EXPECTED GENETIC CHANGES IN PORK PRODUCTION

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For several reasons traits related to pork quality are receiving increases attention nowadays. There is a clear trend towards looking at pork as a product that is appraised differently by various specialised segments of the market, rather than considering it a commodity. This could be one of the main reasons for such change of attitude towards quality traits. Therefore, it is important to know the different quality demands that are posed by each segment of the industry. Here, the main quality demands of three important segments are considered and contrasted with available knowledge about the traits behind them, in order to sketch what genetic changes are expected to provide those commercial niches with high quality pork. The three market segments to be considered are 1- pork for fresh consumption; 2- pork for industrial cooked meats and products and 3- pork for high quality cured products.

1- **Quality demands from the fresh pork market.** Nowadays it is generally agreed that there are three main traits that are of utmost importance for this segment: tenderness, juiciness and flavour. Several studies have shown that consumers prefer, and are willing to pay more, for pork that exhibits markedly these traits. They are associated with diverse objective measurements, of which the ones that are popular at present are pH; tenderness as measured by appropriate equipment and intramuscular lipid content. Acid meats are negatively associated with water holding capacity and thus with tenderness and juiciness. Intramuscular lipid content is positively associated with tenderness and also with desirable flavour. It is generally agreed that pork with less than 2% intramuscular fat is not appropriate for fresh consumption and that 3 % or more gives a most desirable product.
2- **Quality demands from the cooked meat industry**. From the standpoint of this industry there is one trait that is of utmost important and it is the water holding capacity of the meat, which determines the final yield of the cooked product. Of secondary importance is uniformity of colour within hams and shoulders. As it has been pointed out, water holding capacity is strongly associated with meat pH.
3- **Quality demands from the industry of high quality cured products**. There are two types of product from this industry: whole dried pieces, like cured hams (e.g. Parma and Serrano types) and dried sausages like Italian salami. For both the industry requires meat that has a minimum loss of water and a high capacity for salt absorption. Again, this is water holding capacity, basically associated with pH. In addition, the cured ham industry demands meat with a not too high intramuscular fat content. Fat must also be resistant to rancidity, which is inversely proportional to linoleic acid content.

There are a few known loci that exhibit major effects of gen substitution on meat quality traits. These are commented first. Then, the effects of poligenic inheritance on quantitative continuous variation are briefly discussed, considering breed differences. Finally, the possibilities of using this information to discard inadequate genotypes and select appropriate ones are discussed.

The Halothane gen. Allelic substitution in this locus causes major effects on meat quality. Basically, this gene codes for a receptor protein of the sarcoplasmic reticule, called ryanodine, which regulates the entrance and exit of Calcium into the muscle fibre. A point mutation of this gen (from N to n) causes an irregular movement of Ca and triggers the Malignant Hyperthermia Syndrome after several stress stimuli. Furthermore, the mutation has a number of pleiotropic effects on production traits in the pig. The most important amongst them are an increase in lean content, of the order of 2 % per mutant copy, which is desirable, and severe meat quality problems that lead to the defect called PSE (Pale, Soft, Exhudative meats). The PSE condition is dominant (genotypes, nn and Nn) exhibit it in equal grade. Basically PSE meats are recognised by a very fast post-mortem acidification of the meat. One hour after slaughter pH values are in the range 5.8-5.4 and stay there afterwards. This reduces the water holding capacity, which, as shown above, is a trait of maximum importance for all segments of the market that are interested in high quality meat. The n allele, which is found at very high frequencies in the Belgian and German Pietrain breeds, has been widely used by most commercial genetic programs in the composition of their terminal lines with the purpose of producing a slaughter product with increased lean content. However, this policy has also brought severe meat quality problems to the industry. Up to now, these problems cannot be solved by technological means.

The RN gen. There are two alleles at this locus: RN- and RN+. The presence of the RN- produces an enormous increment of glycogen in the "white" muscle fibers, which ends up in very low "ultimate" pH values, of the order of 5.4, and a markedly reduced water holding capacity. This gene is characteristic of the Hampshire breed, were it is estimated to be at a frequency of the order of 0.6. It is also present in synthetic lines originated from crossings with Hampshire.

Other single genes. There are some genes that are being investigated at present, which might have effects on pork quality. Amongst them the h-FABP locus is mentioned, whose allelic variation is suspected to have effects on intramuscular fat content. Also, the Calpain system has deserved some attention recently, in particular the variation in the activity of Calpastatin, an enzyme that inhibits the system.

Quantitative genetic variation. Apart from the major genes mentioned above several meat quality traits also exhibit poligenic variation. It is important in this context the variation exhibited by intramuscular fat content, with heritability of the order of 0.5. There are also known breeds differences due to this variation. Thus, the Duroc breed is well known for having high intramuscular fat content, in contrast with the different strains of the Large White and Yorkshire breeds.

Expected genetic changes to improve meat quality.

In the first place it is clear that for the three segments of the industry considered here it would be very important to produce pigs that are free from the halothane gene. This implies not using the Pietrain breed and its synthetic derivatives, so fashionable these days. The advantage in lean content that this gene confers is equivalent to 2-4 years of selection only. And there are many advanced countries where this gene is not used at all in commercial production (e.g. Denmark).

Secondly, it is also very important to get rid of the RN- gene. This could be achieved, simply, by not using the Hampshire breed or its synthetic derivatives, in production.

Apart from these clear recommendations, some refinements could be intended. Thus, on one hand, the use of the Duroc breed to produce hybrid pigs for the fresh pork market could result in a product of most desirable properties. On the other hand, the use of Yorkshire or Large White terminal boars could produce the best meat for the industry of cured dry hams of very high quality.