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Conformation Traits of Salers Cattle of Different Genetic and Ecological Generations

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***Abstract* — The paper describes the conformation traits of Salers beef cattle raised in the Tyumen region. The studies were conducted on first-calf cows of different generations. The imported animals belong to the zero generation, their offspring belong to the 1st generation, and the grandchildren – to the 2nd genetic and ecological generation. In the process of research, some depreciation of animals over successive generations was revealed with an increase in indicators characterizing the beef qualities of animals.**

Keywords — Beef cattle, the Salers, conformation, generation of animals, correlation.

I. INTRODUCTION

Within a new habitat, animals someway start interacting with the environment. All species of animals in the course of evolutionary development (to a greater or lesser extent) have adapted to the conditions of that environment in which they live. Climatic conditions were a major factor that caused certain morphological changes [1]. The process of adaptation resulted in some features specifying the size and the structure of the body, the special nature of skin that affects the thermal insulation of body surface, the distribution of subcutaneous fat and the structure of digestive system [2].

Getting into new living conditions, animals withstand a number of changes. They can be caused by a new feed regime, a different temperature, air humidity, barometric pressure, relief, etc., and, as a whole, by those living conditions that the organism has to assimilate while living in a new place.

In some cases, such changes are rather profound affecting the entire organism. In others they are relatively superficial, while in the third the body is so tolerant of the environment that it does not withstand any significant changes [3, 4].

Some authors sometimes consider the notions of acclimatization and adaptation to be equal. However, differentiating these meanings of acclimatization seems to be of particular importance for a whole range of factors that have determined the lifestyle of an animal and affect its productive qualities over many generations. Meanwhile, adaptation process incorporates morpho-physiological and biochemical changes, as well as changes in the behavior of animals. If adaptation is long-term, the hereditary traits of animals can be modified [5].

Acclimatization of animals is not always successful and is never complete. It is considered that animals are well acclimatized if they actively adapt to new living conditions, reproduce and give birth to their offspring preserving the valuable economic traits of their parents [6].

Cattle are distinguished by a relatively long acclimatization time to the altered environmental conditions. The acclimatization takes longer if the differences between previous and new environmental conditions are greater, and depends on the age of animals. The most favorable period is considered to be breeding age. It is also known that young cattle of 1 to 2.5 years old are well adapted to new conditions. Besides, the process of acclimatization of animals proceeds better when moving from south to north, not the other way around. It is rather difficult to withstand the process of acclimatization in mountain conditions where animals are exposed to a large difference in daily temperatures and constant hypoxia on the body [7-14].

Acclimatization is a very complicated process that requires a careful study of both the acclimatized organism and the conditions in which it finds itself. It is impossible to expect successful acclimatization during the first 2 to 5 years [15, 16].

The first reports on the impact of acclimatization processes on cattle were produced by the French scientist Roulin in 1928, which advanced the further study.

In his papers Ch. Darwin [17] noted that domestic animals are able to endure various environmental conditions due to their plasticity caused by the natural selection.

II. Ease of Use

In the paper, the authors analyzed the changes in the conformation traits of the Salers cattle for several generations (three genetic and ecological generations) while being acclimatized. It's worth mentioning that imported animals belong to the zero generation, their descendants belong to the 1st generation, and their grandchildren belong to the 2nd genetic and ecological generation [18].

The conformation traits of animals were assessed on the basis of measurements obtained from the conformation samples according to some generally accepted methods. The measurements were taken while judging the 3-year-old heifers following the first calving (Table 1).

III. RESULTS

The results obtained enable to conclude that the zero-generation animals surpass in length and width. Thus, the cows of the 1st and 2nd generation had lower height at rump, as contrary to that of zero generation, by 3.4 and 3.6 cm. The width of chest was 2.3 and 1.8 cm lower, respectively (P> 0.999), the width of loin was 1.1 cm (P> 0.99) and 1.7 cm (P> 0.999) lower.

Such indices as the height at withers, the diagonal body length and the heart girth did not significantly vary in different populations. There was a slight advantage of these indices in the cows of zero generation.

It should be noted, though, that such measurements as the diagonal length and the half-girth of back tend to increase with the change of generations. Thus, the 2nd generation cows surpass the control group by 2 cm (4.1%) and 7.8 cm (7%), whereas the 1st generation cows – by 2.5 cm (5.1%) and 5.6 cm (5%), respectively (P> 0.999).

TABLE 1. BODY MEASUREMENTS OF HEIFERS X±SX, CM

Measurement	Genetic and ecological generation		
	zero	*1st*	*2nd*
Number of cows	170	162	57
Height at withers	129.7 ± 0.41	128.7 ± 0.45	128.9 ± 0.83
Height at rump	137.5 ± 0.42	134.1 ± 0.49***	133.9 ± 1.03***
Chest depth	62.8 ± 0.44	60.7 ± 0.45***	63.1 ± 0.81
Width of chest	39.2 ± 0.33	36.9± 0.28***	37.4 ± 0.55**
Width of hips	48.2 ± 0,41	46.1 ± 0.38***	48.4 ± 0.87
Width of loin	33.2 ± 0.17	31.5 ± 0.16***	32.1 ± 0.31**
Diagonal length of body	150.0 ± 0.66	148.2 ± 0.71	147.2 ± 1.05*
Diagonal length of back	48.9 ± 0.21	51.4 ± 0.21***	50.9 ± 0.30***
Heart girth	192.0 ± 0.70	193.4 ± 0.72	191.4 ± 1.17
Half-girth of back	111.9 ± 0.44	117.5 ± 0.75***	119.7± 0.86***
Skin thickness	0.64 ± 0.01	0.70 ± 0.01***	0.68 ± 0.01***

Note: hereinafter, where * P> 0.95;
** P> 0.99;
*** P> 0.999 relating to cows of 0 genetic and ecological generation (g.e.g.)

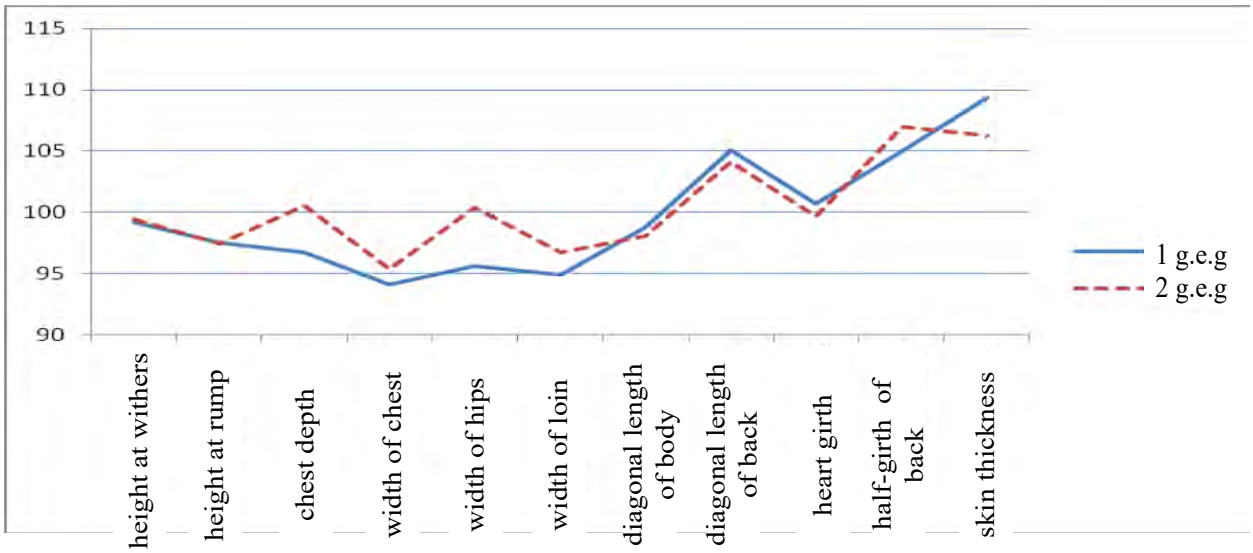

Fig. 1. Conformation profile of heifers (measurements of zero-generation cows are taken as 100 %

Local generation cows also turned out to be the most thick-skinned, exceeding the imported animals in the skin thickness by 6.3 and 9.4% (P> 0.999).

To visually provide measurements, Figure 1 shows the conformation profile of heifers

The presented graph clearly demonstrates that the 1st generation cows are said to be significantly lacking compared to the other generations in such measures as the depth and width of chest, as well as the width of hips and loin, but slightly exceed in such measures as the diagonal length of back, the heart girth and more considerably in the thickness of skin.

The compliance of body parameters of cows with standard values was compared based on the test methodology for distinctness, uniformity and stability [19] and supplemented by the scientists of the Department of Production Technology and Processing of Livestock Products of the Tyumen State Agricultural Academy [20]. Since the breed under consideration is not included in the collection of breeding achievements it was found that the Salers generally have conformation traits typical of the breed, except for the chest measurements that were slightly lower than those recommended [21].

Equally important is the change in the growth rate of cows that belong to different generations in the age parameter. When analyzing the conformation parameters of mature cows, the following changes were noted (Fig. 2, Table 2).

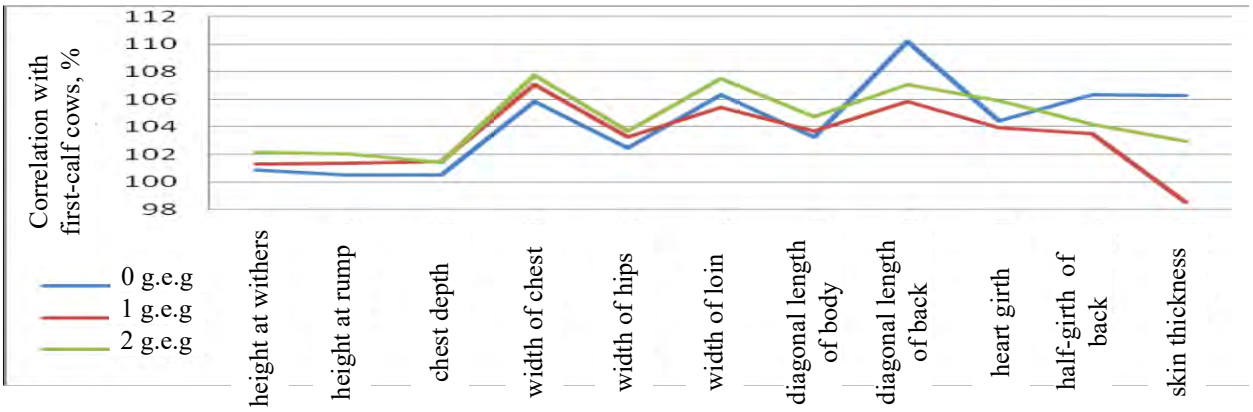

Fig. 2. Changes in body measurements of Salers adults (first-calf cows are taken as 100 %)

With age, there was a natural increase in the overall proportions of the body with the general trend to remain the leading generation unchanged. There was no considerable growth in height measurements with an increase to 0.5-2.2%. The difference in the height at rump between the generations significantly decreased with a sound superiority of the zero generation cows as compared to the 1st generation by 2.3 cm (1.7%, P> 0.99).

The increase in the following indices was substantial, namely: the width of chest by 2.3-2.9 cm (5.9-7.8%, P> 0.999), the width of loin by 1.7-2.4 cm (5.4-7.5%, P> 0.95-0.999) and the length of back by 3-5 cm (5.8-10.2%, P> 0.999). The 2nd-generation cows showed these changes to a greater extent, except for the length of pelvis where the zero-generation cows had a higher increase.

With age, the zero-generation cows also showed a maximum increase in the half-girth of back by 7.1 cm (6.3%, P> 0.999), with a similar increase in the 1st and 2nd generation cows by 4.1-5.0 cm (3.5- 4.2%, P> 0.999). However, the cows of the local generations still had a more distinctive conformation index – 121.6-124.7 cm, with a difference to the representatives of zero generation by 2.6-5.7 cm (2.2-4.8%, P> 0.99-0.999).

TABLE 2. BODY MEASUREMENTS OF SALERS ADULTS ($\overline{X} \pm S\overline{x}$), CM

Measurement	Genetic and ecological generation		
	zero	*1st*	*2nd*
Number of cows	108	84	31
Height at withers	130.8 ± 0.52	130.4 ± 0.82	131.7 ± 0.60
Height at rump	138.2 ± 0.44	135.9 ± 0.58**	136.6 ± 1.12
Chest depth	63.1 ± 0.54	61.6 ± 0.71	64.0± 1.18
Width of chest	41.5 ± 0.39	39.5 ± 0.58**	40.3 ± 0.28*
Width of hips	49.4 ± 0.53	47.6 ± 0.65*	49.0 ± 0.78
Width of loin	35.3 ± 0.31	33.2 ± 0.77*	34.5± 0.69
Diagonal length of body	154.9 ± 0.98	153.7 ± 1.23	154.2 ± 1.14
Diagonal length of back	53.9 ± 0.27	54.4 ± 0.20	54.5 ± 0.69
Heart girth	200.5 ± 0.96	197.9 ± 1.31	202.7 ± 1.14
Half-girth of back	119.0 ± 0.43	121.6 ± 0.92**	124.7± 0.76***
Skin thickness	0.68 ± 0.01	0.69 ± 0.01	0.70 ± 0.01

Note: hereinafter, where * P> 0.95;
** P> 0.99;
*** P> 0.999 relating to cows of 0 genetic and ecological generation (g.e.g.)

An important feature noted while adapting to the new climate was shown by the zero generation cows, which manifested itself in an increase in skin thickness by 6.3% (P> 0.99). This measurement remained without significant changes but at a sufficiently high level in the cows of other generations considered.

The obtained measurements made it possible to calculate the body indices (Table 3).

TABLE 3. BODY INDICES OF FIRST-CALF COWS X±SX, %

Index	Genetic and ecological generation		
	zero	1st	2nd
Length of legs	51.7 ± 0.32	53.1± 0.48**	51.0 ± 0.49
Length of carcass	115.7 ± 0.51	115.1 ± 0.51	114.5 ± 0.95
Chest	62.6± 0.43	61.4± 0.68	59.5 ± 0.79***
Pelvis and chest	81.9± 0.64	80.7± 0.77	78.2 ± 1.33*
Blockiness	128.3 ± 0.58	130.9± 0.57**	130.3 ± 1.13
Overgrowth	106.0 ± 0.21	105.8 ± 0.21	106.6 ± 0.39
Massiveness	148.1± 0.57	150.5 ± 0.52**	148.7 ± 0.89
Body depth	20.4 ± 0.18	19.1 ± 0.14***	19.6 ± 0.25**
Fleshing	85.3± 0.38	89.5 ± 0.59***	89.7 ± 0.64***
Body uniformity	690.0 ± 7.79	713.8 ± 4.71**	726.1 ± 8.89**
Degree of manifestation	263.7 ± 0.91	265.6 ± 0.93	263.5 ± 1.48

Note: hereinafter, where * P> 0.95;
** P> 0.99;
*** P> 0.999 relating to cows of 0 genetic and ecological generation (g.e.g.)

The indices confirm the excessively high legs of animals (the corresponding index is higher than the one recommended by 9.5% in the animals of zero generation and by 10.9 and 8.8% in the animals of the 1st and 2nd generation, respectively) and the insufficient length of carcass (the index is 6.8, 7.4 and 8%, respectively). All width indices are below the desired indicators by more than 10%, which also indicates the relative shallowness of the animals.

The considered animals have a well-defined fleshing and massiveness index, which on average surpasses the recommended index within 10%. These indices are more distinctive in the local cows.

The imported cows have more distinctive chest, pelvis and chest and body depth indices, which indicates some depreciation of the first and second generations in the course of acclimatization.

The index of body uniformity is more prominent in the second generation cows (726.1%), while zero-generation cows have this index 36.1% lower and the second generation 23.8 % lower as contrary to the first generation (P> 0.99).

The degree of breed manifestation is rather high in all analyzed generations. There are no significant differences within each group.

With advancing age, all body indices somehow changed (Fig.3).

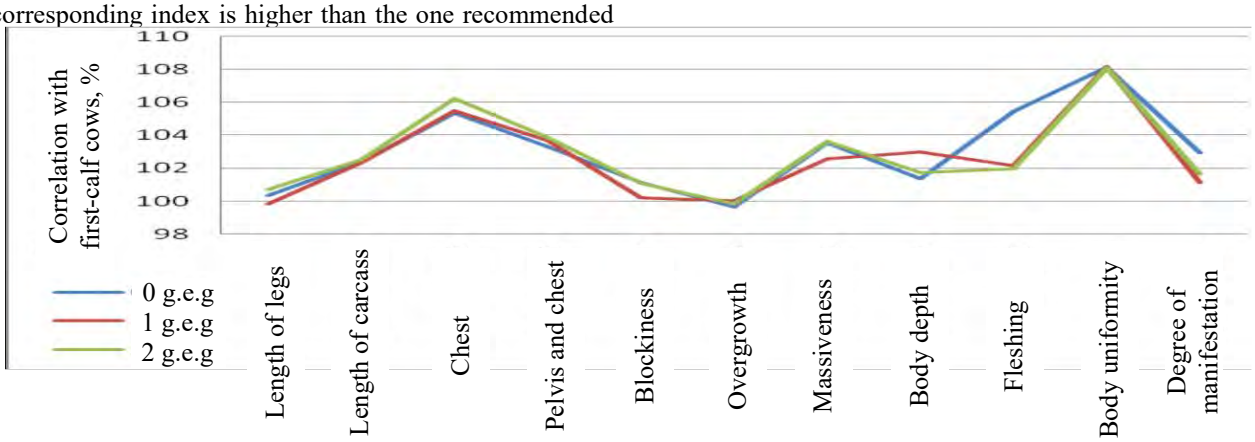

Fig. 3. Conformation dynamics in mature cows (first-calf cows are taken as 100 %)

In the age dynamics, there is a significant increase in the chest, pelvic-chest index, massiveness and body uniformity with a slight decrease in the overgrowth of animals. The mature animals began to show greater compliance with the recommended indicators.

In general, the superiority dynamics of generations remain, although the cows of local generations have a decreased difference to the imported animals (Table 4).

Thus, an increase in the chest index by 5.4-6.2% (P> 0.99-0.999) occurred. The 1st and 0 generation cows had this index almost the same, while the 2nd generation cows reduced the difference to 2.8% (P> 0.95) in favor of the imported animals. The differences in the pelvic and chest index have a similar rate.

Local animals still did not have a high body depth but the 1st generation cows increased the value by 3.0% with age, whereas their zero and 2nd generation counterparts increased it only by 1.4-1.7%. However, the body depth difference in mature cows was still in favor of the zero generation by 0.7-0.8% (P> 0.95)

TABLE 4. CONFORMATION INDICES OF THE SALERS ADULTS ($\overline{X} \pm S\overline{x}$), %

Index	Genetic and ecological generation		
	zero	*1st*	*2nd*
Length of legs	51.8± 0.43	53.2± 0.43*	51.0 ± 1.14
Length of carcass	115.2 ± 0.68	114.0 ± 0.87	113.7± 0.46
Chest	62.7± 0.63	61.5± 0.76	58.8± 1.38**
Pelvis and chest	82.5± 1.20	81.3 ± 1.42	77.2 ± 1.02***
Blockiness	131.9 ± 0.67	131.5 ± 1.15	132.7± 1.06
Overgrowth	105.8 ± 0.26	105.6 ± 0.37	107.8 ± 0.64**
Massiveness	151.6± 0.67	149.5 ± 0.86	150.9± 1.26
Body depth	19.9 ± 0.19	19.3 ± 0.28	19.0 ± 0.14***
Fleshing	93.0± 0.23	88.3 ± 0.79***	92.4± 0.76
Body uniformity	690.7± 7.17	731.4 ± 7.89**	758.7± 6.67***
Degree of manifestation	267.0± 1.26	263.5 ± 1.27	264.6± 1.48

Note: hereinafter, where * P> 0.95;
** P> 0.99;
*** P> 0.999 relating to cows of 0 genetic and ecological generation (g.e.g.)

By the third calving zero-generation cows improved their meat carcass by 4.7% (P> 0.999), whereas in local generations this increase was up to 2.0%. However, the difference in the fleshing index still remained in favor of the 1st and 2nd generation 2, 3-3.7% (P> 0.99-0.999). The body uniformity characterized by the corresponding index also confirmed high and relatively homogeneous indices with a growth rate over successive generations (P> 0.95).

For the other body indices, there are no significant changes with age.

The indicators of interconnection between body indices and live weight of cows are presented in Table 5.

TABLE 5. CORRELATION RELATIONSHIP OF INDICES WITH BODY WEIGHT OF COWS OF DIFFERENT GENERATIONS

Index	Genetic and ecological generation		
	zero	*1st*	*2nd*
Length of legs	0.13	-0.11	0.24
Length of carcass	0.17	-0.04	0.15
Chest	0.11	-0.15	0.06
Pelvis and chest	-0.11	-0.07	0.19
Blockiness	0.11	-0.01	0.06
Overgrowth	0.10	0.14	-0.11
Massiveness	0.30	-0.05	0.31
Body depth	-0.16	0.01	-0.32
Fleshing	0.28	0.47	0.01
Body uniformity	0.88	0.91	0.90
Degree of manifestation	0.29	-0.07	0.25

The correlation coefficients between the body indices and the live weight of cows varies greatly from negative to strong positive. The selection using body indices is desirable in such an indicator as body uniformity (0.88 - 0.91). What is more, when selecting it is worth taking into account such indices as massiveness, fleshing and degree of manifestation.

IV. CONCLUSION

When analyzing the conformation traits of the Salers heifers, it can be noted that the animals generally have body indices typical of their breed. However, over successive generations in the course of acclimatization, there is a decrease in body depth and chest indices, with an increase in indices characterizing carcass traits of animals such as fleshing and body uniformity.

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