Exterior features and meat productivity of Aubrac breed cattle during acclimatization in the conditions of Northern Trans-Urals

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Abstract. The article presents materials on the study of the cows' exterior and meat productivity of Aubrac gobies in the acclimatization period of the third and sixth generation animals in the conditions of Northern Trans-Urals. It was established that as a result of 18 years of Aubrac breeding, animals were formed in the enlarged type of physique in the conditions of the Northern Trans-Urals. Cows of the sixth generation had larger measurements in shoulder height by 9.7cm, in rump - by 5.2 cm, slantwise body length - by 12.8 cm, as well as chest depth - by 5.5cm, chest width by 9.2 cm and chest girth by 10.1 cm. The highest live weight in growing gobies between 9 and 18 months was in sixth-generation animals. The indicators that characterize animals' meat productivity increased. The slaughter weight of the sixth-generation gobies was 330 kg. It was found that by the size of the carcasses' edible part, animals of the sixth generation were superior to the peers of previous generations. The amount of muscle tissue in the sixth-generation gobies was the highest and amounted to 243.2 kg, muscle tissue output - 77.5%.

1 Introduction

In the Russian Federation, meat cattle breeding has been intensively developing in the last decade [1-3]. The industry intensification is associated with the use of imported livestock breeds, one of which is the Aubrac breed. The Aubrac breed was bred in France; during its formation, it was reoriented from dairy to meat productivity direction [4]. In recent decades, selection with the breed in the country of origin is carried out on improving meat forms, increasing animals' meat productivity indicators at slaughter. The cattle of this breed were brought to Tyumen region in 2002. During this period, more than six generations of animals have been obtained, which indicates the completion of the breed's acclimatization process in the zone of the Northern Trans-Urals [5-7].

In meat cattle breeding, such traits as physique type and exterior of animals are of great importance in breeding [8-10].

The study of exterior features and meat productivity in the Aubrac breed acclimatization process in the conditions of the Northern Trans-Urals is an urgent task. There are no studies

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that would show changes in the exterior and meat productivity of animals during their acclimatization period covering at least six generations.

The purpose of the study was to analyze changes in the cows' exterior and meat productivity of Aubrac breed ultra-productive replacement gobies in the process of acclimatization of the Aubrac breed in the conditions of the Northern Trans-Urals.

2 Material and methods of research

The research was carried out in the period from 2002 to 2019 in agricultural enterprises of the Tyumen region. The object of research were cows of zero (n=30), third (n=30) and sixth generations (n=30), as well as ultra-productive replacement gobies aged 9 - 18 months of the first (n=25), third (n=25) and sixth (n=25) Aubrac breed generations. Young cattle was grown on full suction until the age of 8 months. After weaning, groups were formed for nurture and fattening. The level of animal feeding throughout the research period was consistent with the detailed feeding system recommended for beef cattle. The evaluation of cows' exterior was carried out at 4-5 months after the first calving in the autumn period during valuation by taking measurements. The obtained results were compared with measurements and physique indices of first calving cows introduced from France.

To characterize meat productivity in the period from 2004 to 2018, the control slaughter of ultra-productive replacement gobies was carried out at the age of 18 months of 3 heads from each generation, the slaughter was carried out on the slaughter line of the Yalutorovsky meat processing plant in Tyumen region.

Meat productivity was evaluated according to the methodology of VASHNIL, VIZH, VNIIMP (1997). During the control slaughter, live weight, freshly drawn carcass weight, carcass output, internal fat weight, and slaughter output were determined. To study the morphological composition of carcasses, the half carcasses dissection was carried out in accordance with meat industry technology [11].

The live weight of gobies was determined by weighing at the ages of 9, 12, 15 and 18 months [12].

The results of the research were processed biometrically [12] through the Microsoft Excel software application.

3 Results and discussions

Given that the cattle exterior evaluation is of great importance and has a high inheritance factor, we have evaluated the cows' exterior after the first calving by point measurement. The assessment results showed that the Aubrac breed cows had significant changes in measurements (Table 1). Animals have become more elongated and taller. So, in comparison with animals imported from France, the measurements magnitude of shoulder height increased by 8.2 and 9.7 cm ($P \geq 0.999$), rump height - by 5.0 and 5.2 cm ($P \geq 0.999$), slantwise body length - by 3.3 ($P \geq 0.99$) and 12.8 cm ($P \geq 0.999$) in cows of the third and sixth generation, respectively. Cows of the sixth generation were characterized by better chest development; this is evidenced by chest measurements of depth and width. In third-generation cows, chest depth increased by 4.4 cm ($P \geq 0.999$), in sixth-generation cows - by 5.5 cm ($P \geq 0.999$), and the breast width increased by 4.0 and 9.2 cm respectively ($P \geq 0.999$) compared to cows imported from France. Better chest development affected breast circumference measurement, which was the largest in the sixth-generation cows and amounted to 198.2 cm, which is by 10.1 cm ($P \geq 0.999$) greater compared to zero-generation peers.

Hook bone width increased by 3.2 (P≥0.999) and 3.4 cm (P≥0.99), in ischial tuberosities - by 3.0 and 4.5 cm (P≥0.999) in animals of the third and sixth generations respectively. Slantwise stern length remained almost unchanged, but the half-girth of the stern increased by 6.3 and 6.9 cm (P≥0.999) by generations respectively, there was a slight increase in skin thickness.

Table 1. Aubrac breed cows' frame measurements of different generations ($\bar{x} \pm S_{\bar{x}}$)

Trait	Generation		
	zero	third	sixth
Measurements, cm			
Shoulder height	123.1 ± 0.4	131.6±0.8***	132.8±0.7***
Rump height	133.0 ± 0.5	138.0±0.8***	138.2±.06***
Slantwise body length	148.7 ± 0.5	152.0±1.1**	161.5±1.7***
Chest depth	64.6 ± 0.3	69.0±0.6***	70.05±1.4***
Chest width	41.3 ± 0.3	45.3±0.7***	50.5±1.8***
Chest girth	188.1 ± 0.7	191.6±1.9	198.2±1.8***
Hook bone width	48.5 ± 0.3	51.7±0.7***	51.9±1.4**
Ischial tuberosity width	35.7 ± 0.3	38.7±0.7***	39.0±1.8***
Slantwise stern length	49.8 ± 0.2	49.7±0.6	50.0±0.8
Stern half-girth	111.1 ± 0.5	117.4±1.6***	118.0***
Skin thickness, mm	0.64 ± 0.006	0.68±0.01**	0.78±0.02***

Note: here and further - P≥0.95*, P≥0.99**, P≥0.999*** compared to zero generation

Thus, the new habitat conditions caused the formation of animals in a taller and more elongated physique type. The cows' exterior formation was influenced not only by the conditions they were in, but also by breeding work with the herd throughout the acclimatization period. When breeding, animals with exterior deficiencies, underdeveloped in length and height were culled out. The selection of stud bulls, mainly formed in a tall physique type, was carried out. All this work certainly reflected in the formation of the cows' exterior by the sixth generation.

Fattening and meat qualities of ultra-productive replacement gobies were studied at the age of 9 to 18 months in representatives of three generations. With intensive cultivation, young cattle showed a fairly high live weight in all age periods with a significant advantage of sixth-generation individuals (Table 2). At the age of 9 months, their live weight value exceeded the peers of the first generation by 93.9 kg (P≥0.999), at one year - by 89.4 (P≥0.999), at 15 months - by 120.8 (P≥0.999) and at 18 months - 107.3 kg (P≥0.999). Third-generation animals outnumbered first-generation peers by 76.6 (P≥0.999), 80.7 (P≥0.999), 84.8 (P≥0.999) and 53.0 kg (P≥0.99) by periods, respectively. Consequently, the acclimatization process contributed to an increase in animals' live weight.

Table 2. Live weight and average daily growth of Aubrac gobies during acclimatization ($\bar{x} \pm S_{\bar{x}}$)

Age, months	Generation		
	first	third	sixth
Live weight, kg			
9	216.5±6.4	290.1±6.7***	310.4±5.6***
12	298.5±9.1	379.2±3.1***	387.9±4.5***
15	368.0±7.5	452.8±6.8***	488.8±5.1***
18	457.5±18.4	510.5±6.3**	564.8±7.1***
Average daily gain, g			
9-12	911.1±14.1	1089.0±21.0***	861.1±4.8
12-15	772.2±18.6	999.0±17.2***	1117.7±15.8***
15-18	994.4±21.0	800.0±21.0***	930.0±24.6
9-18	889.2±12.1	813.2±16.8	942.2**

Animals of the sixth generation were inferior to the peers of the first and third generations by the average daily gain in live weight in the period from 9 to 12 months. The highest average daily gain in this period was in animals of the third generation and amounted to 1089.0 g. In the period from 12 to 15 months, the average daily increase in live weight of the sixth-generation gobies was highest and amounted to 1117.7 g, which is more than the first-generation gobies by 345.5 g (P≥0.999); in the final period, the gain advantage was for the animals of the first generation - 994.4 g, which is more than the third by 194.4 g (P≥0.999) and the sixth - by 150.0 g. During the analyzed period, the highest increase was in animals of the sixth generation - 938.7 g.

The objective of our research was to find out the impact of acclimatization on meat productivity of Aubrac gobies in three generations. Conducting a control slaughter of young cattle at the age of 18 months showed that the value of pre-slaughter weight reflecting the results of fattening, as well as freshly drawn carcass weight were greatest in the sixth-generation gobies. At the same time, the third-generation gobies occupied an intermediate position between the peers of the first and sixth generations (Table 3). Thus, the freshly drawn carcass weight advantage in the sixth-generation gobies amounted to 41.4 kg, the third - 15.0 kg in comparison with the carcass weight obtained from the first-generation gobies. Generation belonging affected the amount of internal raw tallow obtained at animal slaughter. 9.5 kg (P≥0,999) more raw farrow was received from the sixth-generation gobies, the third generation - 8.1 kg (P≥0,999). Gobies of the sixth generation were characterized by the largest slaughter weight of 330 kg at the age of 18 months. This corresponds to modern trends when working with animals and allows to get heavyweight carcasses at slaughter.

Table 3. Indicators of gobies' meat productivity at the age of 18 months ($\bar{x} \pm S_{\bar{x}}$)

Indicator		Generation		
		first	third	sixth
Weight, kg	pre-slaughter	464.6±21.4	509.4±14.8	545.4±12.1*
	freshly drawn carcass	276.1±16.2	291.1±12.2	317.5±12.5
	internal raw tallow	3.0±0.1	11.1±0.8***	12.5±0.7***
	slaughter	279.1±20.4	302.2±14.1	330.0±12.0
Output, %	freshly drawn carcass	59.4	57.1	58.2
	internal raw tallow	0.6	2.2	2.3***
	slaughter	60.0	59.3	60.5

The animals of the first generation had a slight advantage in freshly drawn carcass output. There was no significant difference between gobies belonging to different generations by the slaughter output amount. There was a significant increase in raw tallow output from the gobies of the third and sixth generation compared to the first.

Comparative results analysis of carcass dissection and meat yield by varieties also showed significant differences between animals of analyzed generations (Table 4).

Table 4. Morphological composition of carcasses ($\bar{x} \pm S_{\bar{x}}$)

Indicator		Generation					
		zero		third		sixth	
		kg	%	kg	%	kg	%
Weight of chilled carcass, kg		270.9±15.4	-	279.3±9.3	-	314.1±3.4	-
Muscular tissue		207.6±10.5	76.7	213.5	76.4	243.2±9.1	77.5
Including by grades	extra	52.4±2.41	19.4	56.1±3.2	20.0	63.5±4.2	20,2
	1st grade	71.6±3.1	26.5	80.2±3.2	28.7	87.3±3.6	27,8*
	2nd grade	80.3±6.85	29.6	77.2±5.95	27.6	91.2±4.8	29,0
Fat tissue		6.9±1.03	2.5	7.3±2.6	2.6	9.4±1.2	3.0

Total boneless meat	214.5±11.4	79.2	220.8±10.2	79.0	252.6±8.9	80.5
Connective tissue	3.6±0.27	3.6	9.7±1.2	3.5	11.2±2.1	3.8*
Bone tissue	46.6±2.9	17.2	48.8±3.3	17.4	50.8±1.2	16.2

The largest weight and relative output of muscle tissue among the analyzed groups were shown by the sixth-generation gobies with average values of 243.2 kg and 7.5% respectively. An increase in the relative output of muscle tissue indicates a high development degree of those body parts that contain a greater amount of muscle. Carcasses obtained from the sixth-generation gobies had a higher amount of fatty tissue in their composition - 9.4 kg, which is 2.5 kg more compared to animals of the first generation.

Thus, in terms of boneless meat amount, i.e. the carcasses' edible part, advantage was on the side of the sixth-generation animals; their boneless meat amount was higher by 38.1 kg compared to the first-generation gobies. The third-generation gobies exceeded the first generation by 6.3 kg of carcasses' edible part.

The yield of prime quality meat in the sixth-generation animals amounted to 63.5 kg (20.2%), which is higher than the first-generation gobies by 11.1 kg. A greater amount of prime quality meat was obtained at sixth-generation gobies' slaughter, which was greater by 15.7 kg compared to the first generation.

The animals of the sixth generation also had an advantage in relative values of prime quality yield, which amounted to 20.2%, the first - 27.8%.

Thus, the animals' adaptation, as well as breeding work carried out with animals, allowed to improve the quality indicators of meat productivity during their breeding in the conditions of Northern Trans-Urals. The findings were obtained earlier in studies by Sheveleva O.M., Bakharev A.A., Sukhanova [13], Bakharev A.A., Sheveleva O.M., Fomintsev K.A. [14].

4 Conclusions

As a result of 18 years of Aubrac breeding, larger animals were formed in the conditions of the Northern Trans-Urals, as evidenced by their measurements. Animals have become more elongated and taller. Cows of the sixth generation outnumbered peers imported from France by measurements: shoulder height - by 9.7cm ($P \geq 0.999$), rump height - by 5.2cm ($P \geq 0.999$), slantwise body length - by 12.8 cm ($P \geq 0.99$). Cows had increased chest depth by 5.5 cm, chest width - 9.2 cm, chest girth - by 10.1 cm ($P \geq 0.999$).

The highest live weight in the growing period of gobies from 9 to 18 months was in animals of the sixth generation. At the age of 9 months, their live weight value exceeded the peers of the first generation by 93.9 kg, at one year - by 89.4, at 15 months - by 120.8 and at 18 months - 107.3 kg ($P \geq 0.999$).

Studies of meat productivity have shown its increase in the breed acclimatization period. At slaughter, sixth-generation animals at 18 months age were characterized by the greatest pre-slaughter weight - 330 kg; heavier carcasses and more prime quality meat were obtained from them. The prime quality meat yield from the sixth-generation animals amounted to an average of 63.5kg (20.2%); this is more than of the first generation by 11.1 kg($P \geq 0.95$). Thus, the cattle type formed in Aubrac acclimatization process corresponds to modern trends when working with animals and allows to receive heavy carcasses at slaughter.

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