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Influence of *MUC4* /XbaI Gene Polymorphism on the Reproductive Traits of Pigs

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Abstract: The aim of this paper was to determine the effect of *MUC4* (DQ848681: g.8227C> G) gene polymorphism on reproductive traits of Landrace pigs (Danish selection). Molecular genetic analysis was performed by PCR-RFPL method (polymerase chain reaction–restriction fragment-length polymorphism). The studies on sows have found out two genotypes - CG and GG with a frequency of 27.4 and 74.5%, respectively. The sows of CG genotype were significantly superior to analogs of GG genotype by total number of born (TNB) of 0.6, the number born alive (NBA) by 0.8 piglets and litter weight at birth (LWB) by 1.1 kg.

Key words: Pigs · Gene · *MUC4* · Reproductive Traits

INTRODUCTION

Currently the genetic markers based on genes (candidate genes), with their protein product of playing a significant role in the formation or regulation of biochemical and physiological processes are becoming increasingly popular [1-3]. Herewith the gene itself must possess a variety of allelic variants (polymorphisms) associated with productivity level [4-7]. One of the most promising candidate genes regarded as a marker of pigs' reproductive efficiency is the MUC4 (Mutsin4) gene. *MUC4* gene is located in the13th swine chromosome (SSC13q41) within the confidence QTL interval, associated with the number of piglets at birth and fertility [8].

Mucins (MUC) are high- molecular glycoproteins and play an important role in protecting the surface epithelium, cell proliferation and differentiation. Normal development of the endometrium is one of the main factors for the successful implantation of the blastocysts and animals' pregnancy [9, 10]. Various changes of endometrium, defective secretory transformation may result in implantation disrupt and abortion at the early gestation period. The role of MUC4 was observed with rodents and pigs during pregnancy, with its expressions varying due to the species. The mice and rats' expression of MUC4 gene on surface epithelium is markedly reduced during diestrus and becomes imperceptible before the adhesion of the blastocyst and conversely, pigs show activated *MUC4* in the uterus [11]. Disturbance of uterine microenvironment may affect the viability of the embryo and result in perinatal mortality from 20 to 46% [12, 13]. Considering the *MUC4* localization in the endometrial epithelium and its blocking access to the surface of various substrates cells, Balcells *et al.* [14] have proposed that *MUC4* plays an important role in the establishment of an optimal environment for embryo survival during pregnancy and so resulting in increasing the pigs prolificacy.

The aim of this work was to determine the relationship of gene polymorphism specified by the point mutation (SNP) in intron 7 (DQ848681: g.8227C> G) with reproductive traits of Landrace pigs (Danish selection).

MATERIALS AND METHODS

Research was conducted on sows of Danish Landrace breed (LD) in Plemzavod «Jubileyny" Tyumen region, Russia. For DNA genotyping tissue samples of 1 sq. sm. were taken from pigs (ear pinching). Molecular -genetic analyzes was performed by PCR-RFLP method (polymerase chain reaction–restriction fragment-length polymorphism). PCR-RFLP analysis of the MUC4 gene

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fragment of 266 bp in length was performed by using XbaI endonuclease. Restriction fragments were separated in 3% agarose gel. Electrophoregram visualization was performed on the transilluminator in UV light. According to the results of molecular - genetic analysis the presence and frequency of alleles and genotypes were determined. The relationship between MUC4 gene genotype and reproductive qualities was determined by the total number of born (TNB), number born alive (NBA) and litter weight at birth (LWB) for LD sows (n = 184). All sows were kept under similar conditions and had at least three farrowings. For analyses the data of the first three farrowing were taken. Statistical data processing was performed according to standard procedures using the MS Excel and STATISTICA 6.0.

RESULTS AND DISCUSSION

The studies of LD sows showed that CC genotype was not found and the frequency of CG and GG genotypes corresponded to 27.4 and 74.5%. The G allele frequency was 0.86, C allele C - 0.14.

The analysis of reproductive characteristics (Table 1) showed that sows of CG genotype were significantly superior to analogs of GG genotype by the total number of born by 0.6 piglets, the number born alive by 0.8 piglets and litter weight at birth by 1.1 kg.

MUC4 gene polymorphism in intron 7 (DQ848681: g.8227C> G) was first noted at studying the resistance to pathogenic E.coli K88, causing piglets' post-weaning diarrhea [15, 16]. Research of Peng *et al.* did not confirm the unique relation of *MUC4* gene polymorphism with resistance to E.coli K88 and, accordingly, so this polymorphism was decided to be unable to serve as the sole factor for mass selection in order to increase the resistance of piglets to diarrhea [17-19].

Further study of correlation of *MUC4* gene and productive qualities of pigs showed that this polymorphism may be considered as a marker of pigs' fertility. The results obtained in this study indicate the presence of significant association of CG genotype of *MUC4* gene with fertility of Landrace sows (Danish). In previous studies [8] of Landrace pigs (Canadian selection) CC genotype was determined in reproductive traits as a desirable one the presence of which is associated with the increase in sows' multiple births by 1.25 piglets. Similar results were obtained by Balcells *et al.* [14], who revealed the correlation of CC genotype and increased fertility of interbreed hybrids (Iberian x Meyshan).

Table 1: Reproductive traits of sows of different genotypes by *MUC4* gene

	Genotypes	
Indicators	CG	GG
Total number of born	13.8±0,18?	13.2±0,17
Number born alive	12.9±0,27?	12.1±0,19
Litter weight at birth	17.8±0,31?	16.7±0,23

* The difference between CG and GG genotypes is reliable at $p \leq 0,01$

On the basis of these results there arises a problem to find a reason of such a low frequency of C allele in the investigated population and absence of homozygous CC genotype. Perhaps, this genotype in addition to enhancing effect on the sow farrow increase is associated with the development of piglets post-weaning diarrhea which leads to decrease - the frequency of C allele in the population. This issue requires further research to identify genotypes of marker genes and their assignment to the population will enhance the reproductive traits of sows and to have healthy piglets with high fattening and meat qualities.

CONCLUSION

The studies have revealed a significant impact of *MUC4* gene genotypes on reproductive qualities of Landrace sows (Danish origin). Sows of CG genotype were significantly superior to GG genotype analogs in the number of piglets at birth by 0.6 heads., the number of live pigs at birth by 0.8 heads and litter birth weight - by 1.1 kg.

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