection based on |3-lacto globulin types has not been performed in the flock, one can suppose that less frequent genotype BB was undesirable in some of the traits the breeding was done for (live-weight. shearing (cut), wool qualities), therefore, the carriers of this type were drafted out more often. It is noteworthy that among the second group animals there were many more heterozygotes of genotype AB than among their peers in the first and the third groups.

Conclusions

1. Kuibyshevkaya. Romney Marsh and North Caucasian-texel breed rams used in the experiment do not differ much in the traits of the constitution and productivity complex (live-weight, wool shearing and quality).

2. Newborn and 7.5-month-old crossbred young rams of the second group exceed their peers of the first and the third groups in live-weight. but the difference is negligible.

3. During the fattening period, the second group young rams' live-weight gain constituted 155.2 g per day, which is higher than in their peers from the first group by 7.8 %. It also constituted 6.9 g per day in the second and 7.9 g. per day in the third group. These data characterize better fattening qualities of young crossbred rams from the second group.

4. The result of slaughtering indicate better slaughter characteristics of young crossbred rams which overperformed their pure bred peers by 3.8% in the fresh (hot) carcass properties; by 29 % in the inner fat. by 4.5% in the slaughter weight and by 1.6 absolute percentage in the slaughter yield. The third group crossbred animals were at intermediate position between the first and the second groups in all slaughter-related indicators. The second group crossbred animals' mutton productivity coefficient constituted 3.24; the second group's one made up 2.88 and that of the third group averaged 3.12. This testifies the higher fleshing index in the second group young rams and thus their better meatiness in contrast with the animals of the first and third groups.

5. The longest spinal muscle in the young rams of the second group contained less moisture, more fat and tryptophan and had higher protein-quality indicator and energy value. These data indicate earlier maturity of the second group young crossbred animals compared with their peers of the first and the third groups.

6. Mutton and broth tasting showed that the meat of the second group animals had higher culinary and gustatory characteristics than that of the same age sheep used for comparative studies. Mutton and broth obtained from peers of the first and third groups' animals did not considerably differ in these indicators.

7. 14-month-old Kuibyshevkaya breed ewes had higher unwashed wool cut (5,48 kg) but their superiority over crossbred animals from the second and the third group was inconsiderable — 2.6% to 1.3% ($p>0.05$).

8. Studying physical and mechanical properties of the wool (fineness, length, density) demonstrated that the wool fineness in the ewes of the second group averaged 27.5 mkm (56 k). These data characterize the second group animals as those with finer wool. Greater fineness is apparently correlated with smaller fiber length in the second group ewes' wool. The wool density of the animals belonging to the groups studied is within the scientific and technological activity limits — 8.1- 8.5 sN/tex.

9. Two P-lactoglobulin allels — A and B. which combination gives three genotypes — AA. AB and BB. - are found in the animals of the investigated groups. The allel A frequency is higher in all cases than that of allel B. The second group animals have considerably more heterozygotes than their peers if the first and the third groups.

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Translated by - O.B.Ulanova and L A.Maslskova,
senior lecturers of the Dept, of Foreign Language

ПРОДУКТИВНОСТЬ ОВЕЦ КУЙБЫШЕВСКОЙ ПОРОДЫ И ЕЕ ПОМЕСЕЙ С БАРАНАМИ ПОРОДЫ РОМНИ-МАРШ И СЕВЕРОКАВКАЗСКАЯ-ТЕКСТЕЛЬ

А.И. Ерохин[1], Е.А. Карасёв[1], Ю.А. Юлдашбаев[1], ТА. Магомедов[1], М.В. Медведев[1], К.Э. Разумеев[2]

(' РГАУ-МСХА имени КА. Тимирязева; [2]МГТУ имени А.Н. Косыгина)

Аннотация: в работе приведены результаты изучения продуктивности овец куйбышевской породы и ее помесей с баранами породы ромни-марш и северокавказская-текселъ. Изучены рост и телосложение, откормочные, убойные и мясные качества; аминокислотный и жирнокислотный состав мяса; настриг и физико-механические свойства шерсти у чистопородного и помесного молодняка; полиморфизм гена fi-лактоглобулина.

Ключевые слова: мясная продуктивность, овцеводство, скрещивание, шерсть, аминокислоты.

Ерохин Александр Иванович - д. с.-х. и., проф. кафедры коневодства и овцеводства РГАУ-МСХА имени К.А. Тимирязева (127550, г. Москва, ул. Тимирязевская, 49; тел. (499) 976-06-90).

Карасёв Евгений Анатольевич - д. с.-х. н., проф., зав. кафедрой коневодства и овцеводства РГАУ-МСХА имени К. А. Тимирязева (127550, г. Москва, ул. Тимирязевская, 49; тел. (499) 976-06-90; e-mail: ckarasev V/1imacad.ru).

Юлдашбаев Юсуп Артакович - д. с.-х. н., проф., декан зооинженерного факультета РГАУ-МСХА имени К. А. Тимирязева (127550, г. Москва, ул. Тимирязевская, 49; e-mail: zoo@ timacad.ru).

Магомадов Тарам Ахматович - д. с.-х. н., проф. кафедры коневодства и овцеводства РГАУ-МСХА имени К.А. Тимирязева (127550, г. Москва, ул. Тимирязевская, 49; тел. (499) 976-06-90; e-mail: magomadov@timacad.ru).

Медведев Максим Вячеславович - к. с.-х. н., кафедра коневодства и овцеводства РГАУ-МСХА имени К.А. Тимирязева (127550, г. Москва, ул. Тимирязевская, 49).

Разумеев Константин Эдуардович - д. т. н,, проф., проректор по научной работе МГТУ имени А.Н. Косыгина (119071, г. Москва, ул. Малая Калужская, д. 1).

Prof. Dr. **Alexander Ivanovich Erochin** - Ph.D. in Agricultural Sciences, professor of Horse and Sheep breeding department RSAU-MTAA (ul. Timiryazev-skaya, 49, Moscow, 127550 Russian Federation; phone: + 7(499) 976-06-90).

Dr. **Evgenyi Anatolievich Karasyov** - Ph.D. in Agricultural Sciences, Head of Horse and Sheep breeding department, RSAU-MTAA (ul. Timiryazevskaya, 49, Moscow. 127550 Russian Federation; phone: + 7(499) 976-06-90; e-mail: ekarasev@timacad.ru).

Prof. Dr. **Yusup Artakovich Yuldashbaev** - Ph.D. in Agricultural Sciences, professor. Dean of the Faculty of Animal Husbandry, RSAU-MTAA (ul. Timiryazevskaya, 49, Moscow, 127550 Russian Federation; e-mail: zoo@ timacad.ru).

Prof. Dr. **Taram Akhmatovich Magomadov** - Ph.D. in Agricultural Sciences, professor of Horse and Sheep breeding department, RSAU-MTAA (ul. Timiryazevskaya, 49, Moscow, 127550 Russian Federation; phone: + 7(499) 976-06-90; e-mail: magomadov@timacad.ru).

Dr. **Maxim Vyacheslavovich Medvedev** - Ph.D. in Agricultural Sciences, Horse and Sheep breeding department RSAU-MAA named after K.A. Timiryazev.

Prof. Dr. **Konstantin Eduardovich Razumeyev** - Ph.D. in Technical Sciences., professor, Deputy Rector in charge of Scientific Affairs, Moscow State Textile University named in honour of A.N. Kosygin (ul. Malaya Kaluzhskaya, 1, Moscow 119071 Russian Federation).