

Two separate valorisation methods for pig carcasses: AD and carcasse cooling

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ADNet/FoodWasteNet – Valorisation of Animal By-Products
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Anaerobic digestion of pig carcass material

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Background to the project

- Bovine spongiform encephalopathy recognised as a disease in 1986
- Commission Regulation (EC) 1774/2002 prohibited the open-burning and burial of fallen stock on-farm
 - legislation covered both ruminants and non-ruminants
- Farmers used alternative disposal methods which incurred greater costs





Establishing farmers' perspectives of fallen stock disposal

- Two questionnaires were conducted during 2008 and 2009, to establish:
 - current disposal methods used to dispose of fallen stock
 - the effect of NFSCo/non-NFSCo membership on disposal methods used
 - the effect of geographical location
 - the level of illegal disposal
 - how farmers would prefer to dispose of their fallen stock
 - establish farmers' views about on-farm biodigestion

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Overall questionnaire findings

- High level of illegal disposal
 - overall level of 13.7% for all ABPs
 - aborted fetuses/placentas of 19.5%
 - placentas of 57.6%
- Farmers' would welcome alternative treatment/disposal methods on-farm





Alternative research developments

- On-farm aerobic digestion of sheep and pig carcasses
- On-farm composting of pig placentas and fallen pigs

Therefore, PhD aim...

Develop a novel method for the treatment and storage of fallen pigs on-farm using anaerobic digestion

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Why use AD?

- Various scales of AD units available for on-farm use
- Relatively low cost
- Secure system
- Biogas yield utilised on-farm (heat or electricity)
- Destruction of key (aerobic) pathogens
- Long-term storage possible to reduce frequency of collections
 - increased biosecurity

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Experimental results

- Range of small-scale and a large-scale experiments were conducted
- Experiments designed to mimic real-world application and potential compliance with EU legislation
 - used a whole, growing gilt
 - reactors sealed for set duration prior to collection
 - co-digestion potential to increase biogas yield
 - destruction of key indicator pathogens – *Enterococcus faecalis*, *Salmonella* spp. and *Clostridium perfringens*





Large-scale experimental results

- Stable digestions process
 - pH
 - Ammonium didn't inhibit the process
- Good total biogas and methane yields
 - Total biogas – 0.9 m³ kg VS
 - Methane – 0.58 m³ kg VS





Large-scale experimental results

- *Salmonella* spp. wasn't found in any samples
- *Enterococcus faecalis* was successfully destroyed
- *Clostridium perfringens* demonstrated no significant decrease
 - Pasteurisation was ineffective, due to spores forming
 - Sterilisation was effective
- Insufficient 5 log₁₀ reduction required by legislation





Further research

- Spiked pathogen experiments
 - Effective destruction ($>5 \log_{10}$) of *S. typhimurium*, *E. coli*, *PPV*, *A. suum* but $<3.0 \log_{10}$ reduction of *C. perfringens*
- Looked at sterilisation of the carcass prior to digestion
- Continuous digestion processes

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Valorisation of carcase material via on-farm carcase cooling

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Dr Stephen Woodgate (FABRA), Mr Ian Campbell (NFSCo), Prof Bob Bansback (HAU), Susan Rabbich (AHDB Pork), Tine Zimmermann (Patriotisk Selskab) and Lisbeth Shooter (Patriotisk Selskab)

Data collection - Jane Rockingham (NFSCo), Mr Thomasse (Coolworks), Daka and stakeholders who provided data





Houston report, 2012

- Identified that carcasses and ABP should be reassessed and no longer treated as waste products
- A value added product should be created
 - greatest possibility is through rendering
- In Denmark and the Netherlands this has been enabled through carcass cooling





Carcase cooling concept

- Carcasses cooled between 5-10°C
- Prevent/limit bacterial degradation, which decreases carcass quality
- As carcasses do not degrade, they can be stored for longer
- Fewer carcass collections
- Improved biosecurity
- Secure storage method which is easy to clean and disinfect
- Reduction in smell and vermin



Producing a value added product

- Rate of carcass degradation measured by the production Free Fatty Acids (FFA)
- Low FFA concentration required for subsequent biodiesel production
- Average value of ABP is £165 per tonne
- Rendered tallow valued between £250 (high FFA concentration) to £450 (low FFA concentration) per tonne
- MBM valued at £50 per tonne



Producing a value added product

- Storing carcasses $>15^{\circ}\text{C}$ (compared to $<10^{\circ}\text{C}$) leads to a 5.3% decrease in total yield of rendered products
 - equates to a loss in yield of £8.75 per tonne
- Storing carcasses $>15^{\circ}\text{C}$ (compared to $<10^{\circ}\text{C}$) produces a lower quality of tallow, with a higher FAA concentration
 - equates to an additional decrease in tallow value of £24 per tonne
- Demand for renewable fuel sources is ever increasing to reduce the UK's reliance on fossil fuels
- Also reduce the carbon footprints of the agricultural and rendering industries, whilst improving public perception



Denmark and the Netherlands

- Carcasses collected directly by renderers
 - no intermediate collectors
- Governments control the costs imposed by rendering companies (co-operative farming)
- Due to potential loss in yield and quality, pig farmers were offered a 30% discount in collection costs



Cooling well - Denmark



Airtight lid
with a
hydraulic lift

Seepage to ground

Thermostat to 5-10°C

Denmark regulated to <8°C

In the Netherlands regulated to <10°C



Cooling well - Denmark

- Two different sizes
 - small cooling well is 2.3m² and 1.5m deep, equating to 10-15 sows or 20 finishing pigs
 - larger cooling well is 3.9m x 2.8m and 1.5m deep, equating to 20 sows or 26 finishing pigs
- Electrical consumption
 - small cooling well uses 500kWh per year
 - large cooling well uses 1,000kWh per year
- Currently 90 wells have been installed, of an anticipated 1000 wells



Cooling well – the Netherlands



Modified the position of the refrigeration unit onto the top of the lid

Inserted removable containers within the well



Cooling wells – the Netherlands

- The Dutch cooling well is 2.5m x 2m and 1.5m deep and contains two carcass containers (950 litres each)
- Each container can store approximately 8 sows or 16 finishing pigs
- Electrical consumption is approximately 800kWh per year
- Initially 13 cooling wells were installed, with 125 cooling wells now in use



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Collection of carcasses



 **Fabra**
Foodchain & Biomass Renewables Association

 **BPEX**



 **nfscO**



Cooling containers

Cadaver cel type 1



Cadaver cel 1 mono



Cadaver cel 3 low S/V



Cadaver cel 3 top S/V



Cadaver cel type 2



Cadaver cel type 6



Various designs
and sizes, with
dirty/clean access

Utilises wheelie bin containers or larger containers



Cooling containers

- Cooling containers can be purchased in various sizes from 240-1,580 litres, holding single or multiple carcase containers of varying sizes
- Electrical consumption is approximately 400-800kWh per year (£197)
- Cooling containers by Coolworks are marketed as “Euratainers” sold throughout Europe to a range of different industries
- A total of 25,000 units have been sold, with Denmark initially purchasing 3,500 “Euratainers”



Collection of carcasses

- In Denmark
 - cooling wells emptied at least every 6 weeks
 - cooling containers emptied at least every 2 weeks
- In the Netherlands
 - cooling wells emptied at least every 2 weeks
 - cooling containers emptied at least once a week or once every two weeks depending on the source of the information



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Carcase cooling in the UK



Utilises wheelable containers of various sizes



Payback periods

- Initially Denmark offered a 30% collection discount for cooled carcasses
- Assuming the best case scenario and a 30% collection discount, payback periods could be a minimum of 6.7 years for a small cooling well, 4.2 years for a cooling container and 3.6 years for a refrigerated container box



Additional project outcomes

- Separate access roads for collection vehicles and farm staff delivering fallen stock to a dedicated, separate collection site
- Increase farmers' awareness to biosecurity issues to aid compliance to fallen stock legislation
- Improve the public's perception of the animal by-products industry
- Benefits of using carcass cooling even where a collection discount is not available



Future applied research

- Two on-farm trials were conducted for a 14 month period
- Cost approximately £20 per month to operate
- Received good reviews from users
 - Farmer - “We think the cooling container is fantastic. As far as creating the best possible environment for the village then it is a winner because the smell is virtually nothing and it looks neat, tidy and professional.”
 - Collector - “An absolutely marvellous idea – there was no smell and no flies – let’s hope everyone gets one!”



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Thank you for listening

