



Brussels, 12 February 2016

COST 016/16

DECISION

Subject: **Memorandum of Understanding for the implementation of the COST Action “Innovative approaches in pork production with entire males” (IPEMA) CA15215**

The COST Member Countries and/or the COST Cooperating State will find attached the Memorandum of Understanding for the COST Action Innovative approaches in pork production with entire males approved by the Committee of Senior Officials through written procedure on 12 February 2016.



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MEMORANDUM OF UNDERSTANDING

For the implementation of a COST Action designated as

COST Action CA15215 INNOVATIVE APPROACHES IN PORK PRODUCTION WITH ENTIRE MALES (IPEMA)

The COST Member Countries and/or the COST Cooperating State, accepting the present Memorandum of Understanding (MoU) wish to undertake joint activities of mutual interest and declare their common intention to participate in the COST Action (the Action), referred to above and described in the Technical Annex of this MoU.

The Action will be carried out in accordance with the set of COST Implementation Rules approved by the Committee of Senior Officials (CSO), or any new document amending or replacing them:

- a. "Rules for Participation in and Implementation of COST Activities" (COST 132/14);
- b. "COST Action Proposal Submission, Evaluation, Selection and Approval" (COST 133/14);
- c. "COST Action Management, Monitoring and Final Assessment" (COST 134/14);
- d. "COST International Cooperation and Specific Organisations Participation" (COST 135/14).

The main aim and objective of the Action is to propose solutions for European pork production systems which abandon surgical castration of pigs without pain relief after 2018. This will be achieved through the specific objectives detailed in the Technical Annex.

The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 72 million in 2015.

The MoU will enter into force once at least five (5) COST Member Countries and/or COST Cooperating State have accepted it, and the corresponding Management Committee Members have been appointed, as described in the CSO Decision COST 134/14.

The COST Action will start from the date of the first Management Committee meeting and shall be implemented for a period of four (4) years, unless an extension is approved by the CSO following the procedure described in the CSO Decision COST 134/14.

OVERVIEW
Summary

Surgical castration of boars without pain relief is now considered unacceptable. Stakeholders of the pork chain committed themselves to voluntarily end surgical castration of male pigs in Europe by January 1st, 2018. The production of entire males (EM) or immunocastrates (IC) results in new challenges in management of product quality (detecting and reducing boar taint, coping with extreme leanness), specific nutritional requirements, appropriate animal management and housing to reduce boar taint and address associated animal welfare issues (aggression, sexual behaviour). Thus, EM and IC production require reconsideration of the whole pork production system, and innovations at all levels of the food chain to achieve high sustainability and product quality. Partially, these aspects have been studied previously but there are still a range of unresolved relevant issues. Additionally, a knowledge gap exists between the Western and Eastern parts of Europe, either due to differences in traditional production systems or differences in public perception of animal welfare aspects. A better coordinated research effort and training of young researchers at international level would significantly improve research efficiency, accelerate knowledge acquisition and dissemination. The COST Action will accelerate innovations by networking, by developing and disseminating science-based best practices to achieve good production quality with EM or IC. It will support the meat industry to cope with the challenge to produce equally valuable products from meat of EM or IC which is adequate for regional specific consumer demands.

Areas of Expertise Relevant for the Action <ul style="list-style-type: none"> • Animal and dairy science: Agriculture related to animal husbandry, dairying, livestock raising, animal welfare • Animal and dairy science: Food chemistry • Biological sciences: Genomics, comparative genomics, functional genomics • Animal and dairy science: Microbiology • Veterinary science: Veterinary medicine (miscellaneous) 	Keywords <ul style="list-style-type: none"> • Sustainable animal friendly pork production with males • High quality pork production with boars and immunocastrates • Consumer sensibilization and information • Genetics of boar taint prevention • Product development and carcass neo-grading
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Specific Objectives

To achieve the main objective described in this MoU, the following specific objectives shall be accomplished:

Research Coordination

- To guide breeding programmes for meat production systems with entire males (EM) or immunocastrates (IC) toward reducing the incidence of boar taint, addressing the meat quality problems associated with EM and reducing aggressive and sexual behaviour
- To develop nutritional concepts for EM and IC to meet nutritional requirements of EM and IC, to reduce boar taint and to compensate alterations of intramuscular fat content and fatty acid composition.
- To define EM specific housing and management conditions, including transport, pre-slaughter handling and slaughter practice to minimize the new welfare issues due to male specific behaviour
- To evaluate innovations of grading and meat quality control systems including boar taint detection at slaughter line and other traits that are important for eating and processing quality
- To summarize innovations in the processing industry, product development to adapt products to the different characteristics of EM pork (texture, water holding capacity, fatty acid

composition) and valorisation of meat with boar taint by masking, cooking, dilution, dry curing or fermentation.

- To develop specific information strategies for different European countries, as well as export markets to increase the acceptance of EM production systems and immunocastration

Capacity Building

- Networking of scientific groups, including COST member/associate countries from both ITC and other European countries, will be organized to ensure efficiency by avoiding redundancies, and bridging separate fields of research to achieve breakthroughs that require the coordinated cooperation of consumer research groups, meat scientists, animal physiologists, nutritionists and breeding organizations.
- To present and disseminate the current state of research in workshops and conferences, and develop a joint research agenda around the topic of meat production from EM and IC hereby concentrating and coordinating the research activities supported by various national research programmes.
- To form a strong foundation for long-term sustainable collaboration in the area of EM production.



DESCRIPTION OF THE COST ACTION

1. S&T EXCELLENCE

1.1. Challenge

1.1.1. Description of the Challenge (Main Aim)

Surgical castration of pigs without pain relief is now considered unacceptable. The European Commission (EC) and representatives of all the stakeholders committed themselves into a road-map to voluntarily end surgical castration of boars in Europe by 2018. The EC strongly supports the initiative (see EC decision OJ EU 2011/C 243/06 on key research necessities). However, the pig sector needs to adjust to the new situation of producing entire males (EM) or immunocastrates (IC) instead of surgically castrated males (SC) which introduces new challenges regarding product quality, nutritional requirements and strategies to reduce boar taint and avoid welfare issues such as aggression and strong sexual behaviour, both associated with EM. The research effort on this topic increased tremendously during the last 10 years, but most studies were conducted within national research programmes, with many redundancies and rediscovery of already well-established knowledge. Additionally, there is a gap in knowledge and public perception between the Western and Eastern part of Europe that needs to be addressed. This IPEMA Cost Action is critical for creating a strong Pan-European network of all researchers and industrials working on this issue, which will be necessary to intensify the efforts during the next decade to ease the transition and optimise the production of non-surgically castrated pigs because it is expected that year 2018 was set too optimistic for its full implementation and adaptation of the sector.

1.1.2. Relevance and timeliness

Although public disapproval of surgical castration without pain relief is rising, particularly in Western Europe, $\frac{3}{4}$ of male piglets are still castrated in the EU. The designated timeline to voluntarily ban pig castration in the EU is now close, but the aim is far from being reached. The main issues in product quality are largely unsolved yet. There are still large gaps in knowledge and the available information is not satisfactorily discussed and shared between scientists stakeholders, between players of the production chains or Non-Government Organisations (NGOs) motivated by societal concerns.

As long as only a minority of males are left entire and/or slaughtered at low weight, the industry can accommodate the overall low incidence of tainted carcasses. This will no longer be feasible in countries where slaughter weight is high. As a consequence, slaughterhouses start to impose price reductions for those farmers that delivered tainted carcasses from EM. Practical solutions to reduce the incidence of tainted carcasses and address welfare issues associated with EM production must therefore be found. The reduction of boar taint, an offensive odour and flavour caused by the accumulation of two malodorous compounds in fat, androstenone (AND) and skatole (SKA), is particularly challenging. Concentrations of both compounds are affected by genetic (mainly AND) and environmental factors (mainly SKA). Selection of boar taint-free lines is conceivable although side effects on other traits have to be avoided. EM are more prone to aggressive territorial and sexual behaviour which results in new welfare problems such as stress, injuries, penis biting) which could exceed those abolished by the ban of castration. EM and IC do not have the same nutritional requirements, which need to be investigated and integrated with the other innovative feeding and management strategies. In addition, ban of castration requires specific solutions for special production systems (outdoor, local breeds) aiming at high quality products that might not be compatible with the production of EM. The ability to detect boar taint on the slaughter or processing lines is critical, but to date, there is no instrumental method that meets industrial requirements. The meat processing industry should also be prepared to develop new pork products that can



accommodate tainted meat and adapt to the expected leaner carcass characteristics. The change to EM production also requires innovation for improving technological and sensory properties of meat (e.g. tenderness) without impairing consumers' satisfaction. Knowledge about consumers' attitude towards products from EM is incomplete, particularly in those countries where animal welfare aspects are viewed as less important. Internationally recognized investigations on consumer attitudes toward meat from EM and IC are required for the meat supply chains to develop their strategies on knowledge based rationales.

Because of the above-mentioned limitations in knowledge acquisition and dissemination, not all European pig producers and meat processors are well prepared for a comprehensive implementation of meat production from EM. This will affect the pork sector and damage the reputation of pork and pork products, which would be detrimental to European pork consumption and export of pork to third countries. In most of the Inclusiveness Target Countries (ITC) notably the Eastern part of Europe, research on that matter is at very early stage and stakeholders are more reluctant to consider alternatives as there is less concern about welfare issues. In view of further progress and development, it is important to foster cooperation between the research groups from different European regions. Thus it is the aim of COST Action IPEMA to generate new knowledge and to accelerate innovations by networking to develop and disseminate science-based best practices and support the meat industry in their challenge to produce high quality meat from EM or IC, which is adequate for regional-specific consumer demands.

1.2. Specific Objectives

1.2.1. Research Coordination Objectives

1. Breeding programmes for meat production systems with EM or IC

- a. To reduce the incidence of boar taint more efficiently. The challenge is to identify more specific markers or candidate genes that have no side effects on performance and reproduction.
- b. To address the meat quality problems associated with entire EM. The aim is to investigate the genetic relationships between meat quality traits, boar taint and performance.
- c. To reduce aggressive and sexual behaviour. The aim is to estimate the genetic parameters for relevant behavioural traits to include them in selection indexes.

2. Development of nutritional concepts for EM and IC.

- a. To meet nutritional requirements of EM and IC innovative nutritional concepts are needed ,
- b. To reduce boar taint
- c. To compensate alterations of intramuscular fat (IMF) content and fatty acid composition.

3. Definition of EM specific conditions for improved health and welfare

- a. To minimize the new welfare issues due to male specific behaviour (e.g. fighting, mounting, penis biting) or due to pregnant gilts at slaughter by housing and management, including transport, pre-slaughter handling and slaughter practice
- b. To clarify if EM have different requirements for space and pen characteristics.

4. Innovation of grading and meat quality control systems:

- a. Demand of a new grading system ("neo-grading") that go further than lean meat content by including traits that are important for eating (e. g. IMF, boar taint detection) and processing quality (e.g. water holding capacity(WHC))
- b. Boar taint detection at slaughter line has to be optimized and thresholds of sensory acceptance have to established across Europe

5. Innovations in the processing industry, product development

- a. Innovations in processing are required to deal with boar taint and to adapt products to the

- different characteristics of EM pork (texture, WHC, fatty acid composition).
- b. Valorisation of meat with boar taint by masking, cooking, dilution, dry curing or fermentation.

6. Evaluation of consumer behaviour and development of specific information strategies

- a. Are there differences in preferences between countries and in market acceptance of boar products in Europe? Which attitudes are knowledge-based?
- b. Acceptance of immunocastration
- c. Impact of EM specific sensory traits on pork consumption in Europe and export markets.

All six sub-topics will address particularities of the standard production systems with modern improved breeds as well as local breeds and special production systems (outdoor, organic, heavy weight pigs) for high value added products.

1.2.2. Capacity-building Objectives

The ban of physical castration of piglets demands new concepts in pig production to assure that this important livestock sector of meat production will not economically suffer when castration is omitted. The main focus is to accelerate scientific developments leading to technical solutions for new problems that emerge in regard to the quality of product and production process and to ensure that the acquired knowledge is properly passed on to the relevant stakeholders across Europe.

IPEMA will organize a networking of scientific groups, including COST member/associate countries from both ITC and other European countries, to ensure efficiency by avoiding redundancies, organizing cooperation at international level, and bridging separate fields of research to achieve breakthroughs that require the coordinated cooperation of consumer research groups, meat scientists, animal physiologists, nutritionists and breeding organizations. IPEMA will present and disseminate the current state of research in workshops and conferences, and develop a joint research agenda around the topic of meat production from EM and IC hereby concentrating and coordinating the research activities supported by various national research programmes.

To achieve these objectives a specific website will be developed and complemented by bottom-up on-line tools such as LinkedIn. To maximize the impact for ITC all IPEMA meetings in Eastern Europe will aim to include local industry. Research outcomes will be translated into practice via a "Pork Quality Research with Impact" brochure (on IPEMA website). The Action will focus on involving Early Career Investigators (ECI) and/or the industry, especially from ITC with less knowhow in the field of EM research, to participate in knowledge/technologies transfer via workshops and Short Terms Scientific Missions (STSM). To achieve this we will organize training and summer schools for the industry and/or young researchers, possibly in cooperation with international meetings (e.g. EAAP and ICoMST). The scientists exchange and knowledge/technology transfer will be facilitated by "scientific speed dating"/ "market of knowledge". To extend our funding opportunities, IPEMA will explore "knowledge exchange" and "Impact" grant applications within each of the participating countries. This will ensure sustainability of the COST Network after the end of the project. We will also explore an opportunity to establish "partnership" PhDs in collaboration between academia and industry to provide the best possible training to new generation of scientists and to expose them to real-life problems at international level. Science Communication grants and other funds will be raised for Public Relation in order to ensure that the innovations are more readily accessible to all the IPEMA members. Achieving these objectives will strengthen the European Research Area and the international competitiveness of the European pork producing chain and meat industry. This project will form a strong foundation for long-term sustainable collaboration in the area of EM production.

1.3. Progress beyond the state-of-the-art and Innovation Potential

1.3.1. Description of the state-of-the-art

Text

Genetics and Breeding

Research in the field of genetics so far has focussed on the reduction of the two compounds responsible for boar taint. SKA production in the hind gut is mostly controlled by environment and nutrition whereas genetics play a key role in SKA metabolism. Fat AND level is mostly controlled by genetic factors via their influence on i) sexual maturity, ii) the balance between the biosynthesis pathway leading to AND and that leading to androgens and oestrogens, and iii) the activity of the enzymes participating in AND degradation. Quantitative trait loci (QTL) and single nucleotide polymorphism in candidate genes and differences in gene expression have been found between pigs exhibiting high and low levels of the compounds. However, the identified genes have a small effect and most of them are unspecific, having an overall effect on sexual maturity. This explains why selection against AND has negative side effects on performance or reproductive traits.

Nutrition

Up till now emphasis was placed on finding nutritional means to minimize SKA levels in EM. Recent results suggest that several feedstuffs also modulate AND by either affecting the microbiome of the small intestine or by interrupting the assumed enterohepatic circulation of AND. Diet composition for EM, particularly the balance between amino acids and energy, must be adapted to account for their reduced appetite and greater muscle accretion and at the same time overcome the low IMF deposition. IC behave similarly to EM prior to second immunization whereas their feed intake dramatically increases afterwards, probably leading to altered nutrient requirements. Precision feeding towards requirements in each growth phase should maximise profit. A better indepth understanding of the temporal pattern of nutrient deposition rates and feed intake as well as their effect on technological and sensorial quality of pork will help to develop growth models for predicting specific nutrient requirements for this new group of animals.

Management and Housing conditions for improved animal welfare

EM are more active and show more aggressive behaviour which leads to more inter-male aggression and fighting lesions on boar carcasses notably after transport. Aggressive behaviour tends to be reduced if EM are raised in litters or together with gilts, where the risk of unwanted pregnancies exists. Mounting behaviour is 10-fold in EM compared to SC and their mounts, are longer than non-sexual mounts by SC, and provoke more screaming by the recipients, indicating stress and reduced welfare. Additionally penis biting during mounting leads to welfare problems, as more than 80% of all EM penises displayed scars and/or fresh lesions in recent studies, whereas those from SC were unharmed. Mounting behaviour by heavier males on females can increase lameness in gilts that become less able to avoid tail-biters. Management approaches should be developed to reduce these potential animal welfare problems and have to be further tested for efficiency and practicability.

Grading and meat quality control systems

At present, the official technologies for grading pig carcasses do not include meat quality parameters. Current technologies to assess relevant quality traits do not meet the requirements of an on/at line grading system as they are either not quick enough to follow the chain speed (e.g. pH, temperature), are invasive (e.g. NIRS for IMF-determination) or time consuming (e.g. methods for WHC). Boar taint is currently evaluated at the slaughter line mainly based on human senses, as there is no instrumental system that measures both AND and SKA and complies with the industrial demands for the detection of boar taint.

Processing industry, product development

Pork from EM has two main issues: boar taint and inferior technological and sensory quality. Boar taint can be masked by processing, either by dilution with untainted meat below sensory thresh- old levels, cooking (AND reduction via evaporation), by the use of spices, smoke, dry-curing and fermentation, or by cold-consumed products. The technological and sensory quality of pork from EM

is further influenced by the low IMF, the thin subcutaneous fat and the higher level of unsaturated fatty acids. Lower IMF content decreases tenderness, juiciness and aroma development. EM meat may be tougher, have lower WHC but also a higher incidence of Dark Firm Dry (DFD). These characteristics may have a high impact for dry-cured meat products. Lower WHC leads to lower processing yields, harder and saltier products. More unsaturated fat results in visual defects and lower oxidative stability which is relevant for processed pork.

Consumer Behaviour

Suggested threshold acceptability levels of boar taint vary between 0.15 and 0.25 ppm for SKA and between 1.0 and 3.0 ppm for AND. Several issues are further fuelling this lack of clarity: The poor comparability of the chemical analysis of AND and SKA between laboratories, the impact of sensitivity to AND, the type of product served, the type of consumer panel and the experimental set-up. Studies on consumer acceptance of pork from IC are severely influenced by consumer knowledge about pig production and about the practice of castration/immunocastration. Thus, at present, market acceptance is deemed very limited.

1.3.2. Progress beyond the state-of-the-art

Genetics and Breeding

Lines of pigs that are well-suited for EM production are crucial for the new production systems. IPEMA will gather information regarding markers or candidate genes, which efficiently reduce boar taint and that have no negative side effects on performance and reproduction. Additionally possible genetic parameters for relevant behavioural traits are investigated to reduce aggressive and sexual behaviour. To address the meat quality problems associated with EM, the genetic relationships between these traits, boar taint and performance will be studied; specific aspects of local breeds will be assessed.

Nutrition

IPEMA will aim at nutritional recommendations for feeding EM and IC, in close collaboration with other scientists involved in the project. For EM, the challenge is to develop optimized recommendations for dietary energy, amino acids, fatty acids and other components which aim at efficient growth, efficient dietary control of the boar taint compounds and optimized technological and sensory pork quality. The objective for IC is to propose nutrient requirements which take into account the specific characteristics of the two metabolic phases, with regard to protein deposition and feed intake.

Management and housing conditions for improved animal welfare

IPEMA aims to provide welfare-oriented housing conditions and appropriate management specifically adapted to requirements and behaviour of boars. Most of the production conditions regarded as animal friendly have been validated with gilts or SC. IPEMA “will provide similar information for EM production system. Additionally IPEMA aims to develop an alert system to identify EM specific welfare problems so early, that interventions are possible.

Grading and meat quality control systems

COST Action IPEMA encourages the exploration of new grading systems for carcasses in Europe that will include parameters for the sensory, nutritional and technological quality of meat in addition to the usual carcass composition. The new parameters would be IMF, tenderness, WHC, fatty acid composition and boar taint. This will be determined by new technologies, which would have to be quick, work on cut off levels, in on line conditions, are not expensive and preferably not invasive. A verifiable reference standard for boar taint is critical and will be established. Sorting criteria will be based on consumer acceptance levels of boar taint.

Processing industry, product development

IPEMA aims to increase the acceptance of meat from IC. Although IC and SC seem to be similar in meat quality, some aspects still need to be examined (e.g. proteolytic potential, compensatory fat deposition after 2nd vaccination) to adapt the processing technology. IPEMA will provide technical solutions to counteract an inferior quality of EM meat by explaining the aetiology of increased toughness and reduced WHC in order to find preventive measures and by establishing impact of using EM meat in dry-cured or thermally processed products. IPEMA will evaluate solutions for tainted carcasses by determination of the effect of various processing factors on boar taint reduction and the possibility to mask boar taint with additives or dilution of tainted meat for the different types of products. IPEMA will improve knowledge on interaction between boar taint thresholds and various volatile compounds, developed during processing.

Consumer Research

Evolution of views regarding alternatives to surgical castration strongly differs between countries. Differences in market acceptance as well as differences in societal pressure to ban surgical castration partly explain this diversity. However, considering foreign trade of pork within the EU, communication and a harmonization towards production systems with EM or IC are crucial. IPEMA will support this transition by gathering information and investigating existing questions, but further transition is only possible if the overall acceptance increases.

1.3.3. Innovation in tackling the challenge

Innovation in genetics and breeding

IPEMA will favour more sophisticated approaches of the genetics of boar taint and extending the genetic research to local breeds that represent specific challenges. Also the goals will shift from the production of boar taint-free lines only to the production of lines of pigs that are completely suited for EM pig production (e.g. complex approach to boar taint, behaviour, meat quality traits).

Innovation in nutrition

Innovative diets for EM and IC by combining specific feed ingredients will be tested by bringing together research from different institutes and industrial partners across Europe. Trial results can be translated into the local feed evaluation system and adopted by local nutritionists.

Innovation of management and housing conditions for improved animal welfare

By synergistic combination of knowledge from current research, IPEMA will provide an outline for best practice in pork production with EM about housing conditions and management measures which allow more animal welfare by increasing play fighting activity and reducing injuries. These production standards will be communicated with consumers and meat industry and should lead to a standardized international labelling of EM pork produced under such conditions.

Innovation of grading and meat quality control systems

The innovation will come as one proposal for a new Grading System in Europe of pig carcasses, including meat quality parameters basing on new technologies. To achieve this, information regarding ongoing studies or outcomes from other COST action like FAIM will be collected to propose such strategies to predict and detect parameter that affect technological, nutritional and sensory characteristics of pork.

Innovation in the processing industry, product development

Based on current knowledge regarding the meat quality and boar taint IPEMA will focus on preventive measures to exclude/minimise the occurrence of inferior WHC or toughness, new product/processing technologies to adapt to different meat quality and easier determination of tainted meat and the development of products suitable for meat with different boar taint levels

Innovation in consumer research

General agreement on the definition of boar taint and the cut-off levels that guarantee consumer acceptance of pork from EM are crucial. A harmonized European approach can accelerate the acceptance of EM production by the various meat supply chains. IPEMA will focus on dissemination of results and stimulating discussion within the sector, to increase the public knowledge about EM production and IC, to provide scientific information about IC towards the pork chain and to get a better understanding of attitudes along the pork chains, including national retailers.

1.4. Added value of networking

1.4.1. In relation to the Challenge

COST Action IPEMA will establish an interdisciplinary network in order to:

1. critically analyse existing approaches to make EM production more sustainable by improving palatability of pork and derived meat products and preventing welfare problems.
2. develop a platform of knowledge transfer for effective multidisciplinary-approach for the improvement of meat quality and increased animal welfare in pig production.
3. to promote coordinated/synchronised activities of different teams for innovative technologies, e.g. neo-grading. Emphasis will be put on optimizing production quality adapted to region- and country-specific consumer demands as well as country specific production systems.

The advantage of creating such a multidisciplinary network is that all the different aspects will be covered to deliver solutions on how to optimize EM and IC production. The networking will include public and private actors across leading European, American and ITC experts and favour an efficient knowledge transfer, hereby counterbalancing unequal access to knowledge infra- structures, and distribution of resources. We are aware that in some fields (e.g. neo-grading, genetics) research is basically competitive. This can be address though the development of joint grant applications. Other research aspects however are precompetitive and should be distributed among the relevant teams in order to speed up the process.

1.4.2. In relation to existing efforts at European and/or international level

The proposal is complementary to the current trends/changes in Europe. In the past, two projects on the issues of abandoning surgical castration (ALCASDE, PIGCAS) were financed, and most of IPEMA participants were involved in them. EC also made a decision (2011/C 243/06 of 19 august 2011) to adopt a work programme to finance the Union's activities on alternatives to surgical castration of pigs. At the same time, an increase of research activities on EM has been observed (as attested by the increase of the number of scientific publications on boar taint). In addition, several national/EU research projects are under way, in which the participants of this COST proposal are involved, providing the possibility/origin of the latest state-of the art/knowledge.

2. IMPACT

2.1. Expected Impact

IPEMA aims to develop a Pan-European sustainable network of established and young researchers and stakeholders to enhance cooperation, knowledge transfer and impact in relation to the European challenge of moving towards the EM production system.

Short-term and long-term scientific, technological, and/or socioeconomic impacts

Scientific impact

- Mapping existing national/ international research expertise, projects and initiatives to avoid redundancy in research and to establish coordinated pork quality research.
- Generating new knowledge and research links will be facilitated by bringing together expertise from various scientific areas, commercial enterprises and other stakeholders.
- Collaborative publications, research/knowledge exchange workshops, and seminars
- Enabling ITC to be a part of the network to facilitate access to knowledge and training.
- Developing a collaborative grant application strategy to ensure high quality and access a wider range of funding.
- Establishing effective mechanisms for training of ECI (e.g. STSM, topic-orientated seminars/summer schools, on-line training courses, jointly-supervised PhDs)

Technological impact

- Creating an open-access database of expertise in the of area pork quality to enable individual countries to access and implement the most appropriate expertise or technologies.
- Making traditional/unique breeds from ITC countries available to breeding industry across the Europe. This will facilitate inclusiveness and positively contribute to the economics of ITC.

Socioeconomic impact

- Harmonizing research on consumer attitudes in relation to conflict between welfare, sustain- ability, and palatability of pork, to develop consumers-informed strategies in pig production.
- Sharing and transferring knowledge/practical experiences in the area of EM pork production.
- Ensuring a complex approach to issues related to EM production system by knowledge ex- change between researchers, pig industry, technology developers and policy makers

Long-term impact (beyond the project duration)

Scientific impact

- In-depth understanding of the biological mechanisms defining high quality of pork
- An effective, animal-welfare friendly EM production which is transparent to consumers
- Career-enhancing training to ECI ensuring inclusiveness across all the European countries.
- Effective sharing of knowledge to provide a common conceptual platform and understanding the complex issue of pork production from EM and consumer attitudes.
- Training a new generation of scientists and supporting their career progression.

Technological impact

- Effective production system for EM and IC
- High quality of pork and pork products, improved quality control through the supply chain
- New technological approaches to utilization of tainted meat
- Adapted technological approaches for processing different type of meat from EM

Socioeconomic impact

- Accelerated implementation of novel technologies and research outcomes across Europe
- Improved pig producers/consumer dialog based on a sustainable pork production system
- Recommendations for high quality pork production with EM and IC under specific national or regional conditions as well as requirements of organic production.
- Increased revenue for pig industry due to ability to produce quality-assured pork
- Fully satisfied consumers and quality meat products derived from EM and IC.

2.2. Measures to Maximise Impact

2.2.1. Plan for involving the most relevant stakeholders

This proposal addresses the implementation of comprehensive EM or IC production system in Europe as has sought input from stakeholders. Including the pig producing industry, meat industry, abattoirs retailers, technology manufacturers, consumer organisations and Non-Government Organisations (NGOs) active in this field. The stakeholders' active engagement will be ensured via the following mechanisms:

- Including the stakeholder in all the events and activities run by the IPEMA action.
- Expanding the network of stakeholders via IPEMA country contacts.
- Spread the good practice and experience of individual countries in collaboration with stake-holders (e.g. Western Europe Round Table meetings with stakeholders).
- Linking the existing national research/stakeholders networks to IPEMA initiative (e.g. EU Marie Curie Internat. Staff Exchange, UK/China Partnership on Novel Technol. for Meat Quality).
- Inviting stakeholders as collaborators or partners in future research and knowledge exchange grant applications.
- Developing the project website open also to industry and other stakeholders.
- Developing industry/academia PhD studentship schemes when PhD students will be obtaining training (for up to 6 months) at the industrial partners' facilities.
- Organising summers schools with stakeholder's involvement.
- Publishing scientific papers with industrial collaborators as co-authors.
- Organising satellite meetings and workshops with involvement of different groups of stake-holders to ensure a complex approach for the problem of EM production.

2.2.2. Dissemination and/or Exploitation Plan

IPEMA will ensure that (i) outcomes are widely disseminated and (ii) the established network will be sustainable and continue beyond the duration of the COST Action. To achieve this, at the Action "kick-off meeting" a Training & Knowledge Transfer (TKT) Coordinator will be elected, who will act as internal coordinators of IPEMA knowledge exchange activities, as well as a facilitator for external activities. The internal TKT activities will include coordinating actions between different work packages and writing annual progress reports which will be included in the Action Monitoring Progress report. External TKT activities will include working with potential new partners, managing the network membership, supporting ECI (post-doctoral fellows and graduate students), working with stakeholders.

The targeted groups for dissemination are:

- Academics – including ECI and facilitating their professional development.
- Pork supply chain (farm suppliers, pork producers, meat processors, retailers) interested in the use of new technologies for meat quality analysis.
- Policy makers and planners, but also the general public and schools
- NGOs active in the area of animal welfare

Specific dissemination mechanism:

- Creating an open IPEMA website (set up and maintained by the web site group). The outline of IPEMA website will be presented at the project "kick-off" meeting
- Working with Science Communication Units of the IPEMA partners (organizing public lectures, presentations at Science Festivals), and writing "public engagement" grant applications for dissemination of IPEMA results via TV and radio.
- Translate research outcomes into practice via a "Research with Impact" brochure.
- IPEMA conferences and workshops will be open for participants outside of this initiative.

- Using social media for promoting the initiative and dissemination of information about IPEMA conferences and workshops (freely available on-line).
- Organizing a social networking forum in IPEMA website for interactive support of ECI and researchers from ITC interested in following the activities of the IPEMA network.
- Setting up International Summer Schools for young researchers and ECI
- Advertising IPEMA-related research vacancies (e.g. a, ERACAREERS, Pan-Europ. Res. Mobility Portal) to ensure inclusiveness and equal opportunities for applicants from ITC.

2.3. Potential for Innovation versus Risk Level

2.3.1. Potential for scientific, technological and/or socioeconomic innovation breakthroughs

The COST Action is a unique opportunity to bring together complementary expertise over various scientific fields from academia, industry, government organisations and other stakeholders to address complex issues associated with moving to the EM production system. Having this multidisciplinary consortium would favour the following scientific and technological innovations
Developing and bringing novel technologies for rapid and cost-effective evaluation of pork quality traits to the market, including boar taint detection. Currently a number of research institutions across Europe work on novel technologies but their effort is not coordinated (no timely and effective data sharing, lack of rapid transfer to industry). IPEMA will provide this opportunity through effective communication and knowledge sharing.

Consumers' acceptance of pork from EM and IC is country specific. Despite numerous studies from individual European countries, facts remain fragmental and are often inconsistent. IPEMA will allow developing a coordinated approach to data analysis/sharing.

Development and application of new genomic technologies for regulation of pork quality. A range of genomic tools and technologies are available. However, genetic/genomic databases are not always shared between countries. There is a gap in knowledge about pig genotypes available in ITC which could be used to improve meat quality across Europe.

Building scientific capacities and enhancing the economy of ITC via training the next generation of scientists, providing access to advanced knowledge and training facilities.

Improving animal welfare will be addressed in a new way via coordinated effort of pig breeders, scientists, technology developers and policy makers

Improving environment. An ultimate aim of IPEMA is moving toward EM/IC production system which is not only more animal but also environmentally friendly compared to production of SC.

Beneficiaries

Benefit for International pig industry. Current EU annual losses related to boar taint are estimated as 78.6m €. Following the EU plans to ban pig castration as a measure to prevent boar taint by 2018, the estimated economic losses will increase to 393m € (www.alcasde.eu). Implementation of novel technologies for boar taint detection will prevent these losses.

Staff training and enhancing employability. IPEMA aims to develop joint Doctorate/ECI scheme with complementary funding for a transnational training programmes with close industry cooperation for more experience and a better employability prospective.

IPEMA will develop an electronic database of equipment, facilities and expertise of the partners stimulate collaboration and interaction.

IPEMA activities will have positive impact on instrumentation companies across Europe. The new technologies for meat quality traits could be manufactured in Europe, thus allowing those companies to grow via sustainable income and increased number of jobs.

IPEMA will focus on education and knowledge transfer to not only the scientific community but also to industry, policymakers, other stakeholders and general public

Participation in the COST action may facilitate funding from national programs

Risks and their mitigation

Risk	Level	Mitigation
Low engagement of stakeholders, difficulties in attracting new partners.	Medium	Establishing training and knowledge transfer coordinator To post detailed plan for knowledge transfer (see 2.2)
Difficulties in attracting follow-on funding for sustaining IPEMA	Medium	Seeking advice on funding opportunities from trained Research and Innovation Teams at participating organisations. Cross-disciplinary collaborative application with contribution from industry which are viewed more favourable by funding bodies when compared to applications from researchers only

3. IMPLEMENTATION

3.1. Description of the Work Plan

3.1.1. Description of Working Groups

Breeding & Genetics (WG 1)

In this WG, geneticists will collaborate with nutritionists, reproductive physiologists, animal ethologists, economists and meat scientists, supply chain stakeholders and animal welfare NGOs to find innovative genetic approaches for the creation of lines of pigs that are fully suited for the production of entire males. Tasks are:

- Establishing multidisciplinary networks of scientists
- Definition and standardization of methods for assessing the sexual development status of EM in order to identify markers/genes specific for the reduction of boar taint compounds
- Identification of conditions in which animals can express their capacity to produce and store SKA in order to define genetic parameters for selection against SKA (with **WG 2**)
- Definition of standardized methods to address other meat quality in parallel with selection against boar taint (with **WG 4** and **WG 5**).
- Definition of goals for selection against boar taint compounds and other meat quality traits (with **WG 4**, **WG 5** and **WG6**).
- Exchange of data and biological samples from different populations to avoid redundancies
- Assessment of genetic parameters for behavioural traits (with **WG3**) for selection indexes.

Activities: Workshops: WkSh 1.1; Conditions to favour expression of SKA deposition and to standardize measurement of boar taint compounds; WkSh 1.2 Methods to assess sexual development status; WkSh 1.3 Methods for assessing product quality traits other than boar taint; WkSh

1.4 Assessment of genetic parameters for behavioural traits. Section at the annual conference, Section on the project website, Work group meetings, STSM for ECI training Publications (see 3.2).

Nutrition (WG 2)

In order to establish recommendations, the scientific work plan for WG 2 will deliver a subset of relevant outcomes contributing to knowledge about practical methods for efficiently feeding EM and IC. Tasks are:

- Development of optimized recommendations for dietary energy, amino acids, fatty acids and other components which aim at efficient growth
- Efficient dietary control of boar taint compounds (with **WG1**) and
- Optimized technological and sensory pork quality.

- Definition of nutrient requirements for IC which take into account the respective length of the two metabolic phases, prior and after the second vaccination.

Activities: Workshops on nutritional aspects of EM and IC production (nutritional requirements, boar taint prevention, carcass/ meat quality); Section at the annual conference; List of open questions for further research and increase comparability of inter-institutional research activities in WG meetings (standardized diets, breeds and/or housing systems); List of feed ingredients with boar taint reducing capacities; Promote STSM for ECI training; Publication (see 3.2).

Management and housing conditions for improved animal welfare (WG3)

To establish production conditions which ensure an animal friendly production processes for EM the EM specific welfare problems have to be evaluated and reduced. By the introduction of a standardized international labelling of pork produced under such conditions this is communicated to consumers and meat industry. Tasks are:

- Assessment of the frequency of welfare problems within the participating countries and identification of the influence of genetics, housing and management on it (with **WG1** and **WG2**)
- Development of an early warning system to address EM specific welfare problems on farms
- Development and promotion of guidelines for an improved production system with reduced animal welfare problems in collaboration with NGOs and consumers (with **WG 6**)
- Introduction of a standardized international labelling and branding of EM pork from high welfare quality productions systems

Activities: Workshop on EM specific welfare problems (prediction, detection, avoidance), STSM for ECI training and exchange of analytical methods (promoted by scientific speed dating on conferences); Section on welfare at the annual conference; Work group meetings; (see 3.2)

Grading and meat quality control systems (WG 4)

Establishing an interdisciplinary network of key players in the area of pig husbandry and pork production, including researchers, industry and carcass grading system companies, will allow to create a competence platform for delivering tasks specified below. Meat quality grading systems (existing and under development) will be discussed and validated on their ability to meet industry requirements and consumer expectations. Tasks are:

- Establishment of a multidisciplinary network of those working in pork quality control.
- To identify industrial requirements for efficient and new meat quality grading systems.
- To review the existing grading technologies/systems with respect to their performance and potential for on-line use.
- To determine a verifiable reference standard for boar taint (with **WG 6**).
- To encourage a validation of meat quality grading systems at the industrial level.

Activities: Workshop with participants from science and industry on at-line/on-line control of boar taint and commonly agreed methods for assessing product quality traits (fatty acid composition, IMF content; tenderness and WHC); Annual WG meetings; A pork quality grading system section at the annual IPEMA conference; Critical overview of existing systems and recommendations on establishment of effective new grading systems; To identify funding opportunities for research on challenges of grading systems. Placements for ECI; Speakers from the corresponding industry in the program of international summer schools for ESI. (see 3.2.)

Innovation in the processing industry and product development (WG5)

Objectives of this WG relate to improving processing conditions/technologies and development of products that satisfy the consumer. The work will be based on collecting, summarizing and re-viewing the existing data on the processing of meat from EM and IC (focusing on boar taint reduction and adaptation of processing to different quality of meat). Tasks are:

- Investigation of indications of reduced meat quality in EM (low WHC, tenderness) as well as the possibilities to improve the quality of the fresh meat.
- Investigation of possible impact of immunocastration on meat quality.

- Evaluation of the impact of reduced meat quality to different products and how to avoid it
- Investigate the impact of boar taint and product specific possibilities of reduction/masking
- Investigate the possibilities for developing new products by incorporating the existing/newly developed knowledge and to avoid/compensate for the differences in raw material quality.

Activities: Joint research and publications; Two workshops on commonly agreed methods for assessing product quality traits other than boar taint and new types of products (with **WG1** and **WG4**); WG meetings; Section on meat processing at the annual conference. Producing literature review reports on meat and meat product quality of IC and EM; (see 3.2).

Consumer and market behaviour (WG 6)

The tasks are:

- Evaluation of consumers attitudes towards pork from EM and IC (questionnaire)
- Stimulate cooperation between research groups performing sensory studies on acceptance of meat from entire male pigs (harmonised protocols, inclusion of other countries)
- Communicate scientific information towards the pork chain regarding IC (e.g. effectiveness to eliminate boar taint, on farm experience, performance results, carcass/meat quality)

Activities: Workshop on sensory consumer studies to determine boar taint cut-off levels and stimulate joint consumer studies, including a discussion with data analysts about different data analytical strategies; Industry session on consumer and market acceptance of EM and IC; Section at the annual conference; Work group meetings (see 3.2).

3.1.2. GANTT Diagram

The following GANTT diagram gives an estimate of the timing of for the key milestones and use of networking tools. Final decisions regarding timing will depend on participating organizations. The major achievement milestones include:

1. Establishing and expansion of the network ensuring that all the relevant fields and sectors are covered

2. Workshop milestones: *WG concerned in brackets and in bold WG leading the WkSh.*

- Establishing standardized measurement of boar taint compounds and define the most relevant positive and negative rearing conditions related to the expression of AND and SKA deposition in pork from EM and (**WG1**, WG2, WG3)
- Reaching consensus on methods to assess sexual development status (**WG1**, WG3) and the most relevant product quality traits other than boar taint for EM and IC (**WG1**, WG4, WG5)
- Update the current knowledge on nutritional traits (nutritional requirements, boar taint prevention, carcass and meat quality) of EM and IC production (**WG2**, WG4, WG5, WG6)
- Detect and address EM and IC specific welfare problems (**WG3**, WG1, WG2)
- Identify requirements for new meat quality grading systems and review the existing grading technologies with respect to their potential for on-line use for EM and IC (**WG4**, WG5, WG6)
- Evaluate (available data) the effect of ban of castration on the expected impaired quality of pork from EM or IC for fresh consumption or for processing purposes (**WG5**, WG6, WG2)
- Investigate the possibilities to develop new types of products by using existing and new knowledge and to overcome the expected differences in raw material quality (**WG5**, WG6)
- Find a consensus on the ways to perform and statistically analyse sensory consumer studies which aims on boar taint cut-off levels(**WG6**, WG1, WG2, WG4, WG5)
- Determine the view of European pork processing industry on consumer and market acceptance of EM and IC (**WG6**, WG1, WG2, WG3, WG4, WG5)
- Determine possibilities to assess genetic parameters for behavioural traits and show ways to include them in selection objectives (**WG1**, WG3)

3. Deliverables:

- a. A list of knowledge gaps for further research activities and initiated inter-institutional research activities at WG meetings (WG2)
- b. Review on existing data on frequency of welfare problems within countries (WG3)
- c. Recommendations regarding rearing conditions aiming to reduce SKA and AND (WG1)
- d. Recommendations for improved production systems with reduced animal welfare issues (WG3)
- e. Created and published list of feed ingredients with boar taint reducing capacities (WG2)
- f. Handbook “Early warning system” to address EM welfare problems on farms (WG3)
- g. Concepts for international labelling of pork from high welfare productions systems (WG3)
- h. Report on possible genetic parameters for behavioural traits for genetic selection (WG1)
- i. Updated nutrient recommendation for EM and IC (WG2)
- j. Review report on meat quality grading systems and their potential for on-line use (WG4)
- k. Recommendations regarding the use of meat from EM, IC for different products (WG5).
- l. Agreed protocol for evaluation of consumers and market attitudes towards EM and IC in at least 5 Western and 5 Eastern European countries (WG6)
- m. Guided communication with NGOs and consumers about improved animal welfare EM production system (identical with D 3g, WG 3)

Year:		1				2				3				4			
Main activities	Quarter:	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1 Establishing Network																	
2 Workshop milestones				2.a 2.c 2.d		2.e 2.f		2.b		2.g 2.h 2.i				2.j			
3 Deliverables					3.a			3.b 3.c 3.d 3.e			3.f			3.g			3.h 3.i 3.j 3.k 3.l 3.m
COST NETWORKING TOOLS																	
Kick off																	
Website operational																	
Regular dissemination																	
STSM																	
Training schools																	
IPEMA joint conferences (see 3.2)							M 0.				M 0.					M 0.3	
Review and opinion papers																	
Final report																	

3.1.3. Risk and Contingency Plans

In addition to the risks described in 2.3.3 the greatest risk is that success of IPEMA might be partially dependent on the success of nationally funded research projects. This risk is reduced by involvement of a large number of research groups and private sector parties in different COST countries. Another resides in the willingness of the industry and policy makers to implement the innovations and policies proposed by the academic sector. This risk is greatly reduced by having partners from the pig industries and in groups defining public policy in nearly every participating country. Another risk is a lack of formal collaborative agreements between different academic partners across different disciplines. This risk is well-controlled by including WGs with multiple partners and ensuring that all primary topics are of interest to multiple research groups in most of the countries. It will be further reduced by ensuring joint obligation for STSMs, and joint supervision of ECI straining, thus producing

synergy and interdependence between the partners. If unforeseen challenges arise, appropriate actions formulated and approved by the Management Committee.

3.2. Management structures and procedures

The COST Action will be coordinated by a Management Committee (MC). The Chair and the Vice-Chair will be elected at the "kick-off" meeting to be held soon after the start of the Action. Each signatory country will send two representatives. In addition, coordinators of the WG and the three WG Supporting Teams (Communication and Dissemination, Training and Education, Inclusiveness) will be appointed. Finally, a secretary at the grant holding institute supporting the Chair in administrative matters will be appointed. IPEMA will run over 4 years in 6 WGs (described in 3.1.1.) aligned with the scientific programme. At the start of the COST Action the 6 WGs will be formed and will be responsible for the fulfilment of the scientific goals. Group coordinators and vice leaders will be elected in order to lead the scientific discussions. Scientists from ITC countries will act at least as vice-group leaders. Together they coordinate the activities of the sub- projects and provide the Chair with a brief yearly written report. All scientists and stakeholders participating in the IPEMA COST Action will be invited to join one or several WG, depending on their research activities and interests. In the course of the COST Action new/additional sub-WG can be established depending on the needs/wishes. IPEMA will help to concentrate the efforts of existing national projects in the different participating laboratories onto the primary and secondary objectives listed in 1.2.1. The COST initiative is the most suitable instrument for supporting this kind of open, flexible and growing network in a nascent research and engineering area including the generation of new projects. Three conferences will be crucial for the coordination of National research (see 3.1.2): The 1st conference (M 0.1) will establish an inventory of progress and problems in pork production with EM and discuss current knowledge and experience to identify knowledge gaps and produce a strategy, including a plan for specific bilateral/multilateral site visits. The 2nd conference will review new developments and demonstrate their economic/societal benefits (M 0.2) The 3rd conference will be dedicated to cross-WG themes, final standardised protocols and knowledge transfer (M 0.3).

3.3. Network as a whole

IPEMA aims in a first step to solidify the fragmentary network of stakeholders over all European countries, to ensure, that the exchange of knowledge and technologies enables pork industry to cope with the ban of surgical castration of boars. Leading scientists from international partner countries will be included, and stakeholders notably from ITC and neighboring countries will be encouraged to participate. In a first step ITC scientists will act at least as vice group leaders. IPEMA will attract ECI as well as established scientists and will provide opportunities to all genders and ages. ECI will be actively encouraged to participate in workshop organization, collaboration building, grant writing and mobility between network organizations. These efforts will be embedded in the activity of the MC. The achievements of IPEMA will be monitored by the MC against the milestones and deliverables. In addition, the MC of IPEMA will ask the non-academic experts to evaluate the output of the network and assess its value to their interests in order to implement IPEMA plans for knowledge transfer. These activities will be facilitated through the integrated involvement of industry/commercial partners in the network and the dissemination activities which are targeted also at policy makers. The cooperation of many experts throughout IPEMA, will ensure that the opportunities for application and exploitation are available as widely as possible.