



IGF2 gene tests in purebred pigs tested at the Deschambault test station



Update for CDPQ Genetics Committee
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The IGF2 gene

Insulin Like Growth Factor 2 (IGF2) gene is known for its large effects on muscle growth. It has been tested several studies in different countries such as Sweden, Belgium, The Netherlands, France and the US for its effects on carcass and meat quality traits. In general, the results have shown very large effects of the mutant allele (A) compared to the wild type (G). In fact, the gene is a result of a substitution of a single nucleotide. The progeny of a homozygous boar carrying two copies of the mutant allele (AA) had higher lean yield compared to a group of pigs from random sires.

The gene was discovered by a group of researchers in Europe and has been patented by Gentec Inv. of Belgium. The testing services for this gene have been made available to Canadian breeders and producers by CCSI through intense negotiations. These services will remain available provided sufficient numbers of pigs are tested.

The gene tests in Canada have been done on AI sires, and pigs tested in Western Canada as a part of the project for genetic evaluation for meat quality traits for breeders participating on the national program through WSTA. It appears that the mutant allele or the lean allele (A) has a high frequency in Canadian populations. It is likely that a gene with such a large effect has been selected due to increased emphasis on leanness. It is a good sign of the leanness in Canadian purebred pigs. This also means that there are very few pigs carrying the wild type or the fat allele (G). The fat allele can be especially useful in maintaining a minimum level of backfat in dam lines and market hogs. There is a risk of losing this allele further.

This brief report is a summary of the results from purebred pigs tested at the Deschambault test station as a part of the research project supported by CDPQ, CCSI, breeders participating on the program and the ACAAF program of Agriculture and Agri-Food Canada. As a part of this project a number of traits for growth, feed intake, carcass quality and meat quality were recorded.

Frequency of the IGF2 genotypes

The number of pigs tested for the three breeds and those carrying the three genotypes of IGF2 are given in the following tables.

Table 1: Frequency of the IGF2 genotypes in different breeds of purebred pigs tested at the Deschmbault test station

<i>Breed</i>	<i>IGF2_Genotype</i>			<i>Total</i>
	AA	AG	GG	
<i>Duroc</i>	62	0	0	62
	100.00	0.00	0.00	
<i>Landrace</i>	28	24	9	61
	45.90	39.34	14.75	
<i>Yorkshire</i>	101	18	3	122
	82.79	14.75	2.46	
Total	191	42	12	245
	77.96	17.4	4.90	

The above tables suggest a high frequency of the lean genotype (AA) and lower frequency of the (GG) genotype in all three breeds. Among the pigs tested there were no Duroc pigs carrying either the AG or GG genotype. It is possible that there are no purebred Duroc pigs carrying the G allele. However, it is also possible that there are some Duroc pigs carrying the G allele but they have not been detected so far. It has been suggested that a similar situation was observed with respect to Pietrain pigs in Europe. At the first stage of the testing, there were no pigs carrying and the G allele in Pietrain but later on a group was found. The above genotypic frequencies are similar to those found in the purebred pigs tested in Western Canada.

The frequency distribution was very similar among the three sexes as given in Table 2. The genotypic frequencies among the three sexes were also very similar when compared within each of the breeds.

Table 2: Frequency of the IGF2 genotypes in different sexes of purebred pigs tested at the Deschmbault test station

<i>Breed</i>	<i>IGF2_Genotype</i>			<i>Total</i>
	AA	AG	GG	
Castrates	57	12	4	73
	78.08	16.44	5.48	
Female	70	17	4	91
	76.92	18.68	4.40	
Male	64	13	4	81
	79.01	16.05	4.94	
Total	191	42	12	245

The distribution of genotypic frequencies within sexes is almost as expected, as the gene is not expected to be linked to any sex.

Preliminary estimates of the genotypic effects

The initial results of the differences among the three genotypes with respect to the traits of carcass and meat quality are given in the following table. The table contains least-squares means for the three genotypes using a statistical model including the fixed effects of the IGF2 genotypes, breeds, sexes and their interactions.

Table 3. Carcass quality and meat quality with respect to the IGF2 genotypes

	<i>AA</i>	<i>AG</i>	<i>GG</i>
<i>Probe fat (mm)</i>	14.52	16.32	19.13
<i>Probe lean (mm)</i>	61.66	61.04	57.85
<i>Carcass fat (mm)</i>	16.70	18.87	20.28
<i>Feed conversion ratio</i>	2.42	2.49	2.63
<i>Carcass yield (%)</i>	77.43	77.14	76.88
<i>Lean yield (%)</i>	61.54	60.42	59.68
<i>Loin eye area (sq cm)</i>	45.76	43.71	38.47
<i>Minolta a* loin</i>	6.38	6.14	5.44
<i>Minolta b* loin</i>	9.36	9.45	7.51
<i>Minolta l* loin</i>	53.38	54.48	48.03
<i>pH loin</i>	5.58	5.60	5.73
<i>NPPC marbling</i>	1.99	1.92	2.07
<i>Minolta a* ham</i>	8.75	9.29	8.64
<i>Minolta b* ham</i>	8.24	9.05	7.43
<i>Minolta l* ham</i>	51.41	53.28	49.49
<i>pH ham</i>	5.61	5.61	5.67

The main comparisons in the above table should be made with respect to the genotypes AA and GG. In case of the heterozygous genotypes AG, the effect of the A allele depends upon its origin due to imprinting. If the A allele is from the father, its effect is expressed but if it is from the mother it is not expressed. The same is true for the G allele. More data analysis will be done to evaluate the effect with respect to the gene of origin.

The number of pigs with the GG genotype is very small. The statistical model accounts for the effects such as breed but the results are still based on small number of observations with GG genotype. There were more observations with respect the G allele among the pigs evaluated in Western Canada and other studies in Europe and USA. The pigs with the genotype AA had lower backfat, higher lean yield and larger loin eye area. There is very little effect on the meat quality traits, except that the meat from the pigs with the genotype AA is slightly paler in colour. These results are similar to those observed in other studies in Europe and USA, except for the meat colour.

Testing for IGF2 gene

Breeders participating on the program and those from outside have tested over 250 pigs in addition to those used in research trials supported by contributions of CCSI and Federal Government. They have received the IGF2 test results on every pig tested. However, the number of pigs tested by breeders is still very low and especially from some of the regions. The licensing agreement with Gentec is being reviewed in light of these developments. The agreement may be modified or terminated if it does not meet the expected targets for the patent holders.

Concluding remarks

The results presented above are based on a small number of pigs compared to the Canadian population of market hogs (over 30 million) or even the purebred pigs tested on the program (over 90 thousand). Therefore, the frequencies reported here from only one trial at the test station should not be generalized beyond their scope. The genotypic effects are based on only 12 pigs with the GG genotype. Therefore, an over interpretation of the results should be avoided. Nevertheless, the results are generally consistent with other studies. The effect on lean content in Canadian breeds appears to be very large and important for both domestic and export markets. Both the lean (A) and fat (G) alleles exist in moderate frequencies in Canadian Yorkshire and Landrace breeds. This gives a good opportunity, to make use of the gene to control fat levels in commercial sows. Close attention should be given to this gene if Yorkshire or Landrace are included in the terminal cross. For Durocs, more testing is required to know whether or not the fat allele (G) exists in Canadian Durocs.