EU PiG
EU PiG Innovation Group

Technical Report
Meat Quality

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1. Introduction

In this technical report, an overview is provided of good practice that are successfully applied in pig farms across Europe. Pig farmers and farm advisors can use this report to learn more about how the good practices have been implemented on the farms and what challenges these practices are able to tackle. This second-year report on the theme "Meat Quality" considers the following two challenges:

1. How to create homogeneous groups of pigs before slaughter reducing stress, losing less time, identifying pigs when ready for slaughter in order to obtain a higher price at slaughter
2. Technology and husbandry techniques e.g. handling, feed and castration to make pork more succulent and flavoursome

Challenge: Creating homogeneous groups before slaughter

Variability in pig weight at slaughter is one of the major issues nowadays in the pig industry aiming at standardizing the final product. Producers often talk in terms of weight average, treating a batch as if it was a single animal. Consequently, the batch will be ready for selling when, on average, it reaches the optimal weight for slaughter. However, when these pigs are evaluated, they will be considered individually: some will fall under the desired weight range, some will fall over (both carrying economic penalties), and only a few will fall inside the optimal weight range, reaching its full economical potential. It is when we look at every group of pigs as a distribution instead of as an average that we quickly understand that, with the same average weight, reducing variance is key to get more animals falling within the desired range. In many cases, homogeneous groups of pigs delivered to the slaughterhouse will obtain higher prices. Also, big differences in pig weight at slaughter age affect the optimal management of a farm, preventing the implementation of efficient all-in all-out programs.

Variability in pig weight starts at birth. It has been widely documented that slight variations of piglet weight at birth amplify through the pig's life causing (partially) the important differences that we can then find at slaughter age. Piglet birth weight impacts not only the final pig weight, as we have just seen, but it also has a strong influence on piglet survival rate, on pre and post-weaning piglet mortality (Collel et al. 2015). Health is a key element in pig welfare and steady weight gain is considered an indicator of good health and productivity (Kashiha et al., 2014). Manual measurements are among the most common ways to get an indication of animal growth. However, this approach is laborious and difficult, and it may be stressful for both the pigs and the stockman. As a consequence, manual measurements can be very time-consuming, induce costs and sometimes cause injuries to the animals and the stockman (Pezzuolo et al., 2018). In relation to this issue, new technologies for visual image

analysis have been developed in recent years to estimate and monitor the live weight of pigs on farm (Knogsro, 2014; Wongsriworaphon et al. 2015, Condotta et al. 2018). Information on the daily growth rate of pigs enables the stockman to monitor their performance and health and to predict and control their market weight and date (Pezzuolo et al., 2018). While certain management strategies such as grouping weights can reduce weight variability, having a tool to help make objective decisions on this issue is of great interest. Thus, the use of mathematical modelling to establish growth curves could be a great help (López-Vergé and Solà-Oriol, 2015). Pig delivery weight optimisation (PDWO) has been studied extensively and has resulted in several optimisation models. A PDWO has been studied to provide insights into four key questions: I) how do the driving forces behind the optimisation determine the optima, II) what is the dependency of the optimal delivery weight on market conditions, III) how do the opportunity costs due to suboptimal delivery evolve, in addition to the mere optimisation results and IV) what is the effect of differences in animal performance profile, in terms of growth, feed intake and average carcass quality on the optimal delivery results? The effect of market conditions on the optimisation depends on the animal profile, which determines the flatness of the payoff curve per pig (Leen et al. 2018).

1. Addressing the Challenge

Already for many years the uniformity of groups of pigs before slaughter is an important issue in the US pork industry. 64% of U.S. pork operations always assemble uniform groups for the slaughter market and another 32% accomplished this management practice most of the time. Many slaughterhouses in the U.S. pay premiums for uniform-sized pigs (USDA, 1996). The European pork industry is also highly aware of the importance of receiving homogeneous groups of pigs.

The creation of homogeneous groups of pigs before slaughter can either be achieved by weighing the pigs and accordingly create groups with a lower weight variance or by means of management techniques related to feeding. This second strategy has received major attention in recent research projects. Bostami and Islam (2015) found higher aggressive behaviour among the individuals of heterogeneous groups compared to homogeneous groups. Their economic analysis indicated that per unit of body weight gain of homogeneous group was better than the heterogeneous group (p<0.05). Weight grouping therefore might be applicable for better management for obtaining uniform slaughter weight group, better growth and carcass characteristics, and ensure animal welfare (Bostami & Islam, 2015). It should be reminded that split marketing, sending a homogenous group to the abattoir first and later another, may lead to aggression and more skin lesions in the pigs remaining at the home pen. (Fabrega et.al, 2011, Fabrega et.al, 2013). Lopez-Vergé et.al. (2018) concluded that higher feeder space availability may improve both body weight (BW) and average daily gain (ADG) along the growing and finishing periods. Regarding feeding management, results suggest that the light piglets, subjected to a specific feeding strategy at the start of the

growing period, increase their growth rate and partially catch up with their bigger/heavier counterparts.

2. EU PiG Best Practice

In order to identify the top five best practices across all the EU PiG regions, a series of criteria, aiming at measuring the effectiveness of the collected practices to match the specific challenge, were defined.

The following set of criteria was scored for each practice.

- **Excellence/Technical Quality**
    - o Clarity of the practice being proposed
    - o Soundness of the concept
    - o Knowledge exchange potential from the proposed practice
    - o Scientific and/or technical evidence supporting the proposed practice

- **Impact**
    - o The extent to which the practice addressed the challenges pointed out by the Regional Pig Innovation Groups (RPIGs)
    - o Clear/obvious benefits/relevance to the industry
    - o Impact on cost of production on farm and/or provide added value to the farming business or economy
    - o 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**
    - o The relevance of the practice to each Member State (MS) or pig producing region/system
    - o Timeframes for uptake and realisation of benefits from implementation of the proposed practice are reasonable
    - o Level of innovation according to the Technology Readiness Level (TRL)
    - o The extent to which there are clear opportunities for the industry to implement the practice/innovation
    - o 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 Thematic Group (TG) sent their scoring sheets to the TG leader
2. The TG members provided brief comments to the first 10 practices they have chosen as best practices, as these comments facilitated the discussion about the first five
3. The first 10 practices have been ranked according to the average scores of all participants of the TG All other lower ranked practices have been excluded
4. The TG leader collected all the comments of the individual members of the TG for each of these 10 practices and sent them around to the TG
5. In a dedicated meeting the TG discussed the results and finally decided on the top five good practices for each challenge based on the comments provided by the group

2.1. Validation of the top five best practices

Sorting pigs by machine vision system

This farm is conceived from a combination of techniques and good practices:

- Large volume buildings, lit by natural light, with significantly increased comfort for men and animals compared to traditional buildings
- An effective ventilation system (materials, slopes, regulation) and energy efficient heating
- Modular rooms to adapt housing to the growth of the animal
- Automation of animal sorting (vision) to limit handling and to devote more time to animal monitoring

The good practice here represented is to use a vision system to anticipate the release dates of the animals ready for slaughter according to a specific objective of live weight. This equipment significantly improves the regularity of production and the organization of selling. The computer records the photo of each animal with its weight assessment.

The farm sells its pigs mainly to two meat processors, which particularly sell cured hams. With this device, all pigs marketed are between 106 and 110 kg of cold carcass weight. This good practice is immediately transferable to other countries.

CIMA Control Pig

The challenge was to prevent the lack of homogeneity of pigs for slaughter and the necessity to dispose of a tool to monitor the productive performances of the finishing pigs. The good practice concerns an electronic weighing system, CIMA Control Pig, for weighing pigs quickly while they are moving without stopping or penning them in. The system saves much labour time, as the animals do not need to be blocked, but are weighed when they move. Each month pigs are weighed before slaughter in order to calculate the growth curve of the finishing pigs. In order to obtain reliable data, it is sufficient to involve a sample of 8% of the pigs. For very large pig farms this percentage may decline to 5%. The system calculates the average weight of all transited animals. The mobile weighing system is equipped with a chip identification device in order to identify the pigs. Data of pigs are transferred automatically to the management information systems of the farm.

An initial result is, that the finishing pigs are delivered in homogenous group to the slaughterhouse, which at the final payment determines a price premium. The growth performance of the finishing pigs is improved as the management system will be fed with detailed growth parameter data which allows to control ADG and feed conversion ratio (FCR). There is an increase of labour time due to weighing the pigs. During a finishing period of five months, five weighings are performed. Each weighing requires ten minutes per each group of 20 finishing pigs. Only 8% of the total number of pigs are involved with the electronic weighings. The costs are related to the purchase and application of microchips on the pigs. These costs are €1 per pig. The purchase of the mobile electronic weighing system is €3,000. One weighing system is needed for a finishing farm of 8,000 pigs, as only 8% of pigs needs to be weighted.

Slaughterhouses pay a price premium for homogenous groups of slaughter pigs.

The electronic weighing system can be fruitfully used in all pig farms in the EU and improve the growth performance of finishing pigs and create homogeneous groups at slaughter.

OptiSCAN: for successful pig fattening

OptiSCAN is a measuring device for mobile weigh pigs with a 3D camera. With OptiSCAN, the pig can be measured without a defined camera positioning. This represents a great relief in the day to daily work for farmer because the animals do not have to be driven to the scale. For the use of OptiSCAN the farmer needs significantly less time and is more cost efficient than the usual weighing process today. OptiSCAN measures the live weight of fattening pigs,

which can be kept in all types of housing. There are two areas of application: first, is the selection of the animals that have reached the optimal live weight. The other is to record the weights of all animals in a group in order to divide the group into performance units, which in the following can be supplied with different feed recipes or quantities. Based on the body measurements, OptiSCAN values the weight of the animals. In this way, animals ready for slaughter can be delivered precisely.

The mobile weight recording at the touch of a button is simple, fast and cost-effective, generates higher marketing revenues through targeted sorting, allows adapted feeding by weight and health control and is suitable for every pig farmer (easy to use). The scanner will cost between about 5,000 to 6,000 €.

Easy weighing of pigs for slaughter

A new barn at the company of Rick Bosgoed has been built for 3,000 pigs. They have chosen to raise pigs in groups of 375 and manage them with the Nedap Pig Sorting system. This system consists of a weighing unit with individual animal identification and three exits. The combined feed and sorting station weighs and identifies each pig and automatically leads it to the right feed type or to the separation area. This allows Rick to optimally feed and deliver his pigs to the slaughterhouse at exactly the right weight. The system ensures that the heaviest 40% of the pigs receive growing-finishing feed, while the lightest 60% get starter feed. When this group reaches a specific weight, the feeding station will adjust automatically. In this way the group remains as uniform as possible. The third exit can be used to separate pigs. The system can also sort gilts from barrows. Rick keeps track of the activity and health of the animals in records of growth and number of visits to the feeding station.

There is a clear insight for improvement. Rick Bosgoed sees the potential for improving their return on investment by using automation to manage their sows and pigs. For example, managing individual animals within large groups helps him to minimize feed waste by feeding pigs based on individual weights and performance. Nedap's smart technology adjusts the feed type and dosage to the weight of each pig. This saves the farmer 20% on the costs of starting feed alone. The system has an easy management. In short: Nedap Sorting Pigs makes the management of meat pigs in large groups easier, more efficient and more accurate. That benefits the return.

In Europe every country has its own demand and preferences for the pig weight. The Nedap Pig Sorting automatically sorts and feeds finishing pigs based on weight. This can be realised in all countries. The sorting station weighs and identifies each pig and automatically directs it to the feed ration you want it to have based on its performance. In all countries they have the possibility to quit wasting pig feed on heavy pigs. Automated grower-finisher pig weighing and sorting gives you the control to feed each pig what he needs and get the most out of every finishing group.

PigWei

PigWei is a contactless solution (portable device for image capture, based on short video records) with high accuracy, that avoids direct contact between animals and workers and cannot be miscallibrated. At several farm visits PigWei created images of about 10,000 pigs in four years and has the following characteristics:

- High Speed (more than 100 pigs/hour)
- Specific for your genetics- Broad use and flexibility
- Cheap (only PigWei is able to manage 20,000 pigs/year)
- Automated measurements of body parts

PigWei is a portable and extremely easy to use system that could be implemented easily for producers between 5,000 and 5,000,000 pigs. Current software works for Danbreed with Pietrain (DxP) in non-castrated males and females and shows both weight estimations. We can tune genetic variations in just two to three days for every customer and achieve maximal precision (i.e. models for castrated and immunocastrated males, Toppig with Pietrain, Large White Landrace with Pietrain, Duroc and Iberico).

- The cost of PigWei is 0.21 €/pig
- Using 1 hour of PigWei by one technician will cost less than 20€ and will enable evaluation of a set of 200 pigs before slaughtering
- Total cost for 200 pigs: 62€ (0.31 €/pig)
- PigWei enables reduction of more than 80% of penalties at slaughter houses, which is 2 €/pig and 10 days of housing and feeding which is 6 €/pig
- Total savings (8 €/pig) for 200 pigs: 1,600€
- Increase of profit for 200 pigs: 1,538€ more benefits, about 7.69€ more benefit for pig
- Therefore, pig producers will pay for a solution that costs 0.31 €/pig and increases value 7.69 €/pig

PigWei system is already in the market since November 2017 and is expanding its market from Spain to the rest of Europe, Canada, Australia, Mexico and Asia. Spain produces 28 million pigs per year, Europe about 200 million pigs and 1,400 million pigs are produced worldwide every year. The potential benefits are similar worldwide, in fact we have customers in Canada, Australia and Mexico.

http://www.ymaging.com/

2.2. Cost and benefit analysis of the EU PiG Ambassador

The Nedap Sorting Pigs systems has an investment costs of €30 per slaughter pig. Comparing pens with the Nedap system with pens without the Nedap sorting system, it appears that the Average Daily Growth of the pigs with the Nedap system is 20 gr/day higher than the control group. Also, the Feed Conversion Rate improves by 0.1 and mortality rate of

slaughter pigs goes down slightly. This improvement can save 0.50 ct in feed costs per slaughter pig. Of course, extra labour is needed to carry out the weighing of the pigs. This extra labour input is about 5 hours per week for 3,000 slaughter pigs.

	Interpig-NL	With Nedap	% var.
Finishing Daily Liveweight Gain (g/day)	822	842	2.4
Finishing Feed Conversion Ratio	2.56	2.55	-0.4
Finishing pigs feed consumption (kg) per slaughter pig	247.4	244.4	-1.2
Time usage per slaughter pig in hours	0.26	0.34	30.8
Building cost, euro/finishing pig place	460	546	18.7
Average quoted pig price (Euro /kg)	1.554	1.569	1.0
Results			
Gross margin I ratio (only feed cost) (%)	45.04	46.38	3.0
Gross margin II ratio (feed cost + other variable cost) (%)	23.00	24.57	6.8
Total costs, (euro/slaughter pig)	146.18	148.71	1.7

It is important that the extra costs made by sorting the pigs is somehow recognised by the market. The pig farmer states that the extra price is about 1% higher than without the sorting system.

The results of this analysis indicate that the Nedap system causes a slight increase in the production costs by 1.7%, but that through better feed efficiency and a higher price the percentage of gross margin in total receipts increases by 6.8%.

2.3. Expert analysis

The experts of the TG Meat Quality agree with the results of the cost-benefit analysis applied to the best practice of the EUPIG Ambassador. The potential cost and benefits can vary due to the fact that the average daily growth, related to the optimisation of the administration of feed to the pigs, can change from farm to farm. Also, the labour input may differ between farms as these costs are related to the size of the pig farm.

(The potential cost and benefits can move within a certain range due to the fact that the average daily growth related to the optimization of the administration of feed to the pigs may vary from farm to farm)

2.4. Conclusions and advice to industry

Key elements for the implementation of the practice

- Defining a proper system to detect and solve individual problems (disease, tail biting…) in big groups

- Proper training of pigs to use the system

- Having a 24h/365 days alert and support system in case of misfunctioning

Common themes that the industry could adopt:

- Homogeneity of pigs all over the fattening period may favour a better conversion ratio and avoid the need of split marketing, which has negative impacts on animal welfare.

The extra costs may be difficult to recover through revenues from the consumers' side. If the farmers using this system are producing under a label of quality from which a higher price is expected, then having this system implemented could be compensated by the price. But it is difficult to think that this system could receive higher prices in conventional intensive production, unless the higher price comes from the slaughterhouse paying for higher homogeneity.

3.   The Future

In general, the technological innovation of pig farms is a way forward, not only to increase profitability for farms, but also to motivate young farmers to stay in the agricultural business. However, there are still gaps to be resolved such as proper internet connection in farms, making very robust systems which work in farm environments. Tools need to be developed that farmers really need, are tailored to their demands, and provide 'farmer-friendly information' (straightforward results). Weighing systems which fall within these demands are useful tools.

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Challenge: Producing tastier pork

1. Introduction

Among other things, meat quality comprises texture, fat content, and juiciness, which are all important in ensuring customer satisfaction. Quality of meat is affected by the genetic propensity of the animal, by how the animal is reared and treated before slaughter and by the nutritional status during production. These factors affect the fat, lean and connective tissue of the meat and therefore influence meat quality. Meat flavor is generated during the cooking process through a complex series of chemical reactions between precursors, intermediate reaction products and degradation products. Pig farmers can influence the precursors present in meat, as these are affected by genetics, feed and handling of live animals. The fatty acid composition can easily be altered through feeding, whereas the carbohydrate content is more closely related to genetics, feeding in the last days before slaughter and handling at slaughter (Aaslyng & Meinert, 2017).

Breed, feeding strategy, rearing conditions and slaughter age/weight of pigs may influence pork eating quality. The effect of *specific genetic x environment interactions* in determining high quality pork is highly relevant (Bonneau & Lebret, 2010). Organic production *per se* has little influence on the eating quality of pork and pork products. Both organic and conventional pig production can yield high quality pork, but information on feed, feed intake, and pig characteristics is important to steer the production process (Sundrum, 2011)

2. Background to the challenge

2.1 Genetics and improvement of taste and flavour of pork

The importance of genetics in affecting the flavor of pork is well known and has been documented in several studies. Pork loins from Berkshire pigs are more tender and have more intense flavor than Landrace and Yorkshire pigs. Over 20% of the variability in the eating quality parameters of pork can be explained by pork quality traits and muscle fiber characteristics (Lee et.al, 2012). The extent to which the Duroc breed is able to improve eating quality is debated and depends on the pig breeds the Duroc pigs are compared with. Ageing of pork for seven days post-slaughter improved eating quality attributes far more effectively than increasing the percentage of Duroc content of pigs, which influenced consumer scores for juiciness (Channon & Walker, 2004). However, when establishing the effect of different pig breeds on eating quality of pork, among the tested breeds, Duroc was the breed with the overall best eating quality, while Hampshire had the lowest eating quality (Meinert et.al, 2008). In another similar study Berkshire carcasses appeared to have the most marbling in the lean and those from Pietrain pigs appeared to have the least. Furthermore, cook loss from chops from Duroc carcasses was lower than that from

Hampshire and Pietrain pig (Brewer et.al, 2002). Traditional breeds, primarily present in the Mediterranean, are well-known for their very pronounced taste and flavor and as pure breeds are at the basis of high-quality products operating on niche markets. An opportunity for pig farmers in Europe is to cross these breeds with the predominant pig breeds. A comparison of different pig crossbreeds showed that by crossing the alternative Iberian and Mangalitza with traditional Duroc and Landrace/Yorkshire (LY) sows, it is possible to produce pork with attractive sensory attributes (Straadt I.K et.al.,2013). Another opportunity for farmers is to produce new or alternative products from these traditional breeds, to obtain an added value as attempted in the Mallorcan Black pig by Gonzàlet et al. (2013).

2.2. Husbandry techniques and improvement of taste and flavour of pork

A first consideration concerns the question to which extent production systems with high animal welfare are able to produce higher quality of pork. A Danish research showed that animal welfare can be linked with eating quality and that certain groups of consumers consider welfare important and valuable given its positive link with attractive quality attributes such as taste (Thorslund, et.al., 2016). It is well known that stressful handling of animals can have a negative effect on the water holding capacity and drip loss.

Shifts in the proportion of the major components of the feed ration do not significantly affect the taste and flavor of pork. The inclusion of different essential oils instead can have an impact on the sensory characteristics of pork. In 2007 the first research was carried out to determine the impact of these oils on the taste and flavor of pork. Pig diets containing 0.05% of essential oils of rosemary, garlic, oregano or ginger had a positive effect on feed intake and average daily gain. Sensory panelists were unable to detect a flavor/aroma difference between treated and control pork (Janz et.al., 2007). The authors concluded that higher levels of dietary supplementation may have been required. In research published in 2015, the inclusion of herbal extracts did not have an impact on the pig performance, but improved oxidative stability, lowered cholesterol and increased the Polyinsaturated Fatty Acid content in pork (Hanczakowska et.al, 2015). Similar results have been obtained in research focused on the supplementation of the pig diet with oregano and sweet chestnut wood extract. A diet with the inclusion of this plant extract mix produced meat that received higher scores for colour, taste and overall liking in both the blind and the labelled consumer tests (Ranucci et.al., 2015). Mas et al. (2011) found that feeding a diet high in oleic acid (Greedy-Grass OLIVA®: 1.4 and 3.8% for growing and finishing diets, respectively) from 30 to 120 kg live weight, modified the fatty acid composition of subcutaneous fat with minor changes in intramuscular fatty acid composition of York-crossed pigs.

3. Addressing the Challenge

Several EU projects have been dedicated to the husbandry techniques, genetics and technologies to make meat more tasty, attractive and flavorsome. A large-scale EU project (Q-PorkChains) funded by EU 6th framework program operated between 2007 and 2011. The aim of this project was to improve the quality of pork and its products for the consumer and to develop innovative, integrated and sustainable food production chains with low environmental impact (Karlsson et.al. 2008). The general objective of module III was to develop innovative technologies for improved pork products to match consumer demands ensuring products that are nutritious, convenient, of high quality and safety, and produced from the best quality pork, nutritional enhancement and quality optimization.

Several projects have been focused on the relationship between local pig breeds and the quality of traditional products. The project TREASURE is an example. The aim of the project is to improve knowledge, skills and competences necessary to develop existing and create new sustainable pork chains based on European local pig genetic resources (local breeds) (https:/treasure.kis.si). Specific attention is given to the intrinsic quality of traditional and new regional high-quality pork products and attitudes of consumers from various market areas.

4. EU PiG Best Practice

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  o 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**
  o The relevance of the practice to each MS or pig producing region/system
  o Timeframes for uptake and realisation of benefits from implementation of the proposed practice are reasonable
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4.1 Validation of the top five best practices

Tasty Dutch Meat

The Heihoef pigs are from the Duroc breed ensuring excellent marbled meat. The meat is wonderfully lean and tender with a full, pure taste. The Heihoef pig has been selected as the Best Pig in the Netherlands for its taste and sustainability. That means you can enjoy pork with a more traditional taste. The farmer increases biodiversity in and around the farm; sowing the field borders with flowers and herbs and add pond's for water retention. As well as this, the genetical crossing of stronger animals with better quality and taste of meat is being carried out by the farmer. Within a small-scale program, together with visual artist Koen van Mechelen, pig farmers try to create a unique pig by crossing breeds, resulting in tastier and better pork meat. The next step is to make their own meat line.

The Heihoef farmers' mission is to deliver top quality pork meat with the best possible care for the animals and their surroundings. Heihoef means tasty and healthy pork meat from traceable sources at an affordable price. It's the challenge to find a fitting economic model, try to create your own market. If there is too much distinction the product doesn't sell. There is a national network of wholesalers, butchers, restaurants and small shops where the meat is sold. The brand works with a Shared Value Strategy. The slogan is: do not think in efficiency, but focus on taste and quality. They reach a higher turnover of 10% per animal.

Similar developments are present in southern Europe. It's more common to invest in a distinctive character of your product. In the Netherlands the main focus is to the world-wide bulk market. Initiatives in creating unique own meat and own breed can strengthen each other by learning from each other and working together.

http://www.heihoef.com/en/

Olive oil as source of fat for the pigs

Duroc d'Olives meat is the combination of a white Landrace sow, that is known for her excellent meat quality, with a brown-red Duroc boar with more intramuscular fat and darker, more tender meat with extra flavour. The result is a light brown red cross that ensures delicious, tender and juicy meat. Together with specialists from the University of Ghent, pig farmers developed the composition of the feed for our pigs after a thorough study. They have chosen olive oil as a source of fat in the feed, because it improves the taste of the meat and makes it even more tender. Olive oil contains few saturated fats that are harmful to our health, and many mono-unsaturated fatty acids. Because the pigs take this oil with their feed, they get a similar fatty acid composition in the pork fat, which is good for the health of the consumer. The basis of the feed is a mix of pure grains (wheat, barley, maize), fibres and proteins. The feeding costs are a little bit higher, the price of the meat can be found on the website. This practice can be easily applied in other countries.

http://www.durocdolives.com/nl-BE/contact/9.html

Pigs fed on rape-seed (canola oil); HK Rapeseed Pork®)

When HKScan asked to pilot on the 'No Antibiotics Ever Rapeseed Pork', this opportunity has been seized. This means that a precise feeding program is followed, where the pigs are fed with rape seed (canola) oil, peas and broad bean in addition to grain; no soya is used at all. The diets are regularly analysed, as well as the meat samples. The canola oil is proven to improve the fat quality in the meat in a natural way, according to research made by HKScan. Combined with antibiotic free production a unique product has been created, which is not only tastier and more tender meat, but also helps in the battle against antibiotic resistant bacteria. Both consumers and professionals appreciate the products pure pork taste, but also the easiness of cooking it. The higher share of soft fat melts into the meat rather than boil away, keeping the meat juicy, tender and tasty. It also enables both shorter cooking time and the use of lower temperatures.

The special feed makes the fat composition softer compared to normal pork (under 33% saturated fat compared with approximately 40% in ordinary production). A clinical study also shows that Rapeseed pork-products as a part of a normal diet improves the fat quality and increases the essential Omega 3 fat intake significantly, compared to those who eat normal pork products. The change of diet has had no impact on the veterinary, bedding or other material costs. The daily growth is about the same as before, but the meat percentage has dropped slightly. The benefit is to enhance the credibility of the product among consumers and increase the sale of pork meat in the retail market. This product has had a good response in the Asian market where it is exported. Also, the meat price is considerably higher than the price of basic pork products.

The pork market in Finland has been challenging for years. Differentiation is the best option, in their opinion, to get better prices from the market, this process can be replicated in other farms.

https://www.sikava.fi/

"Don Ibane" Pork High quality of meat with heavy DUROC pig raised on straw.

Duroc Nucléus as a terminal boar produces high quality meat at a reasonable cost. In a heavy pork system (around 100 kg carcass), the qualitative extra value is significant compared to a standard crossbred raised in the same conditions. The breeding of heavy pork on straw makes it possible to value this superior quality in fresh meat and dried meat. Born from Duroc Nucleus boars specially selected for intramuscular fat and meat quality, pigs produce meat with lower exudate, colour, pH and intramuscular fat while maintaining good breeding performances and sufficiently high lean meat percentage. (Gaudré et Al, 2018). This good practice offers new opportunities for farmers to market a different product.

In the farm SCEA EKIALDE the following results were obtained:

- Breeding: +0.7 piglets weaned per sow because pigs from DUROC boars are tougher
- Post-weaning and fattening on straw until 100kg of carcass weight: Extra feed costs are: 12 cts/kg of carcass

- Loss of 5-6 cts/kg of carcass on the French TMP classification (lean meat percentage)
- Therefore, the extra costs are 15-17 cts/kg of carcass

Heavy hams and high-quality marbled loins are sold as fresh meat on the local market of Pays-Basque. The meat is less exudative and more marbled. The other pieces of pork are dry cured in the farm ELIZALDIA in *lomo*, *coppa*, dried pork belly and high gustative quality Don Ibane cured ham (18 to 20 months of drying instead of 14 months). On February 25, 2018, Don Ibane cured ham was awarded the bronze medal in the superior dry ham category at the Concours Général Agricole of the 2018 Paris Agricultural Show.

Crossbreeding with DUROC is a good alternative for high quality meat at reasonable price for all countries. Indeed, this meat stands out thanks to its high technological abilities (cooking performance, ability to dry, to mature) and high sensorial abilities (flavour, colour).

https://www.ferme-elizaldia.com/

Porc de Palou": A project focused to improve the organoleptic quality of the pork meat

The aim of this good practice lies on improving the organoleptic quality of pork meat. Different strategies have been performed: selection of the best genetics for an optimum meat quality, feed formulations in order to increase intramuscular fat and to ensure a good fatty acid profile, immunocastration, and an increase of slaughter weight in order to increase the back fat and intramuscular fat content. Producers may assess their strategies in the slaughterhouse using conventional tools, such as measures of the lean percentage, or of the back fat depth (mm), together with innovative strategies such as the measure of the intramuscular fat using NIRS on-line or measuring the characteristics of the main carcass parts using magnetic induction.

The main benefits consist of giving an added value to the meat and to expand the market: a better quality, better taste with healthier fat profile with a tender texture and easy to chew products are obtained. Producers get better prices for the meat produced which is sold with the "Porc de Palou" quality label. This should compensate the investments in feeding and management implemented to obtain the better quality.

The market of this pork is mostly national. Even though, there are some parts of the carcass, such as the jowl and the belly, that because of its percentage of fat, have a very good acceptation in oriental markets. As a concept, in other countries the idea of producing under differentiated labels may be of interest for some farmers, especially those running the business at a family scale.

http://porcdepalou.cat/

4.2. Cost and benefit analysis of the EU PiG Ambassador

The addition of olive oil to the feed improves the taste of the meat and makes the meat more tender. Olive oil contains only a few saturated fats and many mono-unsaturated fats. When pigs are fed with feed in which olive oil is added as an ingredient, the pork fat obtains a fatty acid composition, that is similar to olive oil.

According to the pig farmer who is implementing this good practice there are two possibilities:

1. Add olive oil to the feed of finisher pigs for the entire finishing period
2. Add olive with a percentage of 2-3% only in the last two months of the finishing period

The final result of these two alternatives is similar. The fatty acid composition of the pork fat is more or less the same in both cases. For the cost benefit analysis, the following assumptions have been made:

a. Add olive oil either for the entire period or only for the last two months with a percentage of 2.5% of the feed
b. An olive oil price of €3 per litre (or €3,000 per ton)
c. An increased market price of 10%. This is an estimate, because the labelled meat is sold with a price difference of 15%, but part of the meat needs to be sold without label
d. The addition of olive oil to the feed does not change the technical performance of the finishing pigs

Applying these assumptions to the average Interpig farm of Belgium for the year 2017 we obtained the following results. When olive oil is added over the entire finishing period the average feed price increases by 28% and the total production costs by 11.7%. From this it becomes clear that it is not economically convenient to add olive oil to the feed over the entire finishing period of 133 days.

However, if the olive oil is added at a rate of 2.5% to the feed during the last two months of the finishing period, the feed price raises by 16.8% and the total production costs by 7.6%. The profit of the average pig farm will than increase from 0.12 to 0.17 € per kg slaughter weight. The addition of olive oil might therefore be considered as an interesting practice for pig farmers, if they are able to sell their meat at least a 10% higher price, as this price difference would cover the higher feed costs of the farm and the eventual minor cost increases that might be related to the farm logistics of the addition of olive oil, that have not been taken account of in this overview of costs and benefits.

Table – Cost and benefits of the addition of olive oil to the feed ration of finisher pigs

	Interpig-BE	With olive oil	% var.
Finishing pigs feed consumption (kg) per slaughter pig	256.80		
Price of feed for finishing pigs	246.30		
Price of olive oil	3,000.00	3,000.00	
Average feed price with 2-3% olive oil (entire finishing period)		315.14	28.0
Ave number of days in finishing unit, (calculated)	133.00		
Days with olive oil		60	
Average feed price with 2-3% olive oil (only last 2 months)		287.61	16.8
Average quoted pig price (Euro /kg)	1.57	1.73	10.0
Results (entire finishing period)			
Production costs	1.45	1.62	11.7
Profit/loss	0.12	0.09	-25.0
Results (only last 2 months)			
Production costs	1.45	1.56	7.6
Profit/loss	0.12	0.17	39.2

4.3. Expert analysis

The consulted experts of the Thematic Group Meat Quality do agree with the cost and benefit analysis of the EU Pig Ambassador of this challenge. The range in potential benefits and costs of this best practice depends on:

1. The extent to which olive oil is added to the feed ration, either for the entire growing – finishing period or only during the last two months of finishing;
2. The capacity of the pig farmer to market its entire production of pork as a labelled product or only part of its production.

4.4. Conclusions and advice to industry

The supplementation of feed with essential oils is an interesting practice, that is able to significantly improve the taste and flavor of pork. Moreover, these oils often integrate the feed with unsaturated fatty acids, which has a beneficial effect on the healthiness of the produced pork. The winning ambassador adds some olive oil to the pig feed ration. In order to favor the adoption of this practice, dedicated leaflets would be sufficient for the dissemination. The practice would need no specific training. It is important for pig farmers to know what kind of olive oil needs to be used, and how it needs to be added to ration in order to obtain the desired effects and to avoid negative effects related to soft fat.

5. The Future

In order to create a competitive advantage a pig farmer may focus on the strategy of diversification to add more value to the pork they are producing. The improvement of the quality of pork by means of the use of specific breeds or by changing the feed ration of the pigs certainly is an example of product diversification. The best practices described in this technical report represent proof of the fact that several pig farmers in the EU are making efforts in this direction. From the technical or technological point of view, certain knowledge gaps still need to be filled concerning the relationship between certain feed ingredients and the presence of specific components of pork that determine its quality. However, the major training needs in this field of interest is the capacity of creating a new market chain around the new technical quality concept. Many pig farmers are able to produce more flavorsome or succulent pork, but the lack of capacity to market this new product on the market. Tools and technical guidance are therefore necessary to assist pig farmers to create new market chains based on more tasty pig meat.

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