JSR Dr Walling Debates

# 1 Key Fertility Topics

**Infertility is an issue of crucial importance in both humans and livestock. Here, Dr Grant Walling, managing director of JSR Genetics, the leading global pig breeders and geneticists, discusses key fertility topics with Professor Darren Griffin of the University of Kent's School of Biosciences.**

**Dr Grant Walling:** Having already enjoyed a long relationship with the University of Kent we know that, in terms of research, there is much to be gained by collaboration. In your experience, what can we learn from both human and pig fertility research?

**Prof. Darren Griffin:** Humans are the most studied mammals in the world; as a result, the human genome is by far the best described. However, as a species we are slow to mature, have small families and usually one child, and one partner, at a time. In terms of fertility research, this is of course a drawback.

Pigs, on the other hand, of a similar size and physiology to humans, provide an opportunity to look at 'larger families' in a short space of time, which is ideal. Also, their breeding and cross breeding is widespread and ethically acceptable.

With 1 in 50 babies born using IVF, and 1 in 6 couples experiencing fertility problems, there is a lot to be learnt on both sides. In humans, for example, if a person is infertile we immediately look to rule out chromosome translocation, a condition in which part of their genome switches place with another section and can be attempting to produce eggs or sperm. Individuals with this condition are typically healthy, yet have an increased risk of infertility, miscarriage, still birth, or a child with birth defects. Whilst in humans, this is something we look for routinely, it is a new area of interest in pigs and it is thought that some 50% of infertile boars can have this problem.

**GW:** There are also many beneficial synergies in terms of resources. JSR providing high quality data and biological material: the university offering access to an exceptional level of facilities and highly trained personnel to further our technological progress. In your opinion, which human technology offers the pig industry the most potential for commercial development?

**DG:** I think IVF technology, routinely used to screen human embryos for genetic diseases, has many potential applications in the pig industry. Together with JSR, the Bridge Fertility clinic and the University of Kent has recently been awarded a Technology Strategy Board (TSB) grant to explore these possibilities. Used on a very different scale, pig IVF allows us to generate large numbers of IVF embryos to identify particular traits without having to wait for the pig's 113 day gestation and 224 day sexual maturity period.

**GW:** We will be working to identify traits – fertility, fatness, disease resistance – that impact on health and productivity and can be introduced into a herd using gene marker assisted selection. And, we anticipate other benefits too. IVF embryos, suspended in a flask, can be transported at a fraction of the cost of sending live animals to international customers. Rather than individual animal testing, they will need just one test, can be 'disease washed' as required for their destination and can travel as luggage on a normal commuter flight, with far less environmental impact.

So, there can be substantial benefits for the entire pork supply chain from human fertility technology. Are there also technologies initiated in livestock that have mainly benefitted humans?

**DG:** We all remember 'Dolly' the first cloned mammal. Whilst no one is suggesting cloning humans, that same regeneration technology will allow us to generate organs, repair spinal cord injuries, and offer hope for leukaemia sufferers. That, I believe was always the objective.

**GW:** Can the human condition shed light on one of our industry's most stubborn challenges – seasonal infertility?

**DG:** It is well known that temperature can affect fertility. If it is very hot, the ability to produce sperm can be compromised. Length of daylight reduces conception in the female by influencing the pituitary ovarian axis, which ultimately controls ovulation. If it is any consolation, some research groups have provided evidence that suggests even humans, for all our sophistication, show signs of seasonality with ovulation rates higher in the summer, day length being influential in northern climates and the temperature nearer to the equator affecting sperm production.

**GW:** As yet, we haven't been able to demonstrate a genetic component to seasonal infertility. However, our many partners in hotter climates find air conditioning and water trickle systems economically viable, if not essential, in their AI studs. It is much more difficult for an outdoor pig unit in the UK. However, given the cost of seasonality – as much as 25% fewer pigs produced over a 4-8 week period – perhaps floodlit paddocks could be the answer. Finally, which new technology has the most to offer 'both worlds' in the future?

**DG:** I think IVF related technologies will be invaluable to us all in offering a greater opportunity to understand and treat diseases through work on stem cells. Stem cells can also be used for pre-clinical drug toxicity testing to identify drugs that would fail in clinical trials or animal testing. So, in that way, they will also reduce the need for live medical trials. ■

JSR **Dr Walling Debates**

# 2 The Role of Academic Research in Commercial Pig Production

**Research is vital to the on-going success of the global pork industry, and educational establishments play a significant role in carrying out research and teaching tomorrow's farming generation. Here, Dr Grant Walling, Managing Director of JSR Genetics, leading global pig breeders and geneticists, debates the importance of links between academic bodies and industry with Richard Hooper, Manager of the Pig Unit at Harper Adams University College**

**Dr Grant Walling:** Richard, currently what are the main areas of interest to students at Harper Adams?

**Richard Hooper:** With the global population now soon to top 9 billion, food production and security is very much topping the political agenda. With this in mind, the main areas of interest focus on production efficiency: how to increase numbers born, health, welfare and nutrition. We now have around 630 students a year attending Harper Adams, all of whom will have exposure to the pig production unit and gain a hands-on approach and inspiration.

**GW:** As you know, with over half of your unit stocked with JSR Genepacker 90s, as a genetics supplier JSR has concentrated on increasing the prolificacy of the commercial sow, focusing on consistent lifetime performance, rather than short term gain. Are there new areas of research that support this initiative and can be used to improve commercial production?

**RH:** No doubt numbers born alive are going up and strategies to rear piglets as efficiently as possible – and, vitally, without taking too much condition off the sow – are hugely important. One project is proving very beneficial: a milk line system, providing a 24/7 supply of milk to the piglets in each farrowing pen. It means runt pigs don't have to fight for, or share a teat. Also as we 3-week batch farrow, on an 'all-in, all-out' basis, shunt fostering is not an option.
Trialing the system using 3 groups - from birth, day 7 and no milk line at all – the best strategy was to provide the milk from birth. In the first trial we reared .3 more pigs and in the second .7 more. Most interestingly, sows whose piglets had the advantage of the milk line were, on average, 5 kilos heavier and lost less backfat at weaning.

**GW:** So you would also expect those sows to go on to have a bigger litter next time. We have certainly found that Genepacker 90s provide consistent results across long productive lifetimes.

**RH:** Yes, that is certainly what we are expecting. And, whilst I do believe that will be true, what makes research so fascinating to me is that it is so full of surprises.
We have recently completed a DEFRA funded project on the effect of weaning age – 4, 6 or 8 weeks – on days to slaughter in terms of cost-effectiveness and gut health. Whilst we expected the 6 to 8 week piglets to wean better and get to slaughter quicker as bigger, stronger pigs we found no significant difference in days to slaughter. In fact, taking into account sow accommodation and more litters per sow per year, cost effectiveness favoured 4 week weaning. Research is often about the results you don't get, as much as the ones you do.

**GW:** And, of course, research is also cumulative and always on-going. JSR and Harper Adams research into the effect of semen concentration on farrowing rates is a good example. At JSR, we feel that the BPEX rule requiring a minimum of 2 billion sperm per semen dose (so therefore a declared dosage of 2.25 billion to provide a 10% tolerance) could be far too high and stands in the way of advances such as single sexed semen which rely on the viability of sperm being sex-selected. At the moment, JSR send out semen at 2.5 billion for sire lines and 3 billion for dam lines.
As your research proved lowering the rate to 100 million sperm, down from 2.5 billion gave poor conception rates and low numbers born. However, a dose of 400 million sperm per dose gave conception rates and numbers born similar to a normal dose.

**RH:** Yes, it proved that 2.5 billion sperm per AI dose is far too high. It would be interesting to now to do a trial on a 1.2 billion sperm per dose, so around half the concentration of the current dose, to see if we could get similar results, bringing the advantages of single sex semen – common to the cattle industry – closer.

**GW:** Another area of research for JSR is using CT scanning and image analysis software to determine intra-muscular fat (IMF) levels on live animals to improve the marbling profile of pork without incurring backfat penalties. How important do you feel this will be in the future?

**RH:** Anything we can do to positively differentiate our product will be important and improving meat eating quality is certainly the right thing to do. Higher standards of food safety, food quality and production methods are all means of making us stand out from the rest of the world. There are so many factors that affect the growth of the pig: genetics, feed, health and welfare, the environment. On the whole, as an industry, we know what we should be doing. Now it's a matter of finding ways to do them all as well as we can – then we can achieve great things and communicate this to producers globally. ■

JSR **Dr Walling Debates**

# 3 The latest thinking on genetic research

**Genetic research is a vital component in the fight against disease within the pig sector. Here, Dr Grant Walling, Managing Director of JSR Genetics, leading global pig breeders and geneticists, attempts to unravel the latest thinking on the issue with the help of Stephen Bishop, Professor of Animal Disease Genetics at The Roslin Institute and R(D)SVS, University of Edinburgh.**

**Dr Grant Walling:** Pigs seem to be more susceptible to disease than other livestock species, is there any reason why this is the case?

**Stephen Bishop:** I don't think this assertion is necessarily true. All livestock systems are at risk from diseases, with the infectious agent and hence the disease, varying between host species and also between production systems. One factor relevant to pigs is that a high density of animals is a risk factor for the increased spread of infection. The pig industry comprises a lot of intensively managed and well-monitored farms. If an infection does overcome the biosecurity measures and invade the farm, then the relatively high density of animals creates a situation in which infection may spread more quickly. The fact that farms are well monitored means that health problems are more likely to be seen than in more extensive farming situations where they may be missed.

**Dr Grant Walling:** Diseases such as PRRS continue to be a huge threat internationally. Is there a specific reason why pig producers are struggling to win the battle with this disease?

**Stephen Bishop:** The basic difficulty arises from the nature of the virus. Firstly, it is able to subvert and avoid large components of the pig's normal immune response to infection. This makes it extremely difficult to develop effective control strategies. Secondly, the virus is one of the fastest evolving viruses known to science. Hence new strains develop quickly, and even within an animal, it is possible the virus may evolve to avoid whatever immune response that the pig has mounted. These factors make PRRS an on-going threat.

**Dr Grant Walling:** Apart from basic biosecurity what should pig producers be doing to lower the risk of disease epidemic(s) in their herds?

**Stephen Bishop:** Essentially, they should do the basics well. In addition to basic biosecurity, key factors are to use lines/crosses of pigs that are suitable to the production unit and environment. They should also concentrate on good nutrition and management, and closely monitor the health of the pigs.

**Dr Grant Walling:** One of the common criticisms is that modern animals are more susceptible to disease. Is there any evidence of this?

**Stephen Bishop:** This assertion is often made, but I'm not sure that the evidence stands up to close scrutiny. Essentially things change over time. Selection has meant that pigs have become more productive. Simultaneously, the management systems have become more intense and animals are now much more closely monitored. Therefore, much more is now expected of the animals, and departures from high performance targets, especially if due to infection, are more likely to be observed. Pig breeding companies are well aware of the risks of selecting too far and too fast for one performance trait only with the risk that other productive attributes, including the ability to respond to infection, may be compromised. Most companies now concentrate on producing lines of pigs that are robust to a variety of environmental challenges.

**Dr Grant Walling:** Could the pig industry learn any lessons from other livestock sectors?

**Stephen Bishop:** Yes. The key to identifying problems, diagnosing the cause and deriving and implementing solutions lies in data recording. The factors that have been instrumental in developing industry-wide solutions to various issues in dairy cattle have been the collection of health and reproductive data. These data have then been used to develop breeding values for many traits related to health, performance and longevity. Clearly the pig industry is structured differently, and faces different challenges. However, the collection, interpretation and use of data is still the key to solving many problems – 'you can't manage what you can't measure'.

Recording animal health data from as many sources and production environments as possible, and feeding this data back to the breeding nucleuses should assist greatly in breeding healthier pigs.

**Dr Grant Walling:** What do you think are the largest health/disease threats to the pig sector in the future?

**Stephen Bishop:** PRRS is likely to remain the major health threat for the time being. External factors are likely to be the cause of new threats, for example climate change leading to exotic virus threats, difficulties in controlling bacterial diseases as antibiotic usage lessens, and the possibility of worm infections in outdoor reared pigs. However, for the foreseeable future we will continue to have a major focus on PRRS. ■

# 4 Lies, damn lies and scientific claims

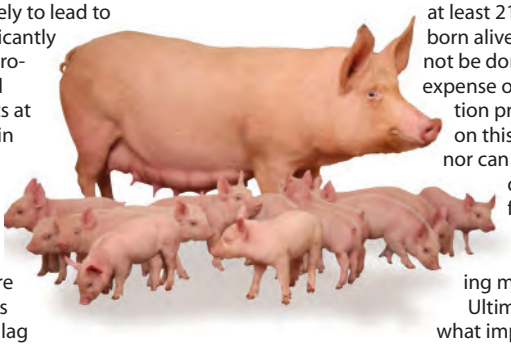
**Following a recent worthwhile visit to VIV China, a well-respected spokesman for a competitor claimed that the 54-pigs weaned per sow per year was achievable, and that it would be available within the next ten years. Of course this caused raised eyebrows and pricked ears, not to mention a piqued interest. But is this 'super sow' achievable within a decade, and if so would it offer any economic benefits or biological merit? To paraphrase a famous film – have scientists become so preoccupied with whether or not they could, that they didn't stop to think if they should?**

Firstly, let's have a look at the numbers. The gestation cycle of a 'normal' sow is reasonably fixed. We have 116 days of gestation, followed by 21 days of lactation (or possibly more depending on the welfare constraints of the system in which we operate) and five empty days before the animal is served again.

So we can calculate that the cycle for a healthy animal that always becomes pregnant on the first service, is 142 days, giving us 2.57 cycles per year.

Using these figures, in order to achieve the 54 piglet target this animal would need to wean 21 piglets per litter.

This is because currently there is no work to show that gestation periods can be shortened and nor is there any biological merit in doing so, as this would be likely to lead to significantly compromised piglets at birth in much the same way premature babies often lag behind their contemporaries that were born to full-term in physical development.



Even if this 'wonder pig' managed to farrow 21 piglets every cycle, notwithstanding the impossible challenge of eliminating every case of pre-weaning mortality, the research suggests a biological limit on uterine capacity.

This limit is dependent on a number of factors such as the size and biochemical capacity for nutrient exchange, including blood flow to the gravid uterus, and the size and efficiency of nutrient absorption by the placenta.

The average uterine capacity of sows has generally not changed through genetic selection and is ultimately a difficult trait to improve, hence larger litters contain lighter pigs as the finite uterine capacity is shared across more piglets.

The consequence of this reduced birth weight is therefore piglets with lower viability and a greater probability of pre-weaning mortality. Of course if selective breeding is used to influence uterine capacity, this has to be done at the expense of other traits. What should these be?

If the average sow has to average at least 21 pigs born alive it cannot be done at the expense of selection pressure on this trait, nor can we reduce influence on pre-weaning mortality. Ultimately what implications would selection for uterine capacity have on the health of both the sow and piglets?

Teat number is also crucial when considering litter size. Even a superior sow may only have 16-18 teats, which raises the question of how 21 piglets could possibly be fed?

Yes, breeders could select for more teats, but this takes time and resources and again requires selection intensity to be transferred from other traits.

Given that we are now already having to incorporate the uterine capacity into the index it would be difficult to make sufficient progress in all traits and would still not guarantee survival rates high enough to achieve the magic 54 pigs weaned, as pre-weaning mortality rates, lactation feed intake and sow survival are likely to become more significant issues.

There is the possibility of using rescue decks, small heated containers with milk lines attached to assist and reduce the burden on the sow, but this is often a compromise and is a poor substitute for access to the sow for the piglet.

It's widely known that modern geneticists can perhaps achieve one extra pig per litter every five years, which means that anyone hoping to achieve 21 piglets per litter within a decade should be averaging 19 piglets born alive per farrowing now.

Currently with even good commercial farms only producing up to 16 pigs born alive per litter, litters of 20 or more within 10 years seem overly optimistic, even with the most sophisticated tolls of genetic progress.

Priming the industry to begin the development of a '54' sow, will take time, money and effort and will put as-yet uncalculated pressure on the animals we work with.

Whether, in the future, this figure is achievable remains to be seen, but at the moment it seems unlikely. Sadly the reputation of science to over-promise and under-deliver on such claims does little for the credibility of the individuals involved or the overall scientific community.

Perhaps a more realistic and deliverable aim focused on customer profitability, and not on enhancing scientific egos would be more palatable to pig production businesses. ■

JSR **Dr Walling Debates**

# 5 Improving pig welfare

**Professor Sandra Edwards is recognised globally as a leading authority in the field of pig welfare and has been instrumental in establishing freedom farrowing systems on the farm at the University of Newcastle. Sandra represents a valuable scientific opinion on pig welfare, whilst understanding the needs of modern production businesses.**

**Dr Grant Walling: Higher welfare means different things to different people. Are there any simple tests a producer or processor could implement to assess their welfare standard?**
**Prof. Sandra Edwards:** Many surveys have demonstrated that animal welfare is viewed from different perspectives by different people. The general public tend to equate welfare with 'naturalness' and thus perceive more extensive systems as delivering higher welfare.

Farmers and veterinarians, on the other hand, tend to equate welfare with good health and performance of animals, which can often be delivered more effectively in intensive systems.

The search is currently on to find more simple, integrative measures that might be more practically applied in larger scale farm audits.

**GW: With the impending EU sow stall ban due to start January 2013 what are the benefits and drawbacks to production businesses implementing this new system?**
**SE:** The adoption of alternatives to gestation stalls, in which the sow has more freedom, will give significant benefits for the image of the pig industry within the wider public domain.

There may also be some practical benefits, since animals with freedom to exercise will have better bone strength, muscle tone and cardiovascular fitness which can improve general health and farrowing ability.

Some people are concerned that greater possibility to exercise might require higher food inputs and we should not forget that stalls were developed for some good reasons, foremost amongst which was protection of the lower-ranking individuals from aggression and competition for food. If group systems are poorly designed or managed, welfare and production can be seriously compromised

**GW: For the rest of the world outside the EU using conventional production methods, what are the simplest ways to improve welfare standards without becoming uncompetitive?**
**SE:** Whilst people often think of welfare in terms of production systems, it is really the management and attention to detail within the system which is most important for the animals.

We now know that the attitudes and skills of the stockpeople on a farm are key to good welfare and good performance. The simplest steps to improve welfare are therefore to select staff who have empathy for the animals under their care and to provide regular and appropriate training.

**GW: You have been instrumental in developing farming systems that don't use the farrowing crate, how successful is this for improving the welfare of the sow and her piglets?**
**SE:** Our objective must be to seek ways of finding alternative systems for farrowing and lactation in which welfare problems are avoided, but without losing the significant benefits that the crate system delivers.

The newly developed 'PigSAFE' system uses the natural behaviours of the sow to steer her towards farrowing in the optimum location, it provides aids to controlled lying and helps her maintain a hygienic nest.

It also incorporates an appropriate microclimate for the piglets and the possibility for safe intervention by stockpeople.

**GW: In your opinion is the poor longevity of sows seen in some countries down to low levels of animal welfare or related to other factors?**
**SE:** The main reason for premature culling of sows is for reproductive failure. As we continue to select sows for increased prolificacy at the same time as higher lean tissue growth rate and lower carcase fat in their progeny, we are asking them to deliver higher output levels from lower body reserves.

With good feeding and management this can be achieved without adversely affecting their welfare, but the margins for error can be very small. Where hot climate, poor quality feeds, lack of easily available water or ill health reduce feed intake in lactation, then both perform-ance and longevity in the herd will suffer.

However, not all causes of breeding problems are nutritional; sows which are stressed by poor handling, aggression from other sows and competition for food after weaning will also be more susceptible to reproductive failure.

This can also result from management failure, where staff are poorly trained and key tasks like oestrus detection and insemination technique are at fault.

**GW: Is there anything more breeding companies could do to improve animal welfare? What sorts of traits would contribute to a welfare breeding goal?**
**SE:** Breeding companies need to deliver a good balance between traits of performance and of robustness.

Desirable traits in a welfare breeding goal will include skeletal and cardiovascular soundness, resistance to disease and high neonatal vitality. As we move towards more extensive housing systems, we will also need an increased focus on behavioural traits such as reduced aggression and im-proved maternal behaviour. ■

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# Dr Walling Debates

## 6 Ensuring good meat eating quality

**This month Dr Grant Walling speaks to Caroline Mitchell, JSR's meat scientist, who has been instrumental in setting up the JSR Food Quality Centre. The Centre includes both a fully trained and commercial taste panel.**

**Dr Grant Walling: Why do we see so much variation in the quality of pork that we eat and what are the three most important causes in variation?**

**Caroline Mitchell:** Everything from conception to consumption affects the final meat eating quality of pork. In a global market there will always be variation and JSR have spent time identifying the best breeds for meat eating quality.

Once genetics have been optimised, nutrition must be addressed. The number of muscle cells within a slaughter animal is decided before birth and within a few days of farrowing. It is therefore crucial that the sow ration aids foetal development. The finisher ration given to the slaughter progeny is also important. By adjusting energy/protein levels and adding supplements such as vitamin E, it is possible to increase marbling, improve colour stability and develop flavour.

Finally, welfare is important to the quality of pork. By preventing disease stress, ensuring stocking densities are optimised, feeder and drink space is sufficient and the production environment allows for consistent growth free from heat or cold stress, it is possible to reduce variation to a level that is not perceived by the consumer.

**GW: For producers, which are the easiest areas to change to improve meat eating quality?**

**CM:** The easiest place to start making the change is genetics. It is important to ensure the genetics selected suit the production system; an animal that grows slower than its potential will produce meat of a reduced quality and an animal that has undergone interrupted growth produces even poorer meat.

**GW: Is there any evidence to suggest modern pig production has decreased meat eating quality?**

**CM:** Modern pig production has made huge inroads in improving meat eating quality. Production systems are larger than in previous generations and genetics are sourced from fewer companies, which means that overall consistency has improved. The introduction of Farm Assurance Schemes has resulted in welfare improvements and a reduction in poor quality meat from stressed animals.

Speaking to consumer panels at the JSR Food Quality Centre, one of the most common criticisms towards pork is lack of flavour and there are several reasons for this.

The laying down of fat is less cost-effective than laying down lean meat and as a result, genetic companies have placed a lot of selection pressure on lean growth, often to the detriment of marbling fat.

However, when producers are paid based primarily on carcase weight, there is little incentive to improve meat eating quality, especially if the farmer will not recoup additional costs.

In addition, there has been a lot of media coverage about the negative affect to human health of animal fats. Luckily, with increased interest of consumers in food, the point-of-purchase decisions are more informed and marbling is less likely to be rejected.

**GW: From your experiences with the taste panels what are the most common reasons why people are not enjoying pig meat?**

**CM:** Lack of flavour is one of the key areas for discussion within a taste panel. However, too much flavour can also be negatively received. The consumer does not want 'piggy' pork but prefers 'sweet' flavour compounds. However there is an interesting split between male and female panellists with more of the men preferring the 'piggy' pork flavour.

Another frequent complaint is that meat is too dry. Whilst largely due to overcooking, this is also a result of reduction in both back fat and marbling fat.

Fat not only creates flavour, but it keeps the meat moist. An added bonus is that marbling fat can cause increased salivation during chewing, which increases the perception of the meat being succulent.

**GW: With increasing competition from poultry, in which areas does pig meat outperform its largest rival?**

**CM:** When you compare the nutritional profile of pork to chicken there are several health benefits associated with eating pork. For example, 100g of pork contains 124% of your iron Recommended Daily Allowance (RDA), while 100g of chicken only contains 6% of the iron RDA.

Pork is also a good source of vitamin C, with 100g containing 19% of your RDA. Chicken is not a source of vitamin C. When you look at the nutrient balance of the two meats, pork outperforms chicken with a completeness score of 52 compared to just 34 for chicken.

**GW: When you are selecting pork to eat what do you look for to ensure good meat eating quality?**

**CM:** If I'm buying from the supermarket I look for good fat coverage, I also want to choose the piece with as much marbling as possible. Next, I look for a consistent colour and a meat surface that looks moist, but not wet.

Finally, mainly when looking at chops, I look for a thick cut. The surface area to volume ratio is important during cooking for maintaining moisture.

When I'm buying from a butcher I will look for the same things but I will also ask for meat that has been aged for a minimum of four days. ■

JSR **Dr Walling Debates**

# 7 Is laboratory grown meat the next big thing?

**Early August saw the world's first laboratory-grown burger cooked and eaten at a press conference in London. Taking cells from a cow, an institute in the Netherlands managed to turn them into muscle, which was used to produce a burger. This was done by culturing cells from a cow's muscle tissue with nutrients and growth-stimulating chemicals to help them develop and multiply. In just three weeks, more than a million stem cells had been produced, which formed small strips of muscle which could be combined and compacted into a patty.**

Scientists suggested that this new technology might eventually be developed into a sustainable way of meeting the growing, global demand for meat. And of course if we could simply grow meat, without having to produce an animal, there would, on paper at least, be a number of advantages. Meat could in theory be produced more efficiently – concerns over food conversion ratios for example would be a thing of the past! And the process would undoubtedly produce fewer pollutants as slurry and urine would be eliminated.

Additionally, to produce the same amount of beef as a conventional farm, this new process required only 55% of the energy, produced only 4% of the greenhouse gas emissions and used only 1% of the land.

So with the need to feed a growing population, is this the future? Well, there's still a very long way to go and the challenges are extreme if not insurmountable. They are also caused because the scientists are not able to meet the most important concerns, those of the consumer. These concerns relate to taste, texture and scale of production.

Firstly, because the muscle cells were grown in a laboratory, with no blood supply, the meat they produced was colourless, meaning that additional ingredients were needed to provide colour. It was also bland, if not tasteless, because muscle cells contain mostly water, and the meat was lacking the usual mix of muscle, blood and fat.

As a result, the research group had to add beetroot juice, breadcrumbs, caramel and saffron to provide colour and taste. Looking ahead one of the scientists, Helen Breewood, is exploring the idea of trying to make the meat red by adding the compound myoglobin.

When the moment of truth came, the best that could be said of the 'artificial burger' which was cooked by Cornish chef Richard McGeown and tasted by two food critics was that it was "close to meat, but not that juicy" and food writer Josh Schonwald said "what was consistently different was flavour."

So whilst the scientists produced the right cells, they would be the first to admit that there is still a long way to go before the technology can artificially achieve the taste that people expect from their meat.

And this is crucial because research conducted by our JSR Food Quality Centre at the Yorkshire Wolds Cookery School found conclusively, that the three primary criteria people consider when buying their meat are taste, tenderness and succulence. And it's why the centre conducts regular taste panel sessions to assess the taste, colour and smell of the meat we produce. Our taste panellists are trained and provide written as well as verbal feedback.

JSR is also globally recognised in the field of pig genetics and have been instrumental in developing industry leading products with exceptional meat eating quality. It is this excellence that has developed pioneering supply chain agreements ensuring all stakeholders in the supply chain deliver on their commitment to quality pork.

Unusually for a global pig breeding business, JSR also own 4,000 commercial sows mated with AI from our own sire lines. As such, we understand that everything from conception to consumption affects the final meat eating quality. We have done extensive research into identifying and developing the breeds, feed and methods to achieve high meat eating quality to suit all tiers of products from our pork.

So until artificial meat can be produced which meets the needs of the consumers, hence delivering great taste, tenderness and succulence, growing meat in the laboratory will never be a viable alternative to rearing livestock.

There's another key problem too and that is scale of production. The lack of blood supply means that scientists can only make small pieces of meat currently as larger ones would require artificial circulatory systems to distribute nutrients and oxygen. This challenge has yet to be tackled.

The world's first 'artificial' burger was certainly an interesting idea and an impressive technical achievement. But is laboratory-grown meat going to become the next big thing? Probably not. But it could make it to our supermarket shelves in 20 years' time as a niche product, similar to Quorn. For the next steps of this project the scientists need to get out of the laboratory and engage with the consumers, changing their emphasis from quantity to quality if this interesting piece of science is to become anything more than yesterday's leftovers. ■

JSR Dr Walling Debates

# 8 Preparing for higher welfare

**In line with changes in the EU over the past 12 months, which has seen loose housing for gestating sows, Michigan is the latest region of the world to state its determination to enforce higher levels of animal welfare on its pig producers.**

Reaction to such legislation tends to fall into two categories. For some, there will be uproar and the belief that it will make the business less competitive because they simply cannot comply.

Alternatively, some producers will take a slightly more constructive view, which will be to embrace the change however disappointed they may be with the decision and then look for opportunities to implement the changes more effectively than their competitors.

Producers in the UK have had much more experience of this and we aware of the pitfalls and adaptations that are required. One of the biggest challenges is coping with how animals that have previously been separated behave when they are then grouped together. This is a problem that the poultry industry experienced when battery cages used in egg production were replaced with group cages. Animals that performed perfectly well when isolated do not necessarily show the right behaviour when grouped together.

Aggression towards other animals can be a significant problem, and animals that were selected on their individual performance are not necessarily the ones that you want to select when considering group performance.

Passive animals can become the victims of bullying and a drop in their performance can often be seen, whereas excessively aggressive animals can cause widespread disruption in a pen.

Producers can take a variety of steps to overcome these problems. Pen design, feeder space, water flow rates and management and mixing strategies are critical to the outcome, however, there are genetic steps that can also be taken to ensure animals are bred to perform in groups, rather than individual environments.

Aggression itself is not an easy trait to measure, but there are other more simple indicators that lend themselves to statistical analysis to make sure genetic improvement doesn't come with the unwelcome introduction of more aggressive animals, unsuited to the standards and systems that are expected of the producers.

Breeding companies have a number of strategies at their disposal to select the correct pigs for the system and producers should discuss these options with their breeding company before purchasing stock. ■