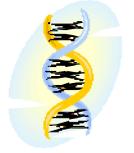




Briefing Notes



“Development of new evaluation and selection methods for swine using advancements in molecular genetics”

A project supported by CARD program of AAFC

1. Project objectives

The project aims to contribute to the genetic and economic improvement for the pork industry by use of recent advancements of science and innovation. This includes evaluating the current advancements in molecular genetics and the economic benefits from their application to the swine industry, and developing a new strategy and methods for integrating molecular genetic advance into Canadian swine breeding programs, as well as providing specific recommendations for choosing DNA tests and marker genotyping.

2. Current status of the project

The project is at the end of task 2 of the four-task work plan:

- ✚ **Task 1:** The current situation of the molecular genetics research in swine, including candidate genes, SNP and QTLs mapped, gene mapping methods and their influence on mapping accuracy, and ways to use molecular information and related statistical approaches have been evaluated. A report entitled “Integration of molecular genetics in selection programs for Swine”, were discussed with the working group on swine molecular research.
- ✚ **Task 2:** The potential economic benefit from the use of molecular information has been evaluated. This includes identified promising candidate genes and QTLs mapped, and results on simulation studies comparing genetic gains from different selections. The results will be presented at the next Genetics Committee meeting.
- ✚ **Task 3:** Methods for integrating molecular information will be developed, including indexes incorporating marker information and BLUP EBV, index weights and the evaluation of selection response to combined index.
- ✚ **Task 4:** Strategic plan for swine molecular genetic research will be developed, including final breeding plans, recommendations to industry and extension papers.

3. Some suggestions based on the activities completed

- ✚ A large number of candidate genes and QTLs have been detected in swine. Pig industries are already adopting MAS strategies to improve swine production according to Rothschild and Plastow (1999) and Klont et al. (2001). **The areas where DNA information is especially useful** are the traits not measurable on living animals, such as meat quality traits; traits of low heritability, such as sow reproduction; sex-limited traits; disease resistance and early stage selection. For the Canadian swine industry, it seems more useful to consider **DNA information of meat quality and reproduction traits** first in the index combining BLUP EBV. Statistical methods for this are under development.
- ✚ One of the promising genes is **the heart fatty acid binding protein (HFABP) gene**. HFABP was identified to be a major gene for marbling or intramuscular

fat (IMF), but not for Backfat, explaining 1/4-1/8 of mean values of IMF, and being polymorphic in all breeds tested so far. This gene offers the possibility of increasing marbling while continuing selection for lean yield. DNA tests for this gene are recommended (1) to produce pork with desirable IMF by choosing boars with known HFABP genotypes or (2) to increase IMF, during continuous selection for high lean yield.

- ✚ Another important gene is **the insulin-like growth factor 2 (IGF2) gene**. This gene is useful for pork leanness, explaining about 25% of phenotypic variance of lean content. It is an imprinted gene. Only the alleles transmitted from sires are expressed in progeny. The alleles inherited from dams are not expressed. DNA tests for this gene are suggested to increase the uniformity of pork leanness. The suggestion is based on the facts that (1) dams' genes at this locus are not expressed and do not cause variation of progeny; (2) homozygous sires, especially AI sires are capable to leave a large number of progeny and (3) the gene effect is very large. This imprinting mechanism of this major gene can also be used for producing commercial hogs with required leanness from fatter dams. This is because only the favourable alleles from sires are expressed in progeny.
- ✚ The negative effects of **Halothane gene**, such as higher incidence rate of stress death, higher incidence rate of PSE meat, lower growth rates, lower feed intakes and smaller litters are well documented. During recent years, the Hal-gene has been screened and eliminated systematically among sires in nuclear populations. In some regions, it was also tested in dams. However, Hal-genes still exist in commercial populations (Webb, 2003). An investigation for Hal-gene status is being suggested by CCSI in order to develop an effective strategy to control this undesirable gene.
- ✚ A mutation of **c-Kit receptor gene**, known as the dominant white allele, disrupts normal melanocyte development in the embryo. This gene is therefore useful in detection of undesirable colour transmission in white breeds. Some countries, such as China, consider the colour uniformity seriously, as an indicator of breed purity. DNA tests for this gene can be especially useful for promoting Canadian genetics in international markets. Testing for this gene can be organized with AAFC Lacombe Research Centre (Dr. Jon Meadus) and with University of Guelph (Dr. Su Chen).
- ✚ Setting up a **DNA Bank** is an efficient way for current gene mapping and DNA tests, and for future breeding uses and paternity tests. A DNA bank for swine was established quite early in some countries, such as Japan (since 1994) and France (since 1999). There is a need to set up a similar national DNA bank in Canada.



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