Effect of three polymorphisms in the estrogen receptor gene on litter size in Slovak Landrace pigs

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Abstract
The identification of genes or genetic markers associated with reproductive traits in pigs could have a great economic impact on pork production. We investigated the effect of Pvu II, Ava I and MspA1 I polymorphisms in the estrogen receptor gene on total number of born (TNB), number of born alive (NBA) and number of weaned (NW) piglets. We analyzed 162 pigs (535 litters) of Landrace breed from two Slovak breeding farms. The genetic polymorphisms were detected by PCR-RFLP method. Associations between the polymorphisms and reproductive traits were evaluated by linear model which included fixed and random effects. The frequencies of B (Pvu II), D (Ava I) and F (MspA1 I) alleles were 0.08, 0.12 and 0.07, respectively. We found out significant additive effects of B allele (Pvu II) of +0.62±0.18 (TNB, $P \leq 0.01$), +0.65±0.18 (NBA, $P \leq 0.01$) and +0.51±0.16 (NW, $P \leq 0.05$) piglets/litter. Significant differences ($P \leq 0.05$) between CD and CC genotypes (Ava I) were also identified in TNB (+0.41±0.16) and NBA (+0.37±0.16). MspA1 I polymorphism showed the smallest effect on the traits. A positive association of F allele with TNB, NBA and NW was found but the differences were not confirmed statistically.

Introduction

Estrogens play an important role in follicular formation and oocyte maturation, in embryonic and fetal development. They also influence female secondary sexual traits, reproductive cycle and fertility. The estrogen action in target cells is mediated by estrogen receptor (ESR). In porcine ESR gene, three polymorphic loci have been described and the occurrence of two codominant alleles has been identified in each of them. Rothschild et al. (1996) identified Pvu II polymorphism in non-coding part of the gene. Drőgeműller et al. (1997) reported Ava I and MspA1 I polymorphisms in translated part of the gene.
We investigated the effect of Pvu II, Ava I and MspA1 I polymorphisms in the estrogen receptor gene on total number of born (TNB), number of born alive (NBA) and number of weaned (NW) piglets in Slovak population of Landrace pigs.

Material and method

We analyzed 162 pigs (535 litters) of Landrace breed from four Slovak breeding farms. The genetic polymorphisms were detected by PCR-RFLP method according to Short et al. (1997) and Drőgeműller et al. (1997) with modifications. Associations between the polymorphisms and reproductive traits were evaluated by linear model which included effects of genotype of sow and genotype of mated boar, parity effect, random herd-year-season effect, random effect of animal, linear and quadratic regression on age at farrowing and random error. Linear model used in the study was close to the statistical model used in routine genetic evaluation of litter size traits in pigs in Slovakia. Additional effects of genotype were included in the model.

Results

The frequencies of B (Pvu II), D (Ava I) and F (MspA1 I) alleles were 0.08, 0.12 and 0.07, respectively. Analysis of Pvu II polymorphism showed higher values of TNB, NBA and NW in AB genotype (Tab. 1). We found out significant additive effects of B allele (Pvu II) of

+0.62±0.18 (TNB, P≤0.01), +0.65±0.18 (NBA, P≤0.01) and +0.51±0.16 (NW, P≤0.05) piglets/litter. Investigation of Ava I polymorphism revealed higher values of TNB, NBA and NW in heterozygous genotype (CD). Significant differences (P≤0.05) between CD and CC genotypes (Ava I) were identified in TNB (+0.41±0.16) and NBA (+0.37±0.16). With MspA1 I polymorphism, higher TNB, NBA and NW were found in EF (L) genotype. However the polymorphism showed the smallest effect on the traits in comparison with the other polymorphisms. A positive association of F allele with TNB, NBA and NW was found but the differences were not confirmed statistically.

Tab. 1 Variability of reproductive traits according to Pvu II, Ava I and MspA1 I polymorphisms in the ESR gene.

ESR genotypes/ differences	**Litters**	**TNB (LSM±S_E)**	**P**	**NBA (LSM±S_E)**	**P**	**NW (LSM±S_E)**	**P**
AA	447	10,82±0,58		10,37±0,56		9,45±0,51	
AB	88	11,43±0,59		11,02±0,57		9,96±0,52	
AB-AA		+0,62±0,18**	<0,01	+0,65±0,18**	<0,01	+0,51±0,16*	<0,05
CC	408	10,78±0,58		10,33±0,57		9,36±0,52	
CD	127	11,20±0,61		10,70±0,60		9,44±0,55	
CD-CC		+0,41±0,16*	0,01	+0,37±0,16*	0,02	+0,08±0,14	0,57
EE	461	10,71±0,59		10,25±0,58		9,33±0,53	
EF	74	11,00±0,61		10,57±0,60		9,40±0,54	
EF-EE		+0,30±0,20	0,14	+0,32±0,20	0,11	+0,07±0,18	0,68

TNB - total number of born; NBA - number of born alive; NW - number of weaned piglets; LSM±S_E – least square means ± standard error; P – P value; * P≤0.05, ** P≤0.01

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