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Bi-polar imprinting of *IGF2* affects litter size in Meishan-F2 crossbred sows

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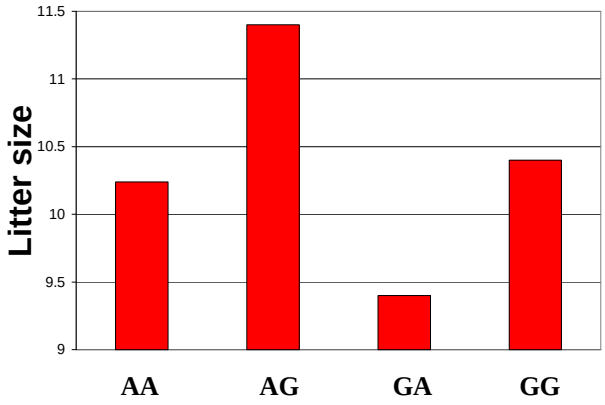
Introduction

- In mice the *IGF2* chromosomal region affects litter size[1]
- Parent-of-origin-specific effects on female reproductive success were also shown in an F2 of inbred mice[2]
- In pigs a regulatory mutation in the *IGF2* gene affects muscle growth[3]. The *IGF2* mutation might also have an effect on litter size in pigs

Objective

The aim was to study the effect of the *IGF2*-mutation on litter size in pigs and to elucidate the mode of inheritance

Results



- *IGF2* genotype significantly affected litter size ($p < 0.05$)
- The genotype effect of the AA was similar to GG (-0.16 and 0.00) while the effect of AG was +1.00 and GA was -1.00
- Of the redefined contrasts only the imprinting contrast was highly significant ($p < 0.001$)
- Estimates: a = -0.08 (± .43); d = 0.08 (± .48); i = 1.00 (± .31)
- Effects of *IGF2* on litter size suggests a mode of inheritance known as bi-polar imprinting[6]: AA = GG and AG = -GA

Conclusion

- *IGF2*, or genes in strong LD, affected litter size in pigs
- Genotype contrast indicate a bi-polar imprinting pattern

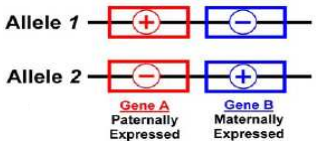
Material and Methods

- Pop. of 256 F2-sows originated from 38 F1-sires and 210 F1-sows
- 1st and 2nd parity litter size records (total number born) from F2-sows were used
- *IGF2*-mutation (A/G) was genotyped via sequencing[3]
- Additional markers genotyped to determine phase of *IGF2*
  13 SNPs surrounding *IGF2* and 3 SSRs (Sw2443, SwC9, Sw256)
- Cluster Variation Method[4] was used to construct haplotypes
- Genotype contrasts were redefined[5,6]

$$\begin{pmatrix} AA \\ AG \\ GA \\ GG \end{pmatrix} = \begin{pmatrix} 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & -1 \\ 1 & -1 & 0 & 0 \end{pmatrix} \begin{pmatrix} \mu \\ a \\ d \\ i \end{pmatrix} \quad \begin{matrix} \text{mean} \\ \text{additive} \\ \text{dominance} \\ \text{imprinting} \end{matrix}$$

- Separately genotypes and contrasts were fitted using a linear model adjusting the data for fixed effects, a random polygenic effect and a random maternal effect

Bi-Polar Imprinting (a hypothetical model[6])



1 1 1 2 2 1 2 2
+,- +,+ -,- -,+

Genotype (Pat,Mat)

- Bi-polar imprinting can be explained by assuming a paternally and a maternally expressed gene in strong LD
- Gene A is paternally and gene B is maternally expressed
- Allele 1 has a positive effect when paternally and negative if maternally inherited. Allele 2 showed the opposite effect
- In homozygotes the effects cancel out, but in heterozygotes they augment each other positively (*1,2*) or negatively (*2,1*)

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