Genetic Testing and Japanese Black Cattle

The genetic ability of Wagyu cattle to transmit important economic traits has traditionally been evaluated by the means of selecting potential animals based on pedigree information and estimated capabilities and subjecting them to progeny testing. However, in spite of the high cost and lengthy time spent in this evaluation process, cases are often found where candidate bulls and cows do not possess the genetic ability sufficient for the application.

The purpose of the development of genetic tests relevant to economically important carcase characteristics is not to dispense with progeny testing at this time, as it remains the most accurate means currently available to assess the genetic potential of breeding cattle to pass on advantageous economic characteristics to their offspring, but as a preliminary procedure in the process of selecting breeding cattle or feeder cattle.

GH Exon 5

This test represents a method for evaluating Japanese Black cattle for the important economic characteristics of growth rate and the deposition of fat in certain tissue (marbling) using genetic polymorphism of the growth hormone Exon 5.

Growth hormone is one of the peptide hormones and has an impact on the growth of cattle by controlling energy flow in the body. GH has been shown to have an impact on fat accumulation in certain tissue of Japanese Black cattle.

The GH gene resides on chromosome 19 of cattle. The GH gene consists of a DNA strand that has 5 segments (the segment unit is called exon) which translate into amino acids. Two mutated points were found in the 5^{th} exon of the GH gene of Japanese Black cattle which changes the amino acids at those points, currently this mutation has not been found in any other breed. These variants are called A, B & C therefore there are 6 genotypes AA, AB, AC, BB, BC & CC.

Allele A: Western type. This allele was introduced into the Wagyu genome from western countries.
Allele B: Unknown origin. This allele has been present in the Wagyu genome for millennia.

Allele C: Wagyu original.
The preferred genotypes for producing bulls for F1 production are BB, BC and CC.
Breeding of 100% Wagyu these are still the preferred bull genotype but AC cows can provide the base female genotype at this time.
Japanese Black cattle that are AA genotype should be removed from the herd.

The purpose of using this test is twofold, it allows us to identify animals of superior genotypes but also allows the removal of animals of unsuitable genotypes.

Insert graphs DG and BMS

Fig 1. Relation between GH genotype and BMS in Japanese Black cattle

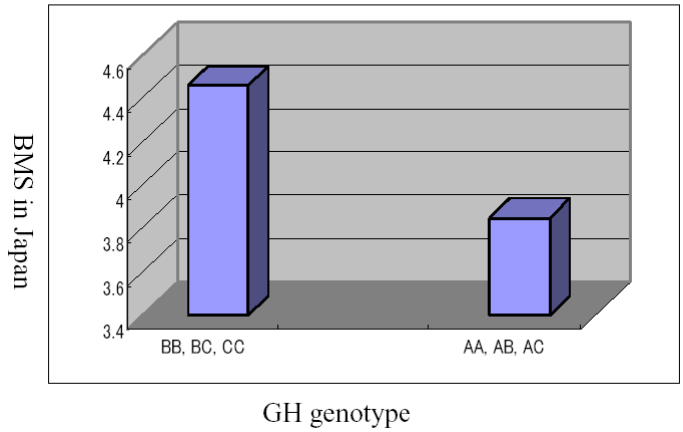
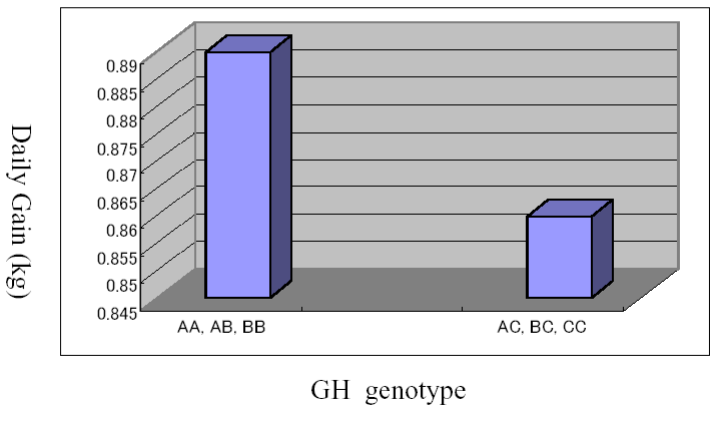


Fig 2. Relation between GH genotype and Daily Gain in Japanese Black cattle



Stearoyl CoA Desaturase

This test is designed to assist in the selection of cattle that show a genotype that produces a superior fat composition.

Stearoyl CA desaturase (SCD) is the enzyme which changes stearic acid into oleic acid. The fat of cattle is composed of 6 main fatty acids. Within these fatty acids one of the saturated fatty acids is stearic acid. Stearic acid makes deposited fat harder and increases the melting point. Conversely oleic acid makes the fat soft with a low melting point. Olive oil is an example of a product that has abundant oleic acid.

There is an opinion in the Japanese market that the percentage of beef that is "not delicious" has increased recently even though marbling has been abundant. Fat of a high melting point is not as palatable to the Japanese consumer as the low melting point fats that have been traditionally associated with Wagyu beef.
Let us imagine we are cooking a piece of beef loin that has a high melting point fat composition in a frying pan. The fat will melt during the cooking process however when we put it in our mouth and it cools to near our body temperature it will become solid. We may feel we are eating butter containing grains of sand and it certainly will not be delicious. I believe that the common incidence of such higher melting point fat in these days has come from a biased view of marbling. We, the Japanese market, have placed too much emphasis on visible marbling and disregarded the type of fat represented. Fat containing high levels of stearic acid is like wax in appearance when the carcase is in the cool room and so it is easier to assess than the soft fats.
Consumers all over the world are becoming more selective and prefer foods that are good for their health. Japanese Black cattle that have a genotype for a soft fat profile are better tasting and healthier when eaten than cattle that have high melting point fat.

There are several different DNA sequences of the SCD gene in Japanese Black cattle. These are categorized into 2 groups, A & V. Some Japanese Black cattle carry a special mutation that changes the corresponding amino acid from Valine (V) to Alanine (A) which has a significant relationship to the melting point of fat. Alanine type has a lower melting point than valine type.
Therefore the preferred type is AA.

By using the SCD gene we can select the cattle which can deposit a soft and oleic acid rich fat that is delicious and healthy.

At this time no gene tests should be used as the single selection criteria that a cattle farmer would use. Rather they should be seen as part of the selection process when choosing cattle for breeding. Cattle that show preferred genotypes for both GH Exon 5 and SCD provide the most likely animals to improve a cattle herds performance BUT ONLY if all other factors are satisfactory.

Dr. Tadayoshi Mitsuhashi
Head
Lab. of Animal Gene Function
Dept. of Physiology & Genetic Regulation
National Institute of Agrobiological Sciences