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Effects of *CAPN1* and *CAST* gene polymorphism on growth and reproductive characteristics in *Bos taurus*, L. as a model object

N.G. Puzik[1], V.O. Babalian[2], V.R. Dorofieieva[3], L.V. Mitiohlo[4], O.M. Fedota[5]

[1]Kharkiv National Medical University;
[2]MNPE "City Clinical Multiprofile Hospital No. 17" of Kharkiv city council;
[3]CNPE of Kharkiv regional council "Regional Clinical Perinatal Center";
[4]SE "RF "Nyva" of the M.V. Zubts IABG of NAAS", Cherkasy region; [5]LLC "AMS", Kharkiv;
e-mail: n.g.puzik@gmail.com

The study aimed to analyze the effect of individual genotypes and allelic variants of the polymorphisms CAPN316 and CAST282 in calpain and calpastatin genes on the reproductive function of Aberdeen-Angus cows estimated by progeny growth traits. The growth dynamics of calves were assessed based on body weight at birth and the ages of 7, 8, 12, 15, and 18 months. The effect of polymorphic variants CAPN316 and CAST282 on the body weight of calves corresponds to the pattern of CC>GG>CG and CC>CG>GG genotypes of mothers. The effect of the G-allele for SNP CAST282 of the mother's genotype on the birth weight of male calves was +0.4±0.2 kg or +9%. By 12 months of age, the effect of maternal age in calves of different sexes tended to: young cows gave birth to heavier male calves (-23%), while heavier female calves were born to older cows (+27%). A 12-20% increase in newborn and weaning BW was associated with a one-day increase in calving interval. The F_{ST} inbreeding coefficient in the studied sample for the CAPN316 and CAST282 polymorphisms was 11.8% and 7.5%, respectively. There was a negative correlation between the CAPN316 F_{ST} inbreeding coefficient and the body weight of male calves at 12 and 15 months of age: r = -0.70 and r = -0.87. The positive effect of the spring-summer season on the body weight of calves at birth and up to 7 months was demonstrated, with calves born in the summer exhibiting higher average daily weight gains of +10% for males.
Key words: calpain and calpastatin genes, CAPN316, CAST282, SNP, body weight, Aberdeen Angus breed.

INTRODUCTION

Bos taurus, L. has 91% of genes in common with humans [1]. Through the extensive practice of artificial insemination, sperm sexing, superovulation, and embryo transfer in *Bos taurus,* L., this type is the best model of assisted reproductive technologies [2]. Despite the traditionally applied focus of research on *Bos taurus*, L., looking at this type as a model object for some genes and traits expands the possibilities for interpreting the results obtained not only in the direction of their practical application as an agricultural object, but also allows us to extrapolate the results research for humans, as far as in other model objects [3].

The genes of the calpain-calpastatin system, *CAPN1* and *CAST*, in mammals are involved in the regulation of some of the key biological processes: cell differentiation, apoptosis, muscle protein metabolism, etc. The mechanism of action of the enzymes of the calpain-calpastatin system is to modulate the activity of molecules by cleaving off small polypeptide fragments [4]. In particular, in cattle, the effect of the *CAPN1* and *CAST* genes extends to the structure of muscle fibers. The influence of the *CAPN316* and *CAST282* polymorphisms of the calpain and calpastatin genes has been shown both on the growth processes of cattle and the characteristics of reproductive function in cows and bulls [5, 6]. Although the direct effect of these genes on the quantitative and qualitative characteristics of cows' milk for dairy breeds is practically not described in the domestic literature, a few works by foreign authors reflect the indirect effect of calpain on the processes of apoptosis during the formation of mammary glands [7].

The growth and development of calves are influenced by both environmental factors and their genotype, as well as the genotype of the mother, since calves are breastfed during the period of most intensive growth [8]. It is worth noting that while animal studies have shown that maternal resource allocation can be sex-biased to maximize reproductive success, research on this basic concept in humans reveals a relationship between, for example, maternal genotype, offspring sex, and prenatal and postnatal weight gain [9]. Maternal ethnicity had different effects on postnatal weight gain in male (n = 2456) and female (n = 1871) offspring. Parity and feeding mode affected the rate of weight gain in girls but not boys. The authors conclude that maternal resource allocation to subsequent offspring increases after the first male birth, but the findings are not replicated in formula-fed infants, which may have potential implications for tailoring infant formula according to sex and birth order [9].

The effect of the mother's genotype determines the quality composition and quantity of milk; other factors include the breed and sex of the calf, the age of the mother, the calving season, the composition of the animal's diet, and the duration of the intercalving interval before calving [10]. The milking period usually lasts until the calf is 210 days old, and can vary from 90 to 270 days [11].

In meat breeds, selection in favor of the quality characteristics of meat, specifically for certain genotypes of the genes calpain *CAPN1*, calpastatin *CAST*, and thyroglobulin *TG*, is becoming increasingly important. At the same time, the influence of these crucial SNPs on reproductive parameters and other economically significant traits remains poorly studied.

The purpose of this study was to analyse the effect of individual genotypes and allelic variants of the *CAPN316* and *CAST282* polymorphisms of the calpain and calpastatin genes on the reproductive function of Aberdeen Angus cows, as assessed by offspring growth parameters.

METHODS

The object of the study were Aberdeen Angus cows (n = 71) and the calves they gave birth to (n = 618) in the period from 2007 to 2017. The age of the cows at the time of the study was 12-14 years; therefore, during the analysis, data on 8-10 calves were available for each cow, i.e., at least 5 calves of cows born after 2005. The calves were conceived through natural mating and were born primarily during the spring months from March to May. In summer, cows and calves were at free range; in winter, their diet was based on dry feed: hay and silage. The body weight of calves was determined monthly until they reached the age of 210 days and then up to 18 months. The body weight of calves was determined monthly until they reached the age of 210 days and then up to 18 months. The growth dynamics of calves were assessed based on the results of weight at birth, weaning (210 days), average daily weight gain, as well as body weight at the age of 8, 12, 15, and 18 months [7].

The growth dynamics assessment of cows was carried out based on the data of control weighing of newborn animals, animals at 8, 12, 15, and 18 months, at 2, 3, 4, 5 years, and older. The average daily gain of animals has been defined as the difference between the weight at the end of the milk period (at 7 months) and the weight of the newborn animals, divided by the number of days (210). Genealogical information of animals (n = 68) belonging to seven factory lines has been analyzed.

Characteristics such as maternal age at calving, calving interval before pregnancy, and calving season were analyzed. We analyzed the season effect based on the scoring of the seasons:

spring, 4; summer, 3; autumn, 2; winter, 1.

To assess the genetic structure of the studied sample, the frequencies of alleles and genotypes, the correspondence of their distribution to the Hardy-Weinberg law, and the value of the random inbreeding coefficient F_{ST} were analyzed.

Description of the molecular genetic analysis carried out using the PCR-RFLP method has been represented by us earlier [7, 8]. Isolation of DNA from samples of venous blood of cows was carried out using DNA extraction kits "NeoPrep DNA" ("Neogeny", Ukraine). Amplification reactions were performed according to protocols [7, 8], optimized by determining the appropriate thermal and time parameters of amplification cycles. Restriction analysis was carried out using restriction endonucleases RsaI and Btgl ("Fermentas", Lithuania); electrophoretic analysis was performed in 2% agar gel.

Statistical analysis included checking the data distribution for compliance with the law of normal distribution using the Kolmogorov-Smirnov and Shapiro-Wilk methods. For multiple comparisons, one-way analysis of variance was used. Multiple regression analysis was used to assess the dependence of animal growth indicators on genetic and non-genetic factors. Pearson's correlation coefficient r was used to assess correlation. Statistical hypotheses were tested using χ^2 and t tests.

RESULTS AND DISCUSSION

The frequencies of genotypes and alleles for the studied polymorphic variants in the sample of Aberdeen Angus cows were: for *CAPN316*: CC = 13.7%, CG = 53.4%, GG = 33.9%; C = 0.404, and G = 0.596; for *CAST282*: CC = 60.3%, CG = 37.0%, GG = 2.7%; C = 0.788, and G = 0.212. Based on the results of assessing the distribution of genotypes in the sample for each of the SNPs, it was found that the population is in Hardy-Weinberg equilibrium.

According to the data for assessing the body weight of calves at each age, a statistically significant difference between male calves and female calves was established at the level of 3-10% of body weight ($P < 0.01$), therefore, in all subsequent analyzes these groups were considered separately (Tables 1; 2).

The influence of the mother's genotype for SNP *CAPN316* on the body weight of male calves up to the age of 12 months corresponded to the pattern CC>CG>GG, and at the age of 12 to 18 months, to the pattern CG>GG≈CC (Table 1). The influence of the mother's genotype for the *CAST282* polymorphic variant generally does not demonstrate a clear pattern as to the growth dynamics of calves. The effects of the mother's genotype for two SNPs in male calves up to 12 months of age do not exceed 10%, while the C-allele for SNP *CAPN316* and the G-allele for SNP *CAST282* are associated with higher body weight in male calves (Table 3). The effect of the mother's G-allele for SNP *CAST282* on male calves' birth weight was $+0.4 \pm 0.2$ kg or +9% ($P < 0.05$).

The influence of the mother's genotype for the CAPN316 polymorphic variant on the body weight of female calves up to the age of 8 months corresponded to the CC>GG>CG pattern, and at the age of 8 to 18 months, to the GG>CC>CG pattern (Table 2). As for female calves, no clear pattern was found regarding the influence of the mother's genotype on the CAST282 allelic polymorphism on the body weight.

In contradistinction to male calves, higher body weights of female calves were associated with the G allele of SNP *CAPN316* and the C allele of SNP *CAST282* (Table 3).

The effects of the genes of the calpain-calpastatin system are mainly described in relation to muscle tissue of animals, namely the mechanisms of regulation of the strength of muscle fibers, growth rates, and development of individual organ systems [12]. We have previously shown the influence of the CC genotype for SNP *CAPN316* in relation to the growth rate of cows after 2 years of age [7]. As in this study, the effect of SNP *CAST282* on the dynamics of animal growth was weakly expressed, while the body weight of cows

Table 1. Distribution of weight indicators of male calves depending on the mother genotype according to SNPs *CAPN316* and *CAST282*

Parameters	Statistics	Calpain gene, SNP *CAPN316*			Calpastatin gene, SNP *CAST282*		
		CC	*CG*	*GG*	*CC*	*CG*	*GG*
Body weight at birth, kg	n	50	154	104	166	133	9
	$\pm s_x$	29.6±0.4	29.7±0.2	29.7±0.3	29.5±0.2	29.8±0.2	31.0±0.6
	CV (%)	8.7	7.9	8.5	8.5	7.9	6.0
Average daily weight gain, g	n	38	124	82	131	105	8
	$\pm s_x$	779.5±13.3	767.2±8.1	762.1±9.6	765.0±7.2	772.4±9.2	741.6±30.3
	CV (%)	10.5	11.8	11.4	10.8	12.2	11.6
Body weight at weaning (210 days), kg	n	38	126	83	133	106	8
	$\pm s_x$	193.3±3.0	189.4±1.6	188.9±2.0	188.7±1.5	191.7±1.9	183.9±6.4
	CV (%)	9.4	9.5	9.8	8.9	10.3	9.8
Body weight at 8 months, kg	n	22	77	52	74	72	5
	$\pm s_x$	212.0±5.1	212.2±2.5	209.2±2.8	210.3±2.4	211.2±2.6	223.6±12.9
	CV (%)	11.2	10.3	9.8	9.7	10.5	12.9
Body weight at 12 months, kg	n	16	54	32	55	44	3
	$\pm s_x$	262.2±10.6	278.9±5.2	269.0±7.4	273.3±5.1	273.1±6.5	270.3±23.2
	CV (%)	16.1	13.6	15.6	13.9	15.9	14.9
Body weight at 15 months, kg	n	9	31	15	27	27	1
	$\pm s_x$	326.5±16.1	342.8±7.5	334.9±10.3	336.5±7.6	338.1±8.6	372.0
	CV (%)	13.8	12.2	11.8	11.7	13.2	-
Body weight at 18 months, kg	n	7	19	10	19	16	1
	$\pm s_x$	389.6±17.9	397.9±9.8	384.3±13.7	401.8±9.6	379.8±10.8	418.0
	CV (%)	12.2	10.7	11.3	10.4	11.4	-

Note: $\pm s_x$, mean value ± standard error of the mean; CV (%), coefficient of variation.

decreased in the direction CG>CC>GG. Thus, the calpain gene can be considered as a candidate gene for the gene network regulating lactation processes.

According to the literature data, during lactation, activation of calpains is observed in mammary gland tissues. Their role is to cleave peripheral membrane proteins, and proteins of lysosomes, mitochondria and the nucleus. In particular, calpain-1 and calpain-2 cleave cytoplasmic nucleoporins in the epithelium of the lobular-alveolar system. The presence of calpain-1 in the nucleus of non-epithelial mammary cells was associated with adipocyte re-differentiation. In the nucleus, calpain-1 cleaves off the N-terminal residues of histone H3, thereby carrying out epigenetic regulation of cell differentiation processes. In addition, the calpain-1 gene shares common sequences with the promoter of the leptin gene (*LEP*), which directly affects lactation processes [13]. It was established that polymorphism of the leptin gene is associated with the productivity of different farm animal species [5].

In addition, Cushman et al. [14] showed an association of individual genotypes for two polymorphisms *CAPN316* and *CAPN4751*, of the calpain gene in cows with the body weight of their newborn calves. The *GT* haplotype, which was associated with increased muscle fiber strength, was also associated with decreased body weight in calves. Despite the differences between the

Table 2. Distribution of weight indicators of female calves depending on the mother genotype according to SNPs *CAPN316* and *CAST282*

Parameters	Statistics	Calpain gene, SNP *CAPN316*			Calpastatin gene, SNP *CAST282*		
		CC	*CG*	*GG*	*CC*	*CG*	*GG*
Body weight at birth, kg	n	31	148	101	174	98	8
	$\pm s_x$	28.5±0.4	27.7±0.2	28.3±0.3	27.9±0.2	28.2±0.3	27.6±1.0
	CV (%)	8.7	8.8	11.6	10.4	8.9	10.2
Average daily weight gain, g	n	28	124	82	144	83	7
	$\pm s_x$	734.6±17.6	715.5±6.6	732.0±8.5	725.9±6.3	719.7±8.9	720.4±24.2
	CV (%)	12.8	10.2	10.5	10.4	11.3	8.9
Body weight at weaning (210 days), kg	n	28	124	83	145	83	7
	$\pm s_x$	183.4±3.7	178.9±1.3	182.5±1.7	181.0±1.2	180.2±1.9	182.0±4.4
	CV (%)	10.7	8.3	8.5	8.3	9.6	6.4
Body weight at 8 months, kg	n	21	91	69	115	60	6
	$\pm s_x$	202.9±5.1	199.5±1.8	203.0±2.1	202.6±1.7	199.0±2.4	198.5±8.9
	CV (%)	11.5	8.8	8.8	8.9	9.4	10.9
Body weight at 12 months, kg	n	14	72	51	88	44	5
	$\pm s_x$	256.8±10.3	259.9±3.9	265.1±4.7	265.0±3.6	253.8±4.7	269.6±21.0
	CV (%)	15.0	12.8	12.5	12.8	12.3	17.4
Body weight at 15 months, kg	n	12	51	38	63	33	5
	$\pm s_x$	302.2±12.1	300.8±4.4	309.8±5.9	306.4±4.0	299.2±6.5	312.0±26.5
	CV (%)	13.8	10.5	11.8	10.3	12.4	19.0
Body weight at 18 months, kg	n	11	41	33	51	30	4
	$\pm s_x$	344.9±10.1	340.5±4.6	352.1±5.4	348.6±4.3	341.3±5.8	339.0±11.7
	CV (%)	9.7	8.7	8.8	8.8	9.3	6.9

Note: $\pm s_x$, mean value ± standard error of the mean; CV (%), coefficient of variation.

processes regulating calf birth weight and calf weight gain during the milking period, birth weight is a predictor of adult body weight [15].

The influence of the age characteristics of the cow, her previous pregnancies, the overlap of the periods of lactation and pregnancy, and other factors, along with the genotype, affects the health of animals and the reproductive function of cows. The majority of the cows had genotypes for the calpain and calpastatin genes, which determine the external and growth parameters, preferred for selection at puberty and reproduction, CC and CG genotypes for the *CAPN1* and *CAST* genes.

According to our results, the influence of the mother's age had a high effect on the growth performance of calves. Up to 12 months, the effect of maternal age in calves of different sexes had a different direction: young cows gave birth to heavier male calves (-23%), while heavier female calves were born to older cows (+27%) ($P < 0.01$). According to the literature data, placental growth and fetal nutrient supply are under the influence of many factors, which in turn affect the size, shape, and body composition in calves. Postnatal growth rate, organ structure, and immunity may be altered [16]. The development of the placenta and fetus is sensitive to the direct and indirect influence of the maternal organism, therefore, the development of the fetoplacental unit can vary from early to late pregnancies [17]. Cow age is associated with features of the

Table 3. Effect of SNPs *CAPN316* and *CAST282* and other factors on the growth dynamics of calves ($X \pm s_x$)

Parameter	Genetic factors		Other factors		
	Calpain gene, SNP *CAPN316* Allele C	Calpastatin gene, SNP *CAST282* Allele C	Season	Mother's age	Intercalation interval
Body weight at birth, kg					
Male	-0.11±0.08 (0%)	-0.4±0.2* (-9%)	0.14±0.17 (5%)	-0.01±0.00** (-23%)	-0.01±0.00 (-7%)
Female	-0.11±0.07 (-2%)	-0.21±0.17 (-4%)	-10.5±5.6* (12%)	-0.01±0.00** (27%)	0.01±0.00* (12%)
Average daily weight gain, g					
Male	8.0±4.0 (6%)	-1.3±0.8 (-1%)	10.5±6.4 (10%)	-0.01±0.00* (-15%)	-0.02±0.05 (-4%)
Female	-3.9±4.0 (-3%)	5.1±4.6 (4%)	-10.5±5.6 (-12%)	-0.01±0.01 (8%)	0.15±0.05** (21%)
Body weight at weaning (210 days), kg					
Male	1.8±1.0 (7%)	-1.3±1.2 (-4%)	2.7±1.3* (13%)	-0.01±0.00** (-17%)	-0.01±0.00 (-4%)
Female	-0.7±1.0 (-3%)	0.4±0.6 (1%)	-2.09±1.14* (-12%)	-0.01±0.00 (9%)	0.03±0.01** (21%)
Body weight at 8 months, kg					
Male	1.8±1.5 (6%)	-2.7±2.2 (-7%)	2.31±2.20 (8%)	-0.01±0.01 (12%)	-0.02±0.021 (-11%)
Female	-1.1±0.9 (-4%)	3.0±2.2 (9%)	-2.42±1.64 (-11%)	0.00±0.00 (0%)	0.03±0.01* (20%)
Body weight at 12 months, kg					
Male	-0.9±1.1 (-2%)	0.6±0.9 (1%)	-4.9±5.8 (-8%)	-0.02±0.00** (-43%)	-0.05±0.05 (-10%)
Female	-4.5±3.9 (-9%)	6.1±5.0 (10%)	-8.63±3.46* (-21%)	-0.01±0.00 (-15%)	0.09±0.03** (28%)
Body weight at 15 months, kg					
Male	-2.5±3.2 (-4%)	-4.6±3.8 (-6%)	-0.88±7.22 (-2%)	-0.01±0.00 (-36%)	-0.07±0.05 (-17%)
Female	-5.3±4.7 (-10%)	2.6±3.0 (5%)	-8.92±4.83* (-18%)	-0.01±0.00 (-13%)	0.08±0.04* (22%)
Body weight at 18 months, kg					
Male	3.6±2.8 (6%)	13.8±11.8 (18%)	8.33±9.01 (16%)	-0.01±0.01 (-21%)	-0.11±0.09 (-22%)
Female	-5.8±4.7 (-13%)	6.2±4.8 (12%)	-10.61±5.15* (22%)	-0.01±0.01 (-10%)	0.04±0.04 (12%)

*P < 0.05; **P < 0.01.

endocrine status and fetoplacental system, while ageing levels of androgens in the blood become lower, which may affect the characteristics of calf body weight that depends on sex.

In Charolais cows in the Czech Republic [18], the body weight of calves at birth increased until the fourth calving, and then decreased, and the effect of calving number on average daily weight gain was statistically insignificant. Our results are confirmed by the fact that in younger cows, the likelihood of developing a more massive placenta with a higher density of cotyledons is higher, taking into account the positive correlation shown in cows between the body weight of calves at birth and the weight of the placenta, including cotyledons [19].

The effect of maternal calving interval on the body weight of newborn calves was observed predominantly in female calves, with a 12-20% increase in newborn calf and weaning weight being associated with an increase in calving interval by one day ($P < 0.01$). Our results are comparable to those of MacGregor & Casey [20] for African cattle, who indicated that increasing the calving interval by 1 day was associated with an increase in body weight at weaning of male and female calves of 0.29 ± 0.01 kg and 0.54 ± 0.01 kg, respectively. On the other hand, even the body weight at weaning of the previous calf influenced the calving interval [21]. Therefore, the body weight of the calf at the first calving may be maximum or close to maximum due to the absence of consequences of previous pregnancy and lactation.

Along with the classical assessment of the level of inbreeding based on the analysis of animal pedigrees, we apply the method of assessing the level of inbreeding based on polymorphisms, which is mainly used in population genetics to study animal populations for which there is no possibility of long-term monitoring over generations [22]. The F_{ST} inbreeding coefficient in the studied sample for the polymorphisms *CAPN316* and *CAST282* was 11.8% and 7.5%, respectively. There was a negative correlation between the level of maternal *CAPN316* inbreeding and the body weight of male calves at 12 and 15 months of age: $r = -0.70$ ($P = 0.071$) and $r = -0.87$ ($P = 0.013$).

According to the literature data, in an Aberdeen Angus herd isolated for 70 years, the negative effect of increasing rates of individual inbreeding (6.8-6.6%) and maternal inbreeding (12.0-12.1%) was demonstrated on calf birth weight, calf weaning weight, 205-day age, and calf average daily weight gain [23]. Also, inbreeding depression is observed during climatic adaptation of beef cattle breeds in tropical regions with shorter, sparse, and lighter hair [24].

Analysis of the effect of the season on the quantitative traits of calves from mothers with all analyzed genotypes showed that, since summer includes better feeding conditions for pregnant cows, the body weight of calves born in the fall was the highest, 31.0 ± 0.4 kg for male calves and 29.5 ± 0.6 kg for female calves, respectively. Calves born in the summer had a higher average daily weight gain of +10% for male calves and -12% for female calves ($P < 0.1$ and $P < 0.05$ for bulls and heifers), due to a better diet containing green feed. Therefore, the male calves born in summer have almost 10% higher growth rates, at least for 7 months. Meanwhile better growth rates of female calves are observed for those born in spring than in summer, thus the influence of the summer season factor is negative compared to the spring season, and is equal to -12%. The season influence on the body weight of calves persists at a later age, and it is more pronounced in female calves than in male calves. In addition, the effects of calving season on cow milk yield are well known. [25]. Thus, to avoid complications after calving large calves, depending on the expected calving season, it is advisable to recommend the use of sires with genotypes that determine small fetuses.

An analysis of literary sources showed that the influence of the season depends on the breed of animals and the climatic and geographical conditions of the region, and therefore, the results of different authors are ambiguous. According to British authors [26], animals that experienced higher daily maximum and minimum temperatures had slower carcass and calf growth rates. The frequency of heatwaves, dry and wet days has significant negative effects on such traits as carcass weight, carcass growth rate, conformation, and fat score. The researchers conclude that these effects may be caused by several factors, including direct effects on the animal, as well as feed availability and management decisions [26]. At the same time, there is potential to mitigate negative effects through a range of animal management strategies. African Sheko cattle in southwestern Ethiopia exhibit significant seasonal variations in birth weight of 1-2 kg ($P < 0.01$) due to both diet composition and seasonal diseases. According to Bayou, et al. [27], the weight of calves born in the dry season in Bangladesh was statistically significantly higher than that of those born in the rainy season, while excess plant feed due to the coincidence of the short and main rainy seasons leads to high milk productivity of cows and an increase in the significance of the season effect. Calves born during the short rainy season had higher daily weight gain before weaning than the other two seasons, which could be due to favorable nutritional conditions for cows during this and recent periods, even with higher milk yields [27]. In Bangladesh, Rahman, et al. [28] described the body weight of calves born in winter as being higher due to the abundance of green forage during this season, which has a beneficial effect on the composition of the cow's diet. The seasonal factor also affects the development of the placenta: placentas during pregnancy in winter and spring have a lower density of cotyledons than in summer and autumn [19].

CONCLUSION

The effect of polymorphic variants *CAPN316* and *CAST282* on the body weight of calves corresponds to the pattern of CC>GG>CG and CC>CG>GG genotypes of mothers. The effect of the G-allele for SNP *CAST282* of the mother's genotype on the birth weight of male calves was +0.4 ± 0.2 kg or +9%. A negative correlation was established between the F_{ST} inbreeding coefficient according to *CAPN316* and the body weight of male calves at the ages of 12 and 15 months: $r = -0.70$ and $r = -0.87$. Up to 12 months, the effect of maternal age in calves of different sexes was in different directions: younger cows gave birth to larger male calves (-23%), while heavier female calves were born to older cows (27%). A 12-20% increase in newborn calf and weaning weight was associated with a one-day increase in maternal calving interval. The effect of the season on the body weight of the calf is shown, with calves born in the summer showing higher rates of average daily weight gain of +10% for male calves and -12% for female calves.

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Н.Г. Пузік[1], В.О. Бабалян[2], В.Р. Дорофєєва[3], Л.В. Мітіогло[4], О.М. Федота[5]

ВПЛИВ ПОЛІМОРФІЗМУ ГЕНІВ *CAPN1* І *CAST* НА ОСОБЛИВОСТІ РОСТУ ТА РЕПРОДУКЦІЇ *BOS TAURUS,* L. ЯК МОДЕЛЬНОГО ОБ'ЄКТА

[1]*Харківський національний медичний університет;*
[2]*КНП «Міська клінічна багатопрофільна лікарня № 17» Харківської міської ради;*
[3]*КПНЗ Харківської обласної ради «Обласний клінічний перинатальний центр»;*

[4]*ДП «ДГ «Нива» ІРГТ імені М.В. Зубця НААН», с. Христинівка, Черкаська обл.;*
[5]*ТОВ «AMS», Харків; e-mail: n.g.puzik@gmail.com*

Метою роботи був аналіз впливу окремих генотипів та алелів за поліморфними варіантами *CAPN316* та *CAST282* генів кальпаїну та кальпастатину на репродуктивну функцію корів абердин-ангуської породи за ознаками росту нащадків. Динаміку росту телят оцінювали за масою при народженні, у віці 7, 8, 12, 15 і 18 міс. Вплив поліморфних варіантів *CAPN316* і *CAST282* на масу тіла телят відповідав характеру генотипів CC>GG>CG і CC>CG>GG матерів. Вплив G-алелі для SNP *CAST282* генотипу матері на масу тіла при народженні телят самців становив +0,4±0,2 кг або +9%. До 12 міс вплив віку матері у різностатевих телят мав тенденцію: молоді корови народжували важчих телят-самців (–23%), а важчі самиці народжувалися від старших корів (+27%). Збільшення маси тіла новонароджених і відлучених на 12–20% асоціювалося зі збільшенням інтервалу отелення на один день. Коефіцієнт інбридингу F_{ST} у досліджуваній вибірці для поліморфних варіантів *CAPN316* і *CAST282* становив 11,8 і 7,5%. Встановлено негативний кореляційний зв'язок між коефіцієнтом інбридингу F_{ST} за SNP *CAPN316* і масою тіла телят-самців у віці 12 і 15 міс: r = –0,70 та r = –0,87. Показано позитивний вплив весняно-літнього сезону на масу тіла теляти при народженні і до 210 днів, причому у телят, народжених влітку, спостерігаються вищі показники середньодобового приросту маси +10% для самців.

Ключові слова: гени кальпаїну та кальпастатину; *CAPN316*; *CAST282*; SNP; маса тіла; абердин-ангуська порода.

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