EU PiG

EU PiG Innovation Group

Technical Report

Welfare

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Challenge: Castration

1. Introduction

Routine surgical castration of piglets is a welfare concern for European pig production. It has been scientifically proven that surgical castration is a painful intervention even when performed in very young animals. Castration is practised to avoid the development of undesirable sexual or aggressive behaviour, and to avoid the development of boar taint, since the expected taste and odour of pig meat is a very important aspect that consumers take into account when buying pork. Castration is not a producer's decision but a market-driven choice. Castration has an impact on the type, quality and quantity of meat and fat. Castration can have a negative impact on feed conversion and, consequently, on the environment.

On the invitation of the European Commission and the Belgian Presidency and following a workshop on alternatives for pig castration, representatives of European farmers, the meat industry, retailers, scientists, veterinarians and animal welfare NGOs met in Brussels in 2010 on several occasions to discuss the issue of pig castration and its possible alternatives, and to consider the possibilities to end this practice. This initiative resulted in a 'European Declaration on alternatives to surgical castration of pigs, intending to provide a European-wide approach and mutual recognition to facilitate trade in pig meat on the internal market and for export to third countries. The declaration stated that from 1 January 2012, surgical castration of pigs should be performed with prolonged analgesia and/or anaesthesia with methods mutually recognised. By 1 January 2018, surgical castration of pigs should be abandoned as such, but only if a number of conditions are met:

- Mutually recognised detection methods for boar taint at slaughter plants should be available.
- Reduction of boar taint compounds by pig breeding and/or management and feeding should be possible
- The production systems and management of entire males during rearing, transport and at slaughter, to minimise sexual and aggressive behaviours, should be present
- The costs for implementing the end of surgical castration should be shared between the economic actors of the chain
- The products from pigs not surgically castrated should be accepted by the authorities and the consumers in the European Union but also in third-country markets
- Alternatives to surgical castration with analgesia and/or anaesthesia in the case of pig meat registered under "traditional specialties guaranteed" or with "geographical indications" should be available

To ensure a sustainable and competitive pig meat chain in the EU, a European partnership on pig castration, supported and funded by the European Commission, should be established.

In the final report (2016) of the “Study on methods of anaesthesia and analgesia for the castration of all pigs and on alternative methods to the castration of pigs used in traditional products”, the CASTRUM Consortium states that castration of male piglets is predominantly done without analgesia and/or anaesthesia. The use of anaesthesia (local or general) is mandatory in only a few countries and prior analgesia is used as part of national assurance programmes in some other countries. Limited advancements have been obtained in the last 10 years on the use of anaesthesia and/or analgesia in male piglet castration, from both scientific and technical points of views. Furthermore, pain mitigation interventions should include anaesthesia (for intra-operative pain) combined with analgesia (for post- operative pain). Analgesics given alone do not fulfil this requirement as they are mainly effective to mitigate pain post-surgically. Applications of analgesics and anaesthetics impose additional handling and stress on piglets. Long-lasting pain-reducing drugs that could be effective during and after castration are not available for the use on piglets. There are no drugs that are effective for three or more days, but meloxicam and ketoprofen are available for piglets and effective for 24 hours. The systematic use of analgesia and/or anaesthesia for pain relief during surgical castration of male piglets is presently rarely used, but it is common in Norway and Sweden (local anaesthesia) and Switzerland (isoflurane anaesthesia) and the Netherlands (CO^2 anaesthesia in piglets for NL market if not raised as entire male, local anaesthesia and analgesia in organic farming). It seems that some practices, such as local anaesthesia and inhalation anaesthesia with isoflurane, both combined with analgesic pre-emptive treatment, could be considered for pain relief as these methods seem to be superior to other methods, considering effectiveness. These methods also have several drawbacks and risks in other aspects, such as legal limitations regarding use by the farmer or health risks for the farmer: isoflurane can pose a risk for the person administrating the anaesthesia and carrying out the castration and safety requirements regarding the environment in which it is used are generally high. But, there are safety devices to reduce the risks. Theoretically, surgical castration could be replaced by entire male pig production, immunocastration, chemical castration or sperm sexing. Sperm sexing is not available yet for the porcine species in commercial conditions, while chemical castration can be painful. Therefore, entire male production and immunocastration are at the moment considered as the only viable alternatives to surgical castration.

There are a number of well-known advantages and disadvantages to the use of entire male pigs in standard productions. In the case of raising heavy pigs, the number of advantages decreases, whereas the number of disadvantages increases and those disadvantages are more serious than at a slaughter weight of around 110 kg. The use of entire males is tentatively evaluated as difficult/impossible to implement and/or damaging for meat quality. Moreover, a large majority of the chain actors (i.e. producers, slaughterhouses and retailers) that are using only surgical castrates are not currently prepared to change their position. Of course, this is not the case all over Europe, for example in the Netherlands, Spain, UK and

Ireland, it is shown that entire male production is possible on a larger scale.

Immunocastration is a practice that uses a vaccine against gonadotropin-releasing hormone (GnRH) to prevent the development of boar taint in non-castrated male pigs. It uses the natural immune system of the pig to form specific antibodies that bind to and neutralise GnRH, thus the hypothalamic-pituitary-gonadal axis is blocked and sexual steroids synthesis is effectively inhibited. Immunocastration becomes effective after the second vaccine injection at four to five weeks before slaughter and is technically feasible in heavy pigs. It prevents most of the disadvantages associated with entire males. There are, however, a number of remaining issues that should be investigated or further considered: the incomplete efficacy of the vaccination in some pigs; the economic convenience of this practice; the security of the operators during the vaccination procedures; and the practical feasibility of the interventions on pigs that are raised in free-ranging systems and on pigs with heavy weights that might require a third vaccination. There is a general concern about the acceptability of pork from immunocastrated pigs by slaughterhouses, retailers and consumers. This problem seems one of the main drawbacks for the application of this technique in all production systems. In general, immunocastrated male pigs exhibit similar meat quality to surgically castrated males. Most producers that use immunocastration are adhering to the system. In addition, they show an improved feed efficiency until second vaccination and possibly even after that until slaughter.

A major constraint to producing entire males or immunocastrated pigs remains the absence of a reliable system for detecting boar taint. In the case of immunocastration, another possible detection method could be the size of testes, but it is not completely satisfactory: some immunocastrated males may present larger testes than entire males. Implementing alternatives for surgical castration is therefore not the producer’s choice. The acceptance of products from pigs not surgically castrated by authorities, consumers, slaughterhouses, and especially retailers in the European Union but also in third-country markets remains the main hurdle for arriving at a surgical castration ban by January 1st 2018.

In order to promote the alternatives to surgical castration, EU PiG has searched for practices at farms that enhance one or more of the tools. However, we weren’t able to find five cases that fit the criteria.

2. Methodology

The EU PiG project invited pig farmers to propose practical and innovative alternatives to surgical castration. Fifteen ideas were submitted by 31 March 2017. The ideas came from eight countries, outlined in the table below.

Austria	1
Belgium	2
Finland	1
France	1
Germany	2
The Netherlands	3
Spain	2
UK	3

In order to identify the top five best practices across all the EU PiG regions, a series of criteria have been used, which are able to measure the effectiveness of the collected practices to match the specific challenge.

The following set of criteria have been scored for each practice.

- **Excellence/Technical Quality**
  - Clarity of the practice being proposed
  - Soundness of the concept
  - Knowledge exchange potential from the proposed practice
  - Scientific and/or technical evidence supporting the proposed practice
- **Impact**
  - The extent to which the practice addresses the challenges pointed out by the Regional Pig Innovation Groups (RPIGs)
  - Clear/obvious benefits/relevance to the industry
  - Impact on cost of production on farm and/or provide added value to the farming business or economy
  - The extent to which the proposed practice would result in enhanced technical expertise within the industry, e.g. commercial exploitation, generation of new skills and/or attracting new entrants in to the industry
- **Exploitation/Probability of Success**
  - The relevance of the practice to each Member State (MS) or pig-producing region/system
  - Timeframes for uptake and realisation of benefits from implementation of the proposed practice are reasonable
  - Level of innovation according to the Technology Readiness Level (TRL)

- The extent to which there are clear opportunities for the industry to implement the practice/innovation
- Degree of development/adaptation of the practice to production systems of more than one MS

Scores had to be in the range of 0-5 (to the nearest full number). When an evaluator identified significant shortcomings, this was reflected by a lower score for the criterion concerned. The guidelines for scoring are shown below (no half scores could be used).

0	The practice cannot be assessed due to missing or incomplete information.
1 – Poor	The practice is inadequately described, or there are serious inherent weaknesses.
2 – Fair	The practice broadly addresses the criterion, but there are significant weaknesses.
3 – Good	The practice addresses the criterion well, but a number of shortcomings are present.
4 – Very Good	The practice addresses the criterion very well, but a small number of shortcomings are present.
5 – Excellent	The practice successfully addresses all relevant aspects of the criterion. Any shortcomings are minor.

The selection of the top five practices followed a procedure in five steps:

1. All members of the Thematic Group[1] (TG) received all relevant information on the candidate good practices on alternatives for surgical castration that were submitted to EU PiG.
2. The TG members scored all the candidates for the above-mentioned criteria.
3. The average score for each of the three criteria was calculated for the scores that were provided by the TG members.
4. A final score was calculated for each of the applications as the average of the mean scores of the three criteria.
5. The applications with the top five final scores were proposed as candidate best practices for alternatives to surgical castration.

[1] A number of stakeholders in the field of welfare will be identified, representing academia, industry, pig producer organisations and veterinarians. This group, which will also include the WP participants and RPIG leaders with a strong interest in welfare, will form the welfare Thematic Group.

4. Results and Discussion

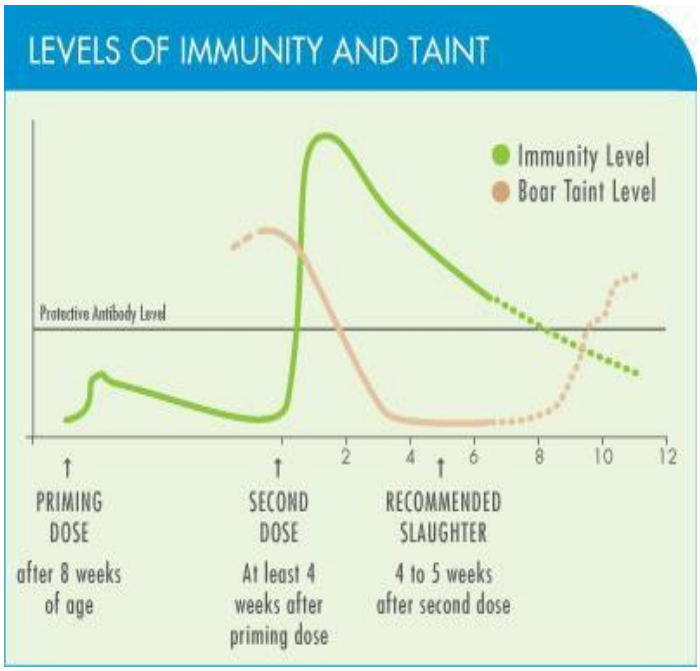
In total, fifteen innovative alternatives to surgical castration were scored. For the five best alternatives, scores, opportunities and shortcomings are presented and discussed below.

4.1. Improvac – Belgium

Improvac, an alternative to physical castration that uses a pig's own immune system to prevent unpleasant odour and taste in pork, received Pfizer's first Environmental Product Declaration (EPD®) certification. EPD provides relevant, verified and comparable information about the environmental impact from goods or services. Unlike physical castration, which is performed early in a pig's life, Improvac is administered twice, with the second vaccination only a few weeks prior to slaughter, and allows pigs to grow naturally and more efficiently as boars most of their lives. They eat less feed, create less waste and provide a greater percentage of lean meat than castrated pigs. This improved efficiency provides direct and indirect environmental benefits, principally due to reductions in feed consumption and manure generation.

EU PiG evaluation of the idea

The product is given in two doses. The first dose of Improvac primes the pig's immune system but does not alter testes size or function. The second dose stimulates the protective immune response that inhibits testes function. Boar-taint levels drop dramatically as Improvac takes effect. Androstenone is no longer produced, skatole clearance increases and testes reduce in size. Optimal time for slaughter is four to five weeks after the second dose.



A questionnaire by 289 farmers from 20 countries gave a list of why some farmers cannot envisage using immunocastration. The most occurring reasons were:

- Fear for meat quality
- Marketing and economic risks
- Occupational safety and health consequence or risks
- Handling of the animal

4.2. Entire Male Production – Spain

Spain has traditionally produced a noticeable percentage of male piglets among those not aiming at heavy pigs market without castration. It is estimated that at present around 80% of male piglets are not castrated, to take advantage of the better efficiency of producing entire males and of the healthier meat with less fat content and to avoid the practice of castration which has raised welfare concerns. The farmer presenting this good practice is aware of the risks of producing entires: boar-tainted carcasses and increased aggression and sexual behaviours. For those reasons, hygiene levels are taken into consideration and pigs are slaughtered at around 105 kg live weight. Surveillance of behaviour is regular, to detect potential problems of increased aggression.

EU PiG evaluation of the idea

Production of entire males is not the most common strategy in most EU countries, for example; Ireland, UK and Spain where, traditionally, numbers were once higher. The benefits of producing entire males have been published in different papers (e.g. Fàbrega et al., 2010): better production efficiency, no need for castration and avoidance of the welfare side effects of the practice or other problems such as scrotal hernias or risk of mortality in some cases. From an economic point of view, farmers save the associated costs of surgical castration: handwork, materials, anaesthesia and/or analgesia. However, the risk of boar-tainted carcases and increased levels of aggression and sexual behaviours need to be properly addressed to ensure that entire male production is a proper alternative to surgical castration, both on meat quality and welfare grounds. Producing entire males requires proper hygiene and health status on the farms and proper management and supervision skills from the farmers to foresee and, if necessary, solve behavioural problems.

4.3. Immunocastration – Spain

The Company has a project to increase meat quality under the label ‘Porc Ral d’Avinyó’. Pigs are slaughtered at 128 kg mean live weight. At that age, females start to show oestrous signs, which may have a negative impact on meat quality. Therefore, females are immunocastrated to obtain a better fat deposition and avoid oestrous influence on meat quality. Females are immunocastrated with two doses of the vaccine, the second one given a month before slaughter. The benefits of the practice are better organoleptic properties of meat, probably associated with an improved pattern of fat deposition.

EU PiG evaluation of the idea

The vaccine inducing the production of antibodies against GnRH was developed for the control of boar taint in intact male pigs. In males, vaccination reduces production of luteinising hormone (LH) and follicle-stimulating hormone (FSH) by the pituitary gland, reducing the production of sex hormones by the testes. The immunisation regimen comprises two subcutaneous injections in the neck, at least four weeks apart. The first vaccination only primes the pigs immune system, the second one (usually administered four to five weeks before slaughter) stimulates high levels of anti-GnRF antibodies that neutralise the pigs endogenous GnRF, which inhibits testicular function. This regimen ensures freedom from boar taint at slaughter and allows pigs to spend most of their fattening period as functional males before puberty. In female pigs, antibodies against GnRF were expected to reduce luteinising hormone (LH) and follicle-stimulating hormone (FSH) production and, thus, to have similar effects in the gonads of females as those in males, resulting in suppression of oestrus. Several studies have demonstrated that, certainly, vaccination in females can suppress oestrus (Dalmau et al., 2015) and, therefore, it may be used to obtain some effects on meat characteristics. Another scenario in which immunisation of females may be of interest is to avoid pregnancies in female pigs raised outdoors until heavy weights, for example in the Iberian pig production system.

4.4. General anaesthesia by intravenous injection of ketamine and azaperone for surgical castration of piglets

This is not actually an alternative for surgical castration, but we found that this practice could be useful for some farmers. General anaesthesia is used during piglet castration in order to reduce pain and distress for the piglets. For the general anaesthesia, a combination of ketamine and azaperone in one syringe is used by intravenous injection administered by the herd veterinarian. Additionally, all piglets are treated with painkillers to reduce post-operative pain. Piglets are castrated at around twelve days of age to reduce potential negative effects of general anaesthesia in piglets less than seven days of age. No negative impact of the older age at castration is seen on wound healing. Due to the intravenous injection of the anaesthetics, the piglets return to suckling within one to two hours after castration. The application of this method could be a good alternative for smaller farms, where a veterinarian visits routinely for injecting the animals, followed by castration by the farmer.

EU PiG evaluation of the idea

Opportunities of method:

- General anaesthesia can be used not only to perform the castration but also other standard procedures like tail docking, ear tagging and iron injection/vaccination

Drawbacks:

- Castration at a higher age can increase the chance of complications (like post-operative bleeding) due to larger anatomical structures like cremaster muscle and blood vessels in the spermatic cord
- Anaesthesia with ketamine and azaperone does not fully prevent the pain initiated by castration, especially the pulling of the testes outside of the animal to enable cutting the cord, let alone preventing the pain when severing the cords by pulling
- A longer recovery time from anaesthesia (which can last hours until full recovery in piglets) can induce hypothermia, crushing by the sow due to uncoordination in the piglets and missing suckling bouts, resulting in higher mortality
- Intravenous injection is a challenging route of administration in piglets this age; the alternative is intramuscular administration with a longer induction period which is easier to carry out (could also be performed by farmers)
- Ketamine is a dissociative drug (used as a party drug) which can induce unpleasant experiences for the piglet
- No post-operative pain relief is achieved

5. Cost-benefit analysis of the EU PiG Best Practice for alternatives to surgical castration

The selected EU PiG Best Practice is ‘Entire Male Production’ (Spain). The unit is a 720-sow, farrow-to- finish ‘closed unit’, producing entire males.

The costs and benefits of this system have been analysed, taking into account the changes in technical performance parameters. Based on the real farm data and calculations with the Interpig model, the following changes have been observed:

- 3.86% lower labour input per pig due to lack of castration practice
- Finishing feed conversion ratio was 5.34% better in the case of entire males compared with castrates; castrates have higher feed intake by 9%
- Daily life weight gain was 3.6% lower in the case of entire males compared with castrates
- Average lean meat percentage is 4 - 5% higher in the case of entire males compared with castrates
- The farmer and ambassador didn’t report higher mortality effects or vet costs due to avoiding castration

Based on these assumptions, the variable production costs **were lower** by 3.2% and total costs by 2.7% in case of entire male production (€1.36/kg vs €1.40/kg hot slaughter weight). However these gains might be neutralised by a slightly lower price (by 3.36%) obtained for non-castrates (€1.092 vs €1.13 /kg).

6. Practical advice

The following recommendations can be taken from these EU PiG finalists:

- Raising entire boars is feasible
- Use anaesthesia and analgesia if boars need to be castrated
- Castration (physical or immunocastrations) is difficult to avoid in heavy pigs production systems at present
- Improvac is an effective alternative to surgical castration

7. References

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Challenge: Tail docking

1. Introduction

Pigs have a natural tendency to perform exploratory and foraging behaviour for many reasons, such as searching for food, finding a place to sleep or simply out of curiosity. Pigs perform it at a very young age even if they are provided with enough feed to satisfy their dietary needs.

Sometimes the exploratory behaviour of pigs is redirected to the tails of pen mates. This can be regarded as a sign of boredom, insufficient stimulation and frustration that the environment is not sufficiently varied enough to satisfy exploratory motivations. This behaviour can also take the form of ear, flank or even vulval or penis biting. However, tail biting is the most widespread and serious of these behavioural abnormalities, as it can result in tail damage and even cannibalism. The cause of tail biting is multifactorial. Most factors have been identified and some factors are more important than others. The ‘overflowing bucket’ model is often used to describe the cause of tail biting. Many associated factors can accumulate without tail biting occuring but an additional minor factor may cause the bucket to overflow and tail biting to take place. Although the exact triggering mechanism remains elusive, a wide range of environmental, dietary and husbandry aspects have been identified as risk factors for tail biting, ranging from lack of adequate enrichment material, high stocking densities, competition for feed/water, inadequate diet (deficiencies of sodium or essential amino acids) to poor health status, climate and ventilation conditions, animal characteristics (breed, genetics, gender) or social environment (herd size, mixing animals).

Tail biting typically occurs after a period of pre-injury tail chewing, in which gentle, non-injurious chewing of the tail occurs, often when pigs are resting. For pigs with intact tails, such non-injurious biting may be noticed due to the low altered tail posture. Furthermore, tail hair may be missing at this stage. This is then followed by a damaging stage - biting is more forceful, blood is present from wounded tails and the behaviour escalates within the group. Once a tail is bitten, the injured pig becomes more active as a result of discomfort and pain. The increase in activity and the taste of blood may attract more biting and more pigs to bite tails. The stockperson will usually become aware of the problem at this stage. Later on, the severely injured pig will become apathetic, lie down much of the time, seldom change its position and react only slightly to being bitten.

Tail-biting incidents also occur, to less extent, when tails are docked. Therefore, docking does not necessarily solve the tail-biting problem, and it certainly does not remove the underlying causes.

The presence of tail biting may be assessed by using a scoring system, but the first stages of the process in tail-docked pigs are difficult to be picked up by the observations of a passing stockperson. Still, it is possible. Tail biting may be seen in different scenarios, starting from a constant low-grade problem in a production unit to explosive outbreaks in batches. As such, the incidence is highly variable, depending on the management of the production site.

As well as this primary outcome of the unnecessary pain suffered and frustration felt by the animal, this aggressive behaviour also leads to important economic impacts in the pig industry. Tail lesions not only increase the risk of carcases being condemned and trimmed, primarily because of abscesses, they are also associated with lower carcase weights.

Tail biting may never be completely eradicated, but risks can be considerably reduced if correct management measures are introduced, such as supplying appropriate enrichment materials and providing other management measures such as appropriate environmental conditions, good health status and a balanced diet. It is therefore advisable to monitor the risk factors by keeping detailed records of the husbandry conditions of the pigs, as well as any findings that may trigger an episode of tail biting. This may help in identifying the underlying cause of the problem and measuring how effective, in the case of an outbreak, the measures put in place are.

The aim of this EU PiG challenge is to show practices at farms that address one or more success factors that contribute to a reduction of tail-biting outbreaks in an attempt to limit the number of tail-docked pigs.

2. Methodology

The EU PiG project invited pig farmers to propose practical and innovative approaches to reduce tail biting. Thirty-one ideas were submitted by 31 March 2017. The ideas came from twelve countries, outlined in the table below.

Austria	1
Belgium	3
Denmark	1
Finland	4
France	1
Germany	2
Ireland	6
Italy	3
Netherlands	2
Poland	4
Spain	1
UK	3

In order to identify the top five best practices across all the EU PiG regions, a series of criteria have been used, which are able to measure the effectiveness of the collected practices to match the specific challenge.

The following set of criteria have been scored for each practice.

- **Excellence/Technical Quality**
  - Clarity of the practice being proposed
  - Soundness of the concept
  - Knowledge exchange potential from the proposed practice
  - Scientific and/or technical evidence supporting the proposed practice
- **Impact**
  - The extent to which the practice addresses the challenges pointed out by the RPIGs
  - Clear/obvious benefits/relevance to the industry
  - Impact on cost of production on farm and/or provide added value to the farming business or economy
  - The extent to which the proposed practice would result in enhanced technical expertise within the industry e.g. commercial exploitation, generation of new skills and/or attracting new entrants in to the industry
- **Exploitation/Probability of Success**
  - The relevance of the practice to each MS or pig-producing region/system
  - Timeframes for uptake and realisation of benefits from implementation of the proposed practice are reasonable

- Level of innovation according to the Technology
- Readiness Level (TRL)
- The extent to which there are clear opportunities for the industry to implement the practice/innovation
- Degree of development/adaptation of the practice to production systems of more than one MS

Scores had to be in the range of 0-5 (to the nearest full number). When an evaluator identified significant shortcomings, this was reflected by a lower score for the criterion concerned. The guidelines for scoring are shown below (no half scores could be used).

0	The practice cannot be assessed due to missing or incomplete information.
1 – Poor	The practice is inadequately described, or there are serious inherent weaknesses.
2 – Fair	The practice broadly addresses the criterion, but there are significant weaknesses.
3 – Good	The practice addresses the criterion well, but a number of shortcomings are present.
4 – Very Good	The practice addresses the criterion very well, but a small number of shortcomings are present.
5 – Excellent	The practice successfully addresses all relevant aspects of the criterion. Any shortcomings are minor.

The selection of the top five practices followed a procedure in six steps:

1. All members of the TG received all relevant information on the candidate good practices on reduction of tail biting that were submitted to EU-PiG.
2. The TG members scored all the candidates for the above-mentioned criteria
3. The average score for each of the three criteria was calculated for the scores that were provided by the TG members.
4. A final score was calculated for each of the applications as the average of the mean scores of the three criteria.
5. The applications with the top five final scores were proposed as candidate best practices for reduction of tail biting.

4. Results and Discussion

The following five ideas were rated highest among all those received.

4.1. Schwanzbeiß-Interventions-Programm (SchwIP) (Tail biting intervention programme) – Germany

SchwIP is a software tool focused on advisory services to reveal weak spots casual for tail biting. Tail biting in pigs is a so-called multifactorial problem. This means that in most cases an outbreak is triggered by the combined effect of a large number of factors. On some farms, many risk factors are related, e.g. health, feeding or climatic issues. Stability and rest is challenged as circumstances change rapidly over time. Thus, identifying the risks specific to a certain farm is a major task. SchwIP is a management tool which combines farm planning (regular status quo determination and adjustment of measures) with farm-specific risk assessment. The management tool is aided by software for PC and Android operating systems, which contains questionnaires, expert weighting of risk factors and checklists to capture the individual risks. A farm assessment takes approximately four hours and includes an interview, as well as direct assessment of husbandry and animal-based parameters.

EU PiG evaluation of the idea

Tail biting and other vices have been studied for many years and have been the subject of numerous research and publications. Nevertheless, experiments are often difficult to implement because of the multifactorial and random occurrence of tail biting. Although many risk factors have been identified and validated, others are often mentioned by livestock advisers who encounter tail biting in farms (technicians, veterinarians). The tool presented synthesises all of these sources of information and pays particular attention to weighting each risk factor by experts. It formalises them through an audit, based on measurements both on the environment and on animals, allowing the risks present at a given moment on that farm to be highlighted. Under normal conditions, there is a balance between risk factors. Failure of any of these factors may be the trigger for tail biting. The result of the audit is discussed with the farmer, which has two advantages: on one hand, the farmer acquires a better knowledge of the risk factors and, on the other hand, he can identify ways of improvement. The software tool allows an immediate discussion between the farmer and the adviser which is likely to favour a better implementation of the proposals discussed. It also allows repeated audits, recognising that farming conditions may change over time. The use of such a management tool is a way to reduce the occurrence of tail biting and a prerequisite for stopping tail docking.

4.2. Tail Biting WebHAT (Web-based Husbandry Advisory Tool) – United Kingdom

A three-year large-scale research project was established in 2006 to examine which risks highlighted in scientific literature were most likely to increase the likelihood of tail biting on commercial grower/finisher pig units. Statistical analysis of the results (based on 176 visits and over 28,000 pigs) enabled the production of a concise set of ranked, key risks (and combinations). This refined set of risks, is now presented within the online Tail Biting "WebHAT" (Web-based Husbandry Advisory Tool). The Tail Biting 'WebHAT' is a website designed to be an interactive resource for producers and their advisers. It enables the identification of early-warning signs and the risks most strongly associated with tail biting and generates a downloadable/printable report of prioritised risks, along with practical advice which is specific to individual situations rather than generic advice about the key risks for tail biting in pigs and suggestions to help reduce these risks on farm.

EU PiG evaluation of the idea

The identification of risk factors is an important first step in trying to address the problem. Risk factors have been well described in several scientific studies, and were summarised in 2014 in an opinion from the European Food Safety Authority. Their list of risk factors at pen level and at farm level are outlined in the following table.

Farm level analysis	**Pen level analysis**
Age	Age
Space per pig	Number of pigs in the farm
Number of water supplies	Space allowance
Slaughter weight	Manipulable material type
Pen size	Number of water supplies
Number of pigs in the farm	Initial weight
Initial weight	Flooring used
Space per 100 kg	Slaughter weight
Temperature	Drinkers type
Manipulable material type	Body condition score
Temperature	
Feed formulation	
Tail docking	
Cleanliness of the pen	

For farmers with persistent biting problems, an analysis by an objective outsider can lead to suggestions for improvement that were previously not identified by the farmer. This problem of 'blindness' to issues which are obvious to outsiders is very common, and a tool that helps farmers to look at their farm through somebody else's eyes can be very useful.

4.3. Finishing farm built in 2016 rearing pigs with intact tails - Finland

Sikana Oy farm has intact tails because docking is banned in Finland. The farm has 2,980 finishers, 10 pigs/pen with $^{1}/_{3}$ slatted floor and $^{2}/_{3}$ solid with heating. There are heating pipes at the wall and negative pressure ventilation. Pens have two wood pieces as enrichment material and provide wood shavings twice a day. The liquid feed consists of grain, barley, whey and supplements. It is supplied five times/day and the trough (30 cm/pig) is never totally empty. Feed consumption is checked daily and supply adjusted as needed. Pigs always have access to water that is quality-analysed regularly. Water pressure is adjusted for finishers. Compartments are preheated and pens have some bedding material and electrolyte solution in troughs when piglets arrive. Health status is high; SPF for enzootic pneumonia, atrophic rhinitis, mange, salmonella, PRRS and swine dysentery. The piggery is divided in to two compartments with separate equipment. Boots are changed between compartments for biosecurity.

EU PiG evaluation of the idea

This seems to be a well-run farm. Crucial risk factors which may lead to tail biting appear to be controlled. The farm has a high health status, a liquid feed is offered, fresh substrate is provided twice daily and piglets are offered bedding material on arrival. Unfortunately, no details on the level of tail biting or other injuries are provided, so it is hard to judge if these measures are effective.

4.4. Enrichment novelty - Spain

The owner of this farm has designed a system to change the type of environmental enrichment in each pen at regular intervals (every day) to promote the sense of novelty for the pigs. It works with a rotatory system of chains attached to the roof, which move hanging enrichment materials from one pen to another one. Enrichment materials included are wooden pieces, balls, straw containers, plastic rings and every day the owner changes the enrichment material in each pen with an automatic rotatory system.

EU PiG evaluation of the idea

Provision of sufficient quantity of enrichment materials is accepted as one of the strategies to avoid tail docking, as long as the materials meet the necessary requirements to enable pigs to fulfil their behavioural need for foraging. Proper materials should be edible, chewable, investigable and manipulable. Position, quantity and cleanness of the materials are among the properties which enhance their effectiveness. Moreover, novelty encourages exploratory behaviour over time and stimulates pigs to show sustainable interest towards the materials provided. For that reason, all those strategies that help the enrichment materials to appear

novel to pigs may have a beneficial impact on their effectiveness. As summarised in the figure below, interest for the materials decreases over time, especially for those made out of artificial components such as iron or plastic. Therefore, the attractiveness of this good practice presented in the practice 'novelty in enrichment material' is that it attempts to sustain the interest of pigs in enrichment material over time, by offering different types of materials and changing them on a regular schedule.

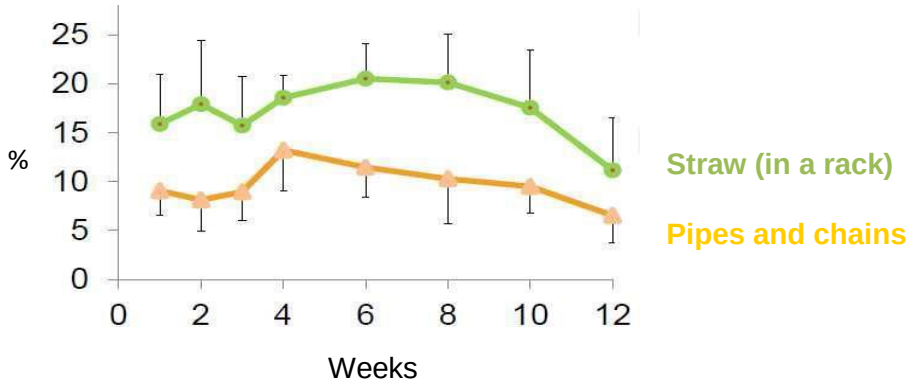

Figure 1. Percentage of use of two enrichment materials over time (from Courboulay, 2013)

4.5. On the risks of tail biting in pigs and avoidance of tail docking - Germany

In this project, online support is provided for farmers, veterinarians and advisers, who support farms in the avoidance of tail docking and tail biting. The basis of the homepage is a five-year exchange of experience. The results of the exchange are presented with a plain guideline. Pictures and videos also supported the results and hints. The challenge of the project is to keep the homepage up to date and close to new findings. With the weblink: www.ringelschwanz.info, farmers, veterinarians and advisers can retrieve helpful information about the prevention of tail docking and tail biting. The homepage should serve as a guideline, which shows possibilities for individual farm solutions to solve the multifactorial problem of tail biting. It should also give information to help those wishing to establish a herd of non-tail-docked pigs. The visitors to the website have the possibility of doing a self-assessment in relation to the docking status of their farms. Animal health and animal observation build very important focuses.

EU PiG evaluation of the idea

Online support is increasingly used to resolve a range of issues, including animal welfare problems on farm. For poultry, a feather pecking score was developed as part of the FeatherWell project of Bristol University (http://www.featherwel.org/injuriouspecking/howtofeatherscore). Another online tool supports

training to reduce tail biting and was developed by the EUWelnet project: http://www.euwelnet.eu/euwelnet/53669/5/0/80. The EUWelnet tool served as a support for the document accompanying the recommendation 2016/336 of the Commission (8 March 2016) on the application of Council Directive 2008/120 EC, laying down minimum standards for the protection of pigs with regard to measures to reduce the need for tail removal. While many support tools exist, it is crucial that each country develops online support in its own language, taking into account the specificity of the production systems present in the country.

5. Cost-benefit analysis of the EU PiG Best Practice for the reduction of tail- biting outbreaks in an attempt to limit the number of tail-docked pigs

The selected EU PiG Best Practice is '4.3: Finishing farm built in 2016 rearing pigs with intact tails' (Finland).

The costs and benefits of this system have been analysed.

Benefits:

- Time is won because the pigs don't need to be treated - this is approximately 15 seconds per pig
- Average daily weight gain from 30 kg to slaughter was 1080 g/d for this pig farm; the average in Finland was 967 g/d and in Europe the average was 946 g/d. The average daily weight gain for Europe can be found on this website: http://www.thepigsite.com/stockstds/17/growth- rate/. The averages for each individual country can be found here: https://pork.ahdb.org.uk/media/274535/2016-pig-cost-of-production-in-selected- countries.pdf
- The production cycle was 12.9 weeks for this farm; the average in Finland was 16 weeks and in Europe the average was 17.5 weeks

Costs:

- The farm invest in minimising stress so that the pigs don't have the urge to bite tails.
    - Extra space for the pigs: the space allowance in Finland is 0.9 m²/finisher compared with 0.65m² generally in the EU. So the cost are 1.38 times higher. The building cost is €757/finisher, which is €841/m² in the box
    - Negative-pressure ventilation - this raises the energy costs by 20%
    - Pens have two pieces of chewable wooden activation toys: in Finland the price of two pieces of activation wood is €0.5, which is divided between ten pigs at a time and lasts two production rounds, so it costs €0.025/pig
    - Twice a day wood shavings are added as enrichment materials – the cost is €1.25/pig
    - Analysis of water: a water analysis is done two to four times a year and the cost is €100/analysis, so this results in €100/3100pigs=> €0.015-€0.03/pig

The farmer doesn't get a higher price for his pigs; it's just mandatory.

6. Practical advice

The following recommendations can be taken from these EU PiG finalists in order to reduce tail-biting outbreaks and limit the number of tail-docked pigs.

- The selected best practice shows that it is possible to keep pigs with long tails on a commercial farm, when combining high welfare status, extra space, good environment and frequent renewal of enrichment material
- Use the various technical supports to know and evaluate the risk factors
- Check the status of the various risk factors on your farm regularly
- Novelty is an important attribute of an enrichment material
- Ensure that these risk factors are addressed and then start reducing the number of tail-docked pigs