



An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
Food and the Marine

Research Stimulus Fund

Final Report

'Environmental enrichment and nutritional strategies to reduce tail biting in pig farms'
(ENTAIL)

DAFM Project Reference No: 14/S/871

Start date: 01 April 2015

End Date: 30 September 2017

Principal Coordinator and Institution: Dr. Keelin O'Driscoll, Teagasc
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Collaborating Research Institutions and Researchers: SRUC/University of Edinburgh were involved in supervision of the associated student. Dr. Rick D'Eath (SRUC) acted as the primary supervisor, along with Dr. Dale Sandercock (SRUC). Prof. Natalie Waran (U. of Edinburgh) acted as the university link.

Please place one "x" below in the appropriate area on the research continuum where you feel this project fits

Basic/Fundamental			→				Applied/Pre Commercial	
1	2	3	4	5	6X	7		

Please specify priority area(s) of research this project relates to from the National Prioritisation Research Exercise* (NRPE) report;

Priority Area (s)	Area I: Sustainable Food Production and Processing
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Key words: pig welfare, tail-biting, enrichment, behaviour

1. Rationale for Undertaking the Research

Pigs are omnivorous animals that under natural conditions spend a high proportion of their time performing exploratory and rooting behaviour in their search for food (Stolba and Wood-Gush, 1989). Exploration of their surroundings also arises from a more general motivation to obtain information about their environment (intrinsic exploration; Wood-Gush and Vestergaard, 1989). Despite domestication, commercially produced pigs continue to express exploratory behaviour even when satisfied nutritionally (Beattie and O'Connell, 2002).

The behavioural elements that the pig uses in exploration are rooting, sniffing and chewing. In barren environments these are directed towards other pigs, and can result in harmful behaviours such as tail and ear biting. Such is the severity of this problem in commercial pig production that the European Food Safety Authority has published a scientific opinion on the subject (EFSA, 2007). The report concluded that 'the occurrence of tail biting has a multi-factorial origin and there is evidence in the report that some causal factors have more weight, such as the absence of straw, the presence of slatted floors and a barren environment.' Indeed a lack of appropriate enrichment is considered the largest risk for tail biting, and this is compounded by a fully slatted floor (EFSA, 2007).

The majority of Irish pigs are reared on slatted floors, and it is thus imperative that appropriate enrichment is provided that doesn't negatively affect the slurry systems underneath. Van de Weerd et al. (2003) carried out a large study with different environmental enrichment substrates, and identified the key characteristics that sustained occupation for growing pigs as: ingestible, odorous, chewable, deformable, and destructible. With regard to commercially produced pigs, Van de Weerd and Day (2009) concluded that successful enrichment should fulfil four criteria: 1) increase species-specific behaviour, 2) maintain or improve levels of health, 3) improve the economics of the production system, and 4) be practical to employ.

It is widely reported that straw bedding is associated with reduced risk and prevalence of tail biting (EFSA, 2007). In fact Day et al. (2008) found that compared with no straw, the provision of straw of any length reduced the occurrence of behaviours such as nosing and tail-biting. However, provision of straw in slatted pens is difficult, due to the risk of damaging the slurry system. Thus wooden posts, or 'chew-bars', which are used successfully in European countries where pigs are reared in slatted pens (Speijers, 2014), could pose a suitable alternative to straw.

This project thus investigated the efficacy of compressed straw blocks and various types of wood, at reducing harmful behaviours in growing pigs. The initial work was carried out on commercial units, with docked pigs, (tail docking is often necessary as a control mechanism for tail biting in Ireland) and the final project used undocked pigs in the research centre of the Teagasc Pig Development Department, Moorepark.

2. Research Approach

The first task which was undertaken was to carry out a producer survey, to obtain an impression of the current use of enrichment in Ireland, and attitudes of producers towards tail and ear biting, and types of enrichment. This was carried out over the telephone by the postdoctoral researcher employed on the project, between August and November 2015. The survey was developed in conjunction with the Teagasc Pig Department advisory staff. It was comprised of 26 questions split into 4 categories: General management, Feeding, Tail biting and Enrichment.

The second task was also carried out by the postdoctoral researcher, and consisted of an experimental study carried out on a commercial pig unit from weaning until slaughter. The experiment was a 2 × 2 factorial design; pens were provided with either compressed straw blocks or hanging plastic toys at a ratio of 1:25 pigs, and contained either male or female pigs. The primary measures of interest were animal behaviour (damaging behaviour and interaction with the enrichment), the amount of tail and ear damage, and salivary cortisol levels. These measurements were taken approximately every 2 - 3 weeks from weaning until slaughter. At slaughter, the pigs were followed to the factory and tail lesion scores collected from the carcasses. In addition to this, when the pigs were in the second stage weaner accommodation (i.e. nearly mid-way through their lives from weaning to slaughter) behavioural tests were carried out to assess the pigs' emotional state. Pigs initially underwent an open field test for 5 minutes, followed by a test where a novel object (red brush head) was placed in the enclosure and their reactions recorded for 3 minutes. Ten pigs per pen underwent these tests, and as well as the effect of treatment (male v's female, straw v's toy) the effects of pig 'type' were also investigated (pigs with badly bitten tails, 'biter' pigs, confident/friendly pigs, and fearful pigs). Finally, the rate of use of the straw was recorded.

The third task consisted of experimental work investigating the effectiveness of a range of wood types at reducing damaging behaviour. A second experiment was carried out on the same commercial pig unit as above during the finisher stage only. Again, the enrichment was provided at a ratio of 1:25 pigs. Four different species of wood were used, with a range of hardness levels, from soft to hard: Spruce, Scots pine, Larch and Beech. The holders for the wood included 2 small chains hanging below them, so we could compare how often the pigs interacted with the wood versus the holder. Measures for analysis included animal behaviour (damaging behaviour, play, and interaction with the wood and wood holder), the level of tail and ear damage, tear scoring, and the rate of wear of the wood. A second, similar experimental investigation of the effectiveness of a range of wood types was carried out in the Moorepark pig unit, concurrently with the experiment on the farm. The primary purpose of this study was to observe in greater detail how finisher pigs interacted with the wood species than we could do on the commercial farm, through the use of video recording. We used a smaller pen size suitable for 7 pigs, and as such were able to observe individual pig behaviour. Moreover, salivary samples were taken from focal pigs in each pen every 2 weeks in order to use physiological measures to supplement behavioural and lesion data. This study, and both studies on the commercial unit, used pigs

with docked tails, as the risk of a tail biting outbreak was considered too high at that time to not dock.

The final experiment was carried out using undocked pigs in the Moorepark pig unit. This study had a 2×2×2 factorial design: pigs were provided with either a rubber floor toy or a soft wood plank in the weaner stage, then treatments were re-randomised across the finisher stage, and from weaning to finishing pigs were provided with a diet with either a standard level of crude fibre for a (weaner at 4.2%; finisher at 6.6%) or a diet with a relatively higher level of crude fibre (weaner at 5.9%; finisher at 13.1%). The crude protein of the diet was kept the same (weaner at 22%; finisher at 17%) and the fibre level increased by the addition of soya hulls to the standard diet. Animal behaviour and lesion scoring were carried out as above, as was a novel object test. In addition, three interventions strategies for tail biting outbreaks (remove the biter, remove the bitten pig, or add extra enrichment) were also compared for effectiveness at stopping tail biting outbreaks as they occurred. If fresh blood persisted for 24 hours a second intervention was implemented.

3. Research Achievements/Results

Producer survey

Fifty eight farmers contributed to the survey (out of approx. 300 in the country). All respondents commented on the sporadic, unpredictable nature of tail biting outbreaks and the fact that there was no definite solution when it does occur. Negative consequences included "seeing a good pig destroyed" with condemnation being the most destructive element for 79% of those surveyed, closely followed by loss of productivity. Ear biting was reported to occur most often during the second stage, and tail biting in the finishing stage. Most respondents felt that biting outbreaks were a "symptom of another problem" with pig health, stocking density, feed and ventilation felt to be the biggest triggers. Many of the respondents also believed that "boredom has a big effect on tail biting"; the majority of those surveyed (65%) found enrichment of importance in both reducing the incidences of tail biting outbreaks and stopping them when it does occur.

Study 1: The effect of sex and compressed straw or a plastic toy on damaging behaviour on a commercial unit

During the weaner stages there was no effect of enrichment type (straw or a hanging toy) on tail lesion scores, but females tended to have worse scores and performed more harmful behaviour than males ($P < 0.001$). Both sex ($P < 0.001$) and enrichment type ($P < 0.01$) influenced the amount of ear biting observed in the weaner stages. Again, female pigs performed more ear biting than males and pigs with straw blocks performed more than pigs with a plastic toy. In both the weaner and finisher stages, male pigs performed more aggressive behaviour than females ($P < 0.001$) and more instances of interaction with enrichment were recorded in toy than straw block ($P < 0.001$) groups. There was no effect of either enrichment type or sex on cortisol levels either during the weaner or finisher stage nor was there an effect of enrichment type or sex on tail lesion scores recorded at the abattoir. Compressed straw blocks provided in this fashion did not have benefits to pig

welfare, relative to hanging plastic toys. The highest straw usage was recorded amongst the second weaner stage (Table 1). The cost of straw was €0.46 per day (€0.37 per pig) in the first stage, €2.85 per day (€0.57 per pig) in the second stage and €0.21 per day (€0.58 per pig) in the finisher stage. During the novel arena test bitten pigs spent less time exploring and tended to perform more high pitched vocalisations than non-bitten. In the novel object test, there was a tendency for bitten pigs to direct attention without touching the novel object for longer than non-bitten. Overall, the behaviour of bitten pigs was more indicative of fearfulness than non-bitten pigs, implying that not only is physical health, but also mental state, affected by tail biting.

Study 2: A comparison of wood species varying in hardness with regard to damaging behaviour on a commercial unit

Hardness of the wood differed significantly between species ($P < 0.001$). Beech was harder than all other types of wood ($P < 0.05$), larch was harder than spruce and Scots pine ($P < 0.001$), while spruce and Scots pine did not differ from each other. Finally, Scots pine had a higher moisture level than spruce and larch ($P < 0.001$). Spruce was consumed more quickly than other wood types in terms of weight loss and reduction in length ($P < 0.001$). Pigs were observed interacting with the spruce more frequently than the other wood types ($P < 0.05$). Pigs also interacted with the wood more often than the chains in spruce allocated pens ($P < 0.001$). Overall the interaction with wood posts did not decline significantly across time. However, there was no difference in the frequency of harmful behaviours (tail/ear/flank-biting) observed between wood types, and also no difference in the effectiveness of the different types of wood in reducing tail or ear damage. There was a positive correlation between ear lesion and tear-staining scores ($P < 0.01$), and between tail lesion and tail posture scores ($P < 0.05$), indicating that these measures may be useful on-farm indicators of welfare, particularly if pens are large and there is dirt on the tails. Wood type did not affect visceral condemnation observed in the slaughterhouse. Thus we found that wood is a potentially suitable enrichment material for pigs, yet the wood species could influence its attractiveness to pigs, and softer woods were more appealing.

Study 3: A comparison of wood species varying in hardness, and a rubber floor toy, with regard to damaging behaviour in the Moorepark research farm

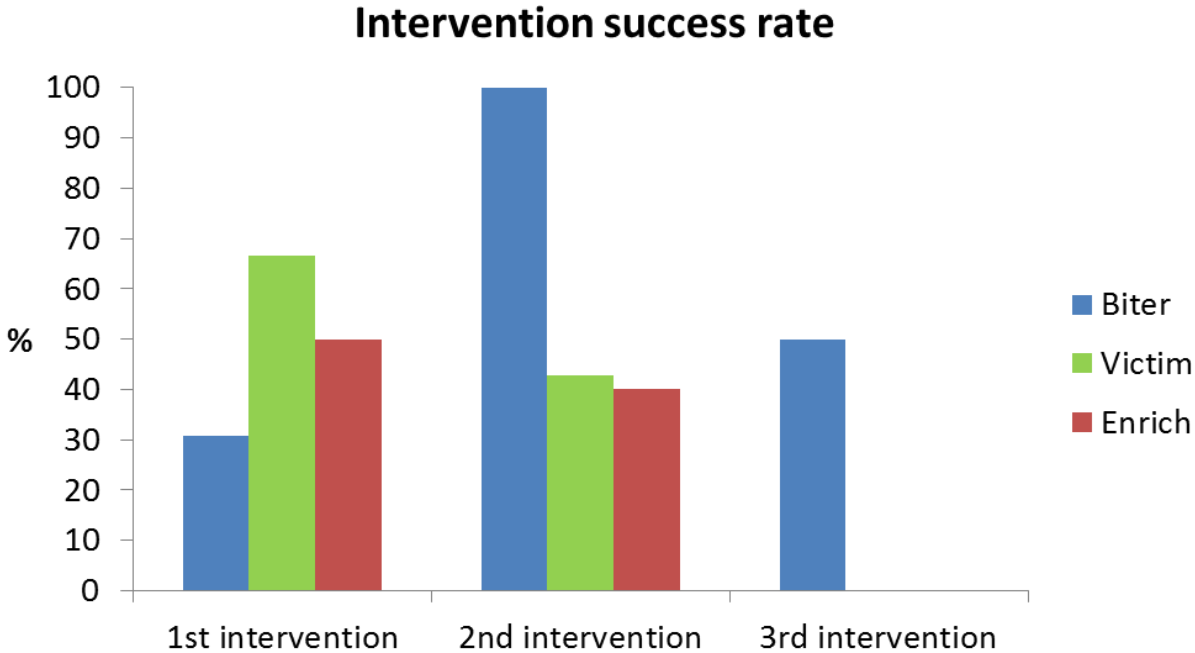
Tail lesions were higher in the spruce group ($P < 0.05$) although there no difference in terms of presence of blood on the tails scored, and in general the scores were extremely low (average of below 1 (mild lesions) for all treatments). No difference was found between treatments for ear lesions or tear staining scores. Salivary cortisol did not differ between treatments, but overall as the pigs grow bigger the salivary cortisol level increased ($P < 0.01$). Neither was a difference found on the performance of tail and ear biting separately or combined. Pigs provided with the rubber floor toy spent a higher percentage of time interacting with the enrichment compared to ones given beech ($P < 0.05$). This could in part be due to the fact that the toy was movable on the floor inside the pen, which created more interaction between the pigs and also easier access by the pigs compared to the wood dispenser fixated on the wall, as well as due to the fact that the beech is the hardest wood, and thus likely less appealing than the softer wood types. There was also no difference in aggression at the enrichment devices or play behaviour. For the growth

parameters, the average daily gain and feed conversion ratio was both the same between treatments. During the carcass inspection in the slaughterhouse, no damage from splinter to the gum, tongue and mouth area was found related to using wood.

Study 4: A comparison of wood and a rubber floor toy with regard to tail biting behaviour and performance of undocked pigs

Although average daily gain (ADG) was similar for pigs on both diets, during the finisher stage pigs fed the high fibre diet had a lower ADG (1.06 Kg/day) than those on the standard diet (1.09 Kg/day; $P < 0.05$). Nevertheless, both are within the normal range expected for finisher pigs, and higher than the average of the farms enrolled in the Teagasc eProfit monitor for 2017 (0.866 Kg/d). Pigs interacted more with the toy than the wood ($P < 0.05$), and there was also less tail directed behaviour in the Toy pens ($P < 0.05$). This implies that perhaps the Toy was more effective at attracting biting behaviour away from other pigs than the wood was. With regard to tail and ear lesions, and tear scores, there was no effect of enrichment type or diet. In the novel object test, we found that bitten pigs took longer to approach the object than pigs that performed tail biting ($P < 0.05$), indicating increased fearfulness. This is similar to the previous results from the novel object test on the commercial farm. We also found that pigs with the Toy approached the novel object faster than ones given wood, and spent a longer time interacting with it ($P < 0.05$), but this could have been because the NO was more similar to the floor toys and therefore was less novel and fearful for them.

Finally, there were a total of 26 tail biting outbreaks during the experiment. As a first intervention, the success rate was the highest if the victim was removed ($n = 6$ outbreaks). However if a third intervention was needed, removal of the biter was successful 100% of the time.



4. Impact of the Research

This research project has been extremely timely, and is of great importance to the industry from both an animal welfare and legislative perspective. Since 2008 it has been prohibited to routinely dock pigs' tails in all EU countries, and it has also been the law that pigs must have permanent access to appropriate manipulable material (Council Directive 2008/120/EC). Due to the widespread lack of compliance with this directive across the EU, in March 2016 the commission released a recommendation regarding management of tail biting in pigs, reiterating that enrichment materials should be edible, chewable, investigable, and manipulable (Commission Recommendation 2016/336). In addition, they released a Staff Working Document describing in detail the characteristics of various types of enrichment, and how they should be used and combined in various pig production systems (Commission Staff Working Document, 2016). Provision of adequate and appropriate enrichment is extremely challenging in slatted systems, which are the predominant types of pig housing in Ireland, due to the risk of materials falling through the slats and interfering the slurry system. Unfortunately, the vast majority of research which has been carried out to date on provision of enrichment to growing pigs has been done in countries where either solid or partially solid floors are prevalent. Thus most of the research has included loose straw on the floor, in varying amounts, as at least one of the treatments, and this is considered the gold standard. Thus the results from these studies are not readily translatable to Irish systems. Our research findings consist of the first body of work carried out in Ireland on the area of enrichment for growing pigs, using materials that are all appropriate for use in slatted systems.

By carrying out part of the project on commercial farms, we were able to demonstrate how our treatments functioned in an applied setting. This provides producers with accurate information about how effective the enrichment materials will be practically, and also means that there can be quick adoption of the best strategies. There has also been significant interest in the scientific community in the work, due to the novelty of investigating purely strategies suited to slatted systems. The researchers and PhD student are members of an EU research network, GroupHouseNet (COST action CA15134) and have shared our research findings and experience. This has led to the development of new collaborations and development of further projects.

Thus the information

4(a) Summary of Research Outcomes

- (i) Collaborative and Industry links developed during this research

The supervision of the PhD student is being carried out by Dr. Rick D'Eath and Dr. Dale Sandercock of SRUC. Dr. Sandercock was previously a member of a European research consortium (FareWellDock), which to date has been the largest project internationally which has focused solely on the issue of tail docking and how to reduce the need for it. Dr.

D'Eath is a behavioural scientist, currently working on automated methods to predict tail biting, and interventions to prevent it. Thus the link with SRUC has been invaluable in development of the project, from design of the experiments to improving the types of measurement used.

I was invited to present the initial stages of the work at a meeting (29 May 2015) of the FareWellDock project partners. This was to update them on the planned research for pigs managed on slatted floors (the partners in that project worked in systems with at least partially solid floors), and to ensure that I was as up to date as possible with current research at the time. This meeting introduced me to several researchers working in this area internationally (e.g. Prof Anna Valros, University of Helsinki, and Dr. Jeremy Marchant Forde, USDA). Further to the current work, Dr. Marchant Forde has requested I collaborate on work that he has obtained funding for in the US through the USDA and Nestle, designing and planning research to determine appropriate enrichment strategies for pigs managed under typical US conditions.

My experience in the area of enrichment and tail docking in pigs meant that I was in an excellent position to be appointed as a management member of COST action CA 15134 (GroupHouseNet). My role is as web-coordinator, and I am participating in writing of two review papers as part of the action. Through this I have met with many more researchers in the areas of tail biting, and have developed collaboration with Dr. Sabine Dippel (Friedrich Loeffler Institute, Germany) to adapt the SchwIP tail biting control protocol, initially developed in Germany, for use in Ireland.

(ii) Outcomes where new products, technologies and processes were developed and/or adopted

No specific new products, technologies or processes were developed or adopted.

(iii) Outcomes with economic potential

No specific outcomes with economic potential were identified.

(iv) Outcomes with national/ policy/social/environmental potential

This research programme was the first in Ireland purely dedicated to identifying appropriate enrichment materials for growing pigs, with the ultimate aim of removing the need to tail dock. Since 2008 it has been the law in the EU that pigs should be provided appropriate materials, yet we identified through the survey we carried out, that this is not being complied with in Ireland. Prior to the start of the project, we were aware that over 99% of pigs in Ireland are tail docked, which is another non-compliance with this legislation. Thus even at the beginning of the work, we knew that what we planned was

extremely pertinent to the industry. However, since the project began, there has been renewed focus by the EU commission on enforcement of the current legislation. This has been enacted through a 3 year project managed by DG Sante. That project has already carried out several audits of EU countries, all of which fared poorly, and has requested action plans from each member state outlining how each state is currently complying and the plans for enforcement. Thus the research that we carried out has turned out to be even more important than we initially anticipated, as it has provided a starting point for validation of methods to reduce the risk of, and control bouts of tail biting. Moreover, our continuous dissemination of the result findings through the Teagasc pig conference and research dissemination days has meant that stakeholders in the industry have become extremely familiar during the past few years with the requirements of the legislation, and the need to make attempts to comply with it. Animal Health Ireland are currently in the process of expanding their remit to cover pigs as well as ruminants, and due to the experience we have obtained in Teagasc in the areas of tail biting, we are in discussions as to how we can work together to develop risk assessment protocols for use on farm. Thus overall, the outcomes of the project have significant potential to improve the welfare status of pigs in Ireland, compliance with legislation, and ultimately the sustainability of the industry.

4 (b) Summary of Research Outputs

(i) Peer-reviewed publications, International Journal/Book chapters.

1. Chou, J.-Y., D'Eath, R.B., Sandercock, D.A., Waran, N., Haigh, A. and O'Driscoll, K. (2018). Use of different wood types as environmental enrichment to manage tail biting in docked pigs in a commercial fully-slatted system. *Livestock Science* 213, 19-27.
2. Haigh, A., Chou, J.-Y. and O'Driscoll, K. (2018). An investigation into the effectiveness of compressed straw blocks in reducing abnormal behaviour in growing pigs. *Animal*, *in Press*
3. Haigh, A. and O'Driscoll, K. (2018). A survey of Irish producers regarding enrichment and tail docking in commercial pig farming. *Irish Veterinary Journal* (*under review*)
4. Chou, J.-Y., D'Eath, R.B., Sandercock, D.A., and O'Driscoll, K. (2018). Can fibre level and enrichment type reduce the risk of tail biting in undocked pigs? *In preparation for submission to Animal, December 2018*

(ii) Popular non-scientific publications and abstracts including those presented at conferences

O'Driscoll, K., Chou, J.-Y., and Haigh, A. (2017) Environmental enrichment for pigs. *Teagasc TResearch*, Vol 12., No. 3, Autumn.

Chou, J.-Y., D'Eath, R. B., Sandercock, D. A. and O'Driscoll, K. (2017). Investigation of response to the novel object test in pigs in relation to tail biting phenotypes. Proceedings of the 51st Congress of the International Society for Applied Ethology, 7-10 Aug, Aarhus, Denmark.

Chou, J.-Y., Haigh, A., D'Eath, R., Sandercock, D., Waran, N. and O'Driscoll, K. (2017). Use of different wood types as enrichment to reduce tail biting in pigs managed on fully-slatted floors. Proceedings of the UFAW International Animal Welfare Science Symposium, 27-29 June, London, United Kingdom.

O'Driscoll, K., Chou, J.-Y., Garcia Manzanilla, E. and Boyle, L. (2017). Enrichment for pigs: Options for slatted systems (ENTAIL). Proceedings of the Teagasc Pig Development Department Research Dissemination Day, 29-31 May.

Chou, J.-Y., Sandercock, D. A., D'Eath, R. B. and O'Driscoll, K. (2017). Entail: Control strategies for tail-biting outbreaks among undocked pigs. Proceedings of the Teagasc Pig Development Department Research Dissemination Day, 29-31 May.

Haigh, A., Chou, J.-Y. and O'Driscoll, K. (2016). Behavioural responses of commercially housed pigs to an arena and novel object test. Proceedings of the 50th Congress of the International Society for Applied Ethology, 12-15 July, Edinburgh, United Kingdom.

Haigh, A. Searching for solutions to pig tail biting. *The Anglo Celt*, April 2016.

Chou, J.-Y., Sandercock, D., D'Eath, R., Waran, N., Haigh, A. and O'Driscoll, K. (2016). ENTAIL: Using wood as enrichment to reduce tail biting in pigs managed on slatted floors. Proceedings of the Teagasc Pig Development Department Research Dissemination Day, 27-28 April.

O'Driscoll, K., Haigh, A., Chou, J.-Y., Garcia Manzanilla, E. and Boyle, L. (2016). Environmental Enrichment and Nutritional Strategies to Reduce Tail Biting (ENTAIL). Proceedings of the Teagasc Pig Development Department Research Dissemination Day, 27-28 April.

Haigh, A., Chou, J.-Y. and O'Driscoll, K. (2016). The last straw: An investigation into the effectiveness of compressed straw blocks in reducing abnormal behaviours in growing pigs. Proceedings of the Teagasc Pig Development Department Research Dissemination Day, 27-28 April.

Haigh, A., Chou, J.-Y. and O'Driscoll, K. (2016). Behavioural responses of commercially housed pigs to an arena and novel object test. Proceedings of the Teagasc Pig Development Department Research Dissemination Day, 27-28 April.

Haigh, A. 2016. Irish Farmers experiences of tail biting. *The Irish Pig Health Society*, 43rd Symposium and Trade Fair 2016

Haigh, A. A Summary of Some of the Findings from the Tail Biting Survey. Teagasc Pig Newsletter, March 2016

Haigh, A. Fitter, happier, more productive", a guide to environmental enrichment. Teagasc Pig Newsletter, September 2015

O'Driscoll, K. 2015. Entail: Environmental enrichment and nutritional strategies to reduce tail biting in pig farms. Proceedings of the Teagasc Pig Development Department Research Dissemination Day, 12th and 15th May.

(iii) National Report

(iv) Workshops/seminars at which results were presented

Chou, J.-Y., D'Eath, R. B., Sandercock, D. A., Waran, N. and O'Driscoll, K. (2017). Using different wood types as environmental enrichment to manage tail biting in pigs on slatted floors. SRUC Post Graduate Conference, Edinburgh, 22 March.

Chou, J.-Y. (2016). Strategies to reduce the risk of tail biting in pigs managed on slatted floors. SRUC Post Graduate Conference, Edinburgh, 23 March.

(v) Intellectual Property applications/licences/patents

(vi) Other

5. Scientists trained by Project

Total Number of PhD theses: 1

Jen-Yun Chou, University of Edinburgh, Teagasc and SRUC, Strategies to reduce the risk of tail biting in pigs managed on fully slatted floors. Anticipated submission 30 Sep 2019.

Total Number of Masters theses: 0

6. Permanent Researchers

Institution Name	Number of Permanent staff contributing to project	Total Time contribution (person years)
Teagasc	3	0.538

Total

7. Researchers Funded by DAFM

Type of Researcher	Number	Total Time contribution (person years)
Post Doctorates/Contract Researchers	1	1 year
PhD students		
Masters students		
Temporary researchers		
Other		
Total		

8. Involvement in Agri Food Graduate Development Programme

NA

9. Project Expenditure

Total expenditure of the project: €182,276.02

Total Award by DAFM: €182,276.02

Other sources of funding including benefit in kind and/or cash contribution(specify): €NA

Breakdown of Total Expenditure

Category	Institution 1
Contract staff	45,417.95
Temporary staff	
Post doctorates	
Post graduates	44,000
Consumables	38,709.97
Travel and subsistence	9,785.04
Sub total	137,912.96
Durable equipment	2989.17
Other	
Overheads	41,373.89
Total	182,276.02

10. Leveraging

NA

11. Future Strategies

Jen-Yun is continuing her studies as she has two further years to complete to obtain her PhD after the final date of this project. She has carried out a further research project, which provided multiple enrichment devices to undocked pigs, with the aim of determining what is the optimum amount to prevent biting behaviour. I have recently submitted a research project proposal to the Teagasc internal funding call to develop a tail biting control protocol for use in Ireland, adapted from the SchwIP system already used in Germany. If funded this project will involve training of a PhD student (UCD) and liaising with Animal Health Ireland, PVP's and pig farmers, to develop and validate a protocol which will be effective in commercial pig units. This can then be used on an ongoing basis by farmers and vets after the completion of the project.

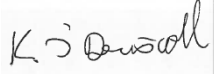
12. Consent to Publish Final Report on the DAFM Website and/or Through Other Dissemination channels

I consent to this report being made available to the public, through the Department's website and other dissemination channels.

Yes No

13. Declaration

I declare that the information contained in this final report is complete and true to the best of my knowledge and belief.

Signed:  Project Coordinator

Date: 23 October 2018