Innovation for carcase assessment and payment?

Dr Grant Walling, research and genetics director

Reviewing the payment systems for pigs and pig carcases around the world is a relatively simple task. The majority of established pig markets use a combination of weight of the carcase and an assessment of carcase quality.

In the big developing markets of Eastern Europe, China and South East Asia payment schemes are typically based solely on the liveweight of the pig. History and business economics mean that these emerging markets are likely to change from the liveweight payment to a more meaningful method of evaluating the value of the pig.

When paid on liveweight alone, producers are rewarded for stomach and intestines filled with partially digested food and water as well as receiving payments for sections of the carcase that are of lower value to the consumer such as offal, trotters and the head. It is therefore highly likely that the industry will see changes over the next decade in Russia, Ukraine, China, Vietnam, Thailand and the Phillippines changing a larger proportion of animals across to more sophisticated payment systems. But given the experience of the more established pig slaughter markets what technologies are likely to be adapted?

Firstly weight is likely to remain in the calculation with heavier pigs attracting larger payments typically because they contain the most meat. However experience suggests a carcase weight payment (rather than liveweight) would be more realistic. This means stomach, intestine, trotters and possibly heads may not be included in the payment calculation. Secondly a measure of meat distribution is desirable. Although individual markets vary, the loin, shoulder, belly and leg do not all have equal value. Use of a scanning system on the slaughter line such as the Autofom allows the payment to reward the presence of meat in the most valuable cuts. Finally, in some markets use of meat eating quality indicators have had some use for setting payments. This may include the pH of muscle 24 hours post slaughter as an indicator of drip loss or the amount of marbling or intramuscular fat as is assessed in Korea. Eventually some or all of the above assessments are likely to be used to ascertain the value of a pig being sold to the abattoir.

What changes will this mean for producers? Firstly ensuring animals reach their maximum profitable weight will be important for a successful business. With considerable costs invested into simply producing an animal, the relative cost of gaining an additional 5kg at the end of the growth period is relatively small subject to suitable FCR figures. For this reason later maturing animals in the slaughter generation will be highly desirable but must be coupled with the desire not to delay maturation in the reproductive sows.

To maximise the yields of pork from the most desirable cuts, producers may wish to review their current sire lines. Depending on the size and shape desired by the slaughter plant, producers may wish to move towards Pietrain type lines for higher yield from the leg but this may compromise the yield of the loin. In many Asian markets the belly is a highly valued cut and genetics houses may have to significantly adjust their sire line strategies if they are to maximise the value of their product in the Asian markets. Detailed information from technologies such as CT scanning may prove invaluable in such assessments.

Finally to maximise meat eating quality Duroc genetics have traditionally been the best performing with a high pH and lower levels of drip loss. The meat has better flavour due to the higher levels of intramuscular fat. However due to earlier maturation and an overall lower carcase yield compared to white lines the modern Asian pig industry may be tempted away from their traditional terminal sire most commonly used across the continent. ■

Latest research into taint free lines

Caroline Mitchell, meat scientist, JSR

Boar taint, which affects pork by creating an unpleasant flavour or odour, is still a major issue for pig producers globally. The consumer's eating experience of the resultant meat is typically poor, especially in Asian populations who are anecdotally more sensitive.

Approaches to avoiding boar taint have varied across the globe. The majority of countries practice surgical castration; however, elastic rubber bands (bloodless castrators) are also used. Both methods sever the vas deferens, the tubes that connect the testes to the urethra. The prevalence of boar taint in pig meat has been combated in the UK by butchers only using gilt pig meat in their shops. Drug companies have developed immunocastration techniques; however these are not used extensively in certain pig producing countries, plus large retailers in the UK are not receptive to the use of these methods.

It is therefore vital that breeding companies such as JSR take the lead in developing taint free lines.

History

It is widely known that boar taint is associated with the fatty tissue of boar meat. In 1959 Craig and Pearson carried out experiments to identify the compound(s) responsible for the taint. It was suggested by Sink (1967) that steroids which have a musk-like odour could be responsible for boar taint. However, two compounds have been identified as being the main contributors of boar taint – androstenone and skatole. There are many other compounds that may contribute to the odour and flavour of meat, however, it is the levels of androstenone and skatole that are the main contributing factors.

Androstenone is fat soluble and can be used to predict the presence of boar taint in backfat.

Skatole is useful for determining levels of boar taint in both fat and lean meat since it is both fat and water soluble.

Breeding selection

JSR aim to develop taint free lines through breeding selection made possible because the heritability of both androstenone and skatole is moderate to high. However, when pigs have been selected for low levels of boar taint previously, reproductive problems have been observed. To minimise the negative effects on reproduction JSR have been working with Guelph University in Canada to develop specific genetic markers for boar taint. These markers can then be used to identify pigs with a greater chance of developing boar taint and removing them from the breeding pool.

The genetic markers can target one of two metabolic routes:

- They can be used to select pigs that produce only low levels of the taint compounds.
- They can be used to select animals that reduce the accumulation of androstenone and skatole through an increased degradation and decreased synthesis of the taint compounds.

Six lines of unrelated pigs from JSR were assessed for levels of boar taint compounds. Of 73 genetic markers (known as SNPs) originally identified as being related to boar taint, 39 were significantly associated with fat skatole and androstenone. However, the strength of the association varied between the six breed lines assessed. On average across all lines the SNPs explained approximately 51% of skatole variance and 50% of adrostenone variance with 12 of the effective SNP's being associated with both skatole and androstenone across all lines.

These results mean that we are able to explain 50% of variation between animals and subsequently now know that boar taint reduction is possible via breeding selection. To enable further development of the marker technology a larger sample of pigs will be required so that SNP validation and prediction accuracy can be confirmed. JSR will shortly be outlining their plans on how they will do this, with work likely to start this year. ■

Skeletal muscle – a barrier against infection

Dr Grant Walling, Managing Director, JSR Genetics

The aim of the British Society of Animal Science (BSAS) is to enhance and promote the understanding of animal sciences, improve the productivity and welfare of farm animals and the quality and safety of food.

As a leading pig genetics company, JSR Genetics have obvious symmetries with the society and their annual conference always provides a good opportunity to exchange information, particularly around advancements in new science and technology. This year's theme was based on Food Security – Challenges and Opportunities for Animal Science.

One paper at the conference suggested that skeletal muscle is an innate immune organ – containing cells and mechanisms that defend the animal from infection.

Pigs are constantly being exposed to infectious agents and yet, in most cases, are able to resist these infections. It is the immune system that allows this resistance. The innate immune system is the first line of defence against invading organisms and acts as a barrier to infection.

The theory behind the paper is that Calcineurin, a protein phosphatase found in skeletal muscle, provides resistance to influenza infection. This is because it activates T cells of the immune system through a process known as Dephosphorylation, where phosphates are removed from cells in skeletal muscle by hydrolysis.

The paper demonstrated that Calcineurin can affect meat eating quality, due to its affect on calcium levels in the muscle and calcium's known affect on the Calpain system, responsible for the tenderisation of meat post slaughter.

The paper therefore suggested it is possible to improve the meat eating quality and the health of the animal, the resulting benefits of which would be huge for the pig industry. The ultimate goal is to produce an animal with both a high meat eating quality and a disease resistance to a variety of endemic diseases. Time will tell just how beneficial this new research will prove to be, but it certainly helps to demonstrate the substantial impacts new scientific thinking and research can have on the pig industry.

Also at the BSAS conference, Dr Kirsty Moore presented her findings related to the beneficial use of CT scanning in commercial lamb production. Marking 10 years of CT scanning by pedigree ram breeders, the results showed that lamb producers will see increased returns if they only buy terminal sires from flocks which have been consistently selecting rams with the help of CT scanning. Dr Moore pointed out the potential benefit to the industry, and for genetic improvement, if more breeders used CT scanning.

JSR have used CT scanning to great success in the pig industry for some time now. It allows for extremely accurate predictions of carcase composition and, of greater benefit to the processing and retail sector, the ability to be able to differentiate muscle yield within the different primal cuts.

The heritability of the CT muscling traits is moderate-high (typically around 40%) and so suited to genetic improvement. Work with CT scanning has suggested a methodology for the selection of meat quality using measures of muscle density.

Without this technology, breeding companies have previously had to use carcase dissection data, the downside of which is the necessity to slaughter animals prior to data collection. CT scanning is able to collect the valuable information on live animals (under anaesthetic), which can then be used for further breeding.

Conventional selection schemes ensure that JSR boars meet the high criteria required by producers. JSR regularly scan groups of AI boars prior to entry into the AI studs, providing the processing and retail sectors with information that ensures only the most suitable boars are used in their supply chains. ■

Longevity is the key to climate smart agriculture

Dr Grant Walling, Managing Director, JSR Genetics

Agriculture needs to work harder to clean up its environmental emissions of greenhouse gases. This has been highlighted repeatedly over the last decade however it seems that many have chosen to ignore this warning.

The FAO in 2006 released the report 'Livestock's Long Shadow' highlighting agriculture was making a larger contribution to greenhouse gas emissions than almost any other industry including transport. Given the negative publicity that food miles have had this is a staggering fact that the production systems themselves are doing more climate damage than the air and sea freight of moving foodstuffs around the planet.

More recent reports have also highlighted this trend and have noticed very little change since the original FAO report.

The UK Foresight Report* on the future of food and farming highlights that "The food system must become sustainable, whilst adapting to climate change and substantially contribute to climate change mitigation."

Interestingly one of the ways of doing this is to improve the longevity of animals in modern farming systems. A good example given at the British Society of Animal Science meeting this year by Phil Garnsworthy was provided by dairy cattle. Animals surviving to produce a fourth lactation rather than just three lactations had a lower methane output per litre of milk produced.

Fourth lactation animals had 13% less methane produced per litre in comparison to their third lactation equivalents. This is due to the methane excreted during the growing (unproductive) phase being spread across the four rather than three lactations.

A similar analogy can be used in pigs, which of all the main domesticated farm livestock food species are the highest excretors of phosphate. Sows that survive to higher parities excrete lower emissions per piglet produced than those sows that may produce one or two large litters but fail to reach higher parities. Whilst the animals with higher longevity are environmentally more sustainable they are also more cost effective to pig producers. This win-win situation is an excellent example of the sustainable intensification leading to climate smart agriculture advocated in the Foresight Report.

Recent JSR trial work has highlighted significant differences between groups of animals for longevity even within the same production system. A recent trial at Harper Adams University College looked at Genepacker 90 gilts versus a large global competitor's gilts. At the end of parity 2, 87% of the Genepacker 90 animals had survived and were imseminated for the next parity.

In contrast the other group of gilts had been reduced to 70% of their original population. In total 60% of the JSR animals survived all six parities in the trial (the point we would normally recommend culling animals). In contrast, only 45% of the competitors animals were still productive at the same point. The work demonstrated a significant financial advantage of the JSR gilt due to the improved longevity and overall production – around £40,000 for a 500 sow herd on a UK payment system, equivalent to ~$65,000.

However, this latest research also demonstrates an added environmental benefit. Whilst pig producers are not paid (or penalised) for environmental benefits, given the political interest and pressure on meeting environmental targets it is likely that in the future financial penalties will be placed upon the worst polluters and benefits shared with the lowest emitters.

When this day arrives, a productive animal with a longer productive life will be significantly more desirable than a high producing disposable sow produced by poor selection strategies.

*www.bis.gov.uk/foresight/our-work/projects/current-projects/global-food-and-farming-futures/reports-and-publications

Endocrinology: the answer to seasonal infertility?

Stephen Waite, Geneticist, JSR Genetics

For years the annual cycle of infertility has had major implications for the pig industry globally, from indoor producers in Korea to outdoor units in Scotland.

It can cause up to a 15% reduction in conception rates during the months of July to September in the Northern Hemisphere for example. No one has ever touched on a sure fire way to solve this issue.

Instead, like many issues in the pig industry, people have focused on treating the more obvious elements in the hope they see a significant improvement on commercial output.

Temperature and light have long been the stalwarts of this thinking – light controlled and air conditioned boar studs and sow accommodation being the apparent answer.

This too was the thinking among researchers looking into many other species, the hope that closely controlling the environment can somehow trick the animal into thinking it is winter all the time. Some studies suggest an increase in rain fall around the time of service results in a lift in production, but still no definitive answer to the problem.

What has been found, in Marmoset monkeys, is that light and temperature are merely the first breadcrumbs on the trail to what appears to be the true cause of seasonal infertility.

It was shown via endocrinology that even sensory deprived monkeys still showed the same reproductive traits as those with normal access to light and temperature. This sparked a study into the actual regulation pathway of fertility.

This guided researchers to the hypothalamus in the animal's brain, which acts as a so called reproductive clock, by releasing gonadatrophin-releasing hormone (GnRH) in pulses, thus controlling the animals reproductive cycle. The pulses are regular over the winter period, which is the breeding season, and decline over the summer period, thus limiting the number of successful ovulations. What was noted was that even in the sensory deprived animals these pulses still lessen over the summer period, thus causing infertility. This appears to be a trait you cannot breed out of a species. Even in subsequent generations bred from the sensory deprived animals, the same reproductive response over the summer period can be observed.

The control mechanism of these pulses are still not fully understood, and may well never be, along with the precursors to puberty, but the use of a range of different 'peptins' have been seen to reinstate these pulses in animals. The translation of this work into pigs could have a considerable impact on the industry. It would spell the end of higher intakes of gilts and the practice of over serving at some units in the UK, especially those outdoors, in an attempt to soften the blow of lower productivity over the summer period.

This form of research could also be used to assess the influence stress has on the reproductive abilities of pigs, as it has been shown that stressors on the animals also affects this pathway in the brain causing ovulation to stop in females and semen production to lower in males.

The possible welfare angle of this research should not be ignored; in some cases stress and seasonal infertility are very hard to separate in an on farm situation.

This has been demonstrated and put into practice in human reproductive studies with many women now being offered cognitive stress therapy ahead of IVF when trying to conceive.

A lowering of stress can allow the subject to regain fully functional reproductive cycles in females. The research and genetics team of JSR will be keeping a close eye on the results of ongoing research with a view to expanding this line of thinking into their current research portfolio. ■

Consumer food technophobia

Dr Grant Walling, Managing Director, JSR Genetics

A quick glance through the advertising literature of many advertising brands demonstrates the science and technology that they implement into their products.

Whether it is skin products advertising complementary ingredients of zinc, lipopeptides and caffeine at Garnier, Hi-Tec walking boots promising 4:SYS dynamic, motion-control technology, ionmark waterproofing and v-lite design or brake energy regeneration in the BMW Efficient Dynamics system, the message is that technology sells.

So why is it that when it comes to the marketing of food it is words such as natural and traditional that are more widely used and some food products even market themselves on the basis of not using the latest technology, for example GM Free?

It is difficult to conceive the latest smart phone would ever be advertised as 'using traditional methods and natural materials' as for most of us this would create the image of two children with tin cans connected by a piece of string. Similarly, a clothing company promising only hand made garments from organic materials would be unlikely to produce garments for many sectors of society, such as sports or military clothing.

This technophobia in the food sector is becoming a mounting issue because the global population is increasing and eating more calories per capita with an increasing proportion of these calories coming from meat products.

All this is happening at a time when less land is available for agricultural production and variations in climate are making production cycles less reliable. During these challenging times science is capable of producing solutions and in some cases already has answers to many of these problems.

The biggest hurdle is, therefore, not the technology itself, but the legislators and public's acceptance of using this technology in the food sector. Legislators and the wider public must recognise that Luddite views of new technologies will be the cause of global hunger, not the scientific community's inability to provide the necessary response.

JSR is proud to be at the forefront of many technologies in the pig supply chain. These include detailed image analysis for intramuscular fat of all animals scanned in the breeding programme, the use of computerised tomography (CT) in the analysis of live animals for their slaughter attributes, the establishment of taste panelling and routine pH testing of JSR customers' slaughter products.

JSR have recently been awarded funding to investigate pre-implantation embryo diagnosis technologies in pigs and greater use of genomics for growth and feed efficiency in sire lines.

Genetics companies such as JSR would like to develop many of these technologies further and implement others into the research portfolio, including the widespread use of embryo transfer, the use and acceptance of genetically modified organisms both in feed products and in animals and the possible role of cloning in the animal breeding sector.

Unfortunately, many of the technologies on the 'wish list' are sadly derailed not by the abilities of geneticists and other scientists but the protectionist views of politicians and legislators more interested in the short term popularity of winning electors votes rather than the long term good of feeding the growing global community.

Only when these 'decision makers' wake up to the wider need for the huge efficiencies available by adopting new science and technology in the agri-food sector have we a hope that the public can be presented with the true facts, and make up their own minds, rather than the current nostalgic view of food production that suggests farmers should embrace lifestyles more common when bubonic plague accounted for more deaths than starvation.■

Failure to 'footprint' food production

Dr Grant Walling, Managing Director, JSR Genetics

Today's consumer is more aware of environmental issues and concerns than ever before. There is however a conflict between high animal welfare and a desire for lowering environmental impact.

High welfare systems are often inefficient, and in many circumstances will have a greater subsequent impact on the environment.

The main challenge currently is how to measure the carbon impact of food production.

We may see a point in the future where food labelling will include a measurement of environmental impact. To date the carbon footprinting of food products has failed.

The system is overly complicated and there is a great deal of confusion as to whether we are supposed to work with carbon equivalents or global warming potential. So why has the measurement of the environmental impact of food production failed thus far?

Firstly retailers have failed to lead as each is waiting for the other before declaring their status and preferred method to try and claim a marketing edge. Secondly, any unit of measurement currently offered is relatively meaningless to the consumer. If your product has a footprint of 900 carbon equivalents is that good or bad, should it be 9 or is 9 million better?

A suggested and sensible alternative is kg pigmeat produced per kWH of fossil fuel used. This is a relatively simple measure and one with which the public will be more familiar, given it is how many are charged for their domestic energy supply. For example:

- **Step 1:** A 1,000 breeder sow unit producing 25,000 weaners and using 50,000 kWh of energy per annum would have used 2 kWh per piglet.
- **Step 2:** A finisher unit taking the 25,000 weaners and producing 24,000 finished pigs using 24,000 kWh would have used 1kWh per pig.
- Step 1 + Step 2 gives a total of 3kWh per pig, which can be expressed as 0.027kWh per kilo liveweight (based on a liveweight of 110kg).

The system is not perfect in that it does not recognise diesel or oil use, but these could be added at an agreed rate, for example 10 litres of diesel is equivalent to a number of kWh. Overall this is an easier system to understand and one that should have been adopted five years ago.

To further assess green credentials, energy from renewable sources would not be included. Hence if the sow unit produced 50% of their own energy from wind turbines and solar panels the kWh per pig would halve.

The JSR target is to reduce their fossil fuel kWh by £1 million (around 6.7million kWh). They aim to achieve this by greater use of renewable energy systems utilising land and resources already available in the business.

Currently this is being achieved by the installation of solar panels on large roofs on agricultural buildings, the identification of suitable sites for wind turbines and the use of manure and slurry to replace a proportion of purchased mineral fertilisers.

As legislators put more emphasis on the impact livestock farming is having on climate change, there is a need to further quantify the value modern genetics brings to the planet in terms of reducing greenhouse gas emissions and better utilisation of the planet's resources. To achieve this, more academics and leading companies such as JSR must take the lead in promoting breeding technologies that are favourable to the environment. In the pig sector traditional key performance indicators must be reviewed to better reflect modern pig production and consumer attitudes towards efficiency and sustainability, including such criteria as lifetime productivity, saleable meat produced per tonne of feed, kg of pigmeat produced per unit of land required and kg of pigmeat produced per kWH of fossil fuel used. ■

Fight the resistance

Dr Grant Walling, Managing Director, JSR Genetics

A frightening problem facing the global pig sector, and indeed the wider global agri-food industry, is the overuse of antibiotics.

On the 17th November, the EU Commission launched a 12 point plan to tackle antibiotic resistance and have called for farmers, and the wider livestock industry, to play a key role. A staggering statistic is that around half of all antibiotics prescribed in Europe are prescribed for animals; this figure is thought to be even higher for the rest of the world and indeed nearer 70% in the US.

The 'Alliance to Save our Antibiotics' (formed by Compassion in World Farming, the Soil Association and Sustain) claims that nearly 50% of all antibiotics are used in farming and point the finger squarely at 'factory farming' as being the main cause of antibiotic resistance. Do they have a valid argument?

Many pig herds will routinely use antibiotics, in most cases the antibiotics are included in the feed, meaning all animals are treated regardless of their requirement or effectiveness. This overuse is clearly contributing to an ever-increasing amount of antimicrobial resistance as strains of bacteria such as Methicillin-resistant Staphylococcus aureus (MRSA) and E. coli evolve.

What's more there is now evidence that resistant 'superbug' bacterium are being transferred to humans via the food chain. The risk to public health from food is arguably the most emotive subject for many consumers.

A thesis carried out by Els Broens of Wageningen University in Holland, details how MRSA has spread rapidly on pig farms in the past few years and that the extensive use of antibiotics has been a major contributing factor.

Broens reported that from early 2007 to the end of 2008, incidence of MRSA on pig farms increased from 30% to 75%. Large pig farms (with more than 500 sows) are particularly likely to be MRSA positive. The bacterium is transported from farm to farm in livestock trucks. Many pigs also become infected in this way during transit to the abattoir. Pig farmers and abattoir workers who come into contact with live pigs are at risk of infection, whereas abattoir staff who only work with dead pigs do not run any risk, says Broens.

Whilst reducing the amount of antibiotics used on pig farms is a step in the right direction, it is still not enough to eliminate MRSA because the resistant bacteria can thrive among pigs that have received no antibiotics.

In order to cut the transmission of MRSA from pigs to humans, the bacterium needs to be combatted at source: on the farm. Broens argues for greater hygiene measures in order to prevent the spread of resistant bacteria on and between pig farms.

This requires a joint approach by politicians, supermarkets, vets and farmers and I would welcome the 'powers that be' to take a greater lead in raising awareness of the issues and present workable solutions, both on farm and in the laboratory.

The bottom line is that pig producers need to be more responsible when it comes to the use of antibiotics, starting with gaining a greater understanding of exactly what antibiotics are being administered on their own unit and how often. Interestingly, a recent report showed that farmers who believed they had a low antibiotic usage were actually some of the highest users and vice versa.

If you want to improve something you first have to measure it and if you set clearly defined targets most groups will move towards it.

For the good of the global pig industry we should all be aiming to reduce the use of antibiotics, otherwise we are likely to be hit by legislation. It is crucial that as an industry we start to take significant steps in the right direction.

Responsible breeding companies do not and would not routinely medicate. JSR is currently reviewing levels of antibiotic usage across the whole business to ensure it is at the lowest levels possible. Let's hope others follow that example.