


Crowshall Veterinary Services LLP

Campylobacter- Introduction

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Crowshall Veterinary Services LLP
Poultry Consultancy and Diagnostic Services




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Do you think the answer to campylobacter control lie on?

1. The Farm
2. The processing plant
3. The retailer
4. The home
5. All of the above



What is Campylobacter?

- Campylobacter is a bacteria- bigger than a virus and smaller than coccidia
- Campylobacter means "curved bacteria"
- You cannot see it with the naked eye but we can see it if we grow it in the lab, stain it and then look down the microscope
- Gram negative bacteria (does not stain using gram method)
- It is motile so it has a tail and can swim
- Thermophile- prefers to grow in higher temperatures- 41.5°C




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How many species of Campylobacter are there?

- There are at least a dozen Campylobacter species implicated in food poisoning but there are only 2 that are frequently implicated
 - *Campylobacter jejuni*
 - *Campylobacter coli*
- There are strain differences – studies are being undertaken to further understand which strains are most pathogenic and to understand whether our management practices are favouring some strains over others whether on the farm or in the processing plant




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Campylobacter and the Chicken



- The chicken is considered a natural host for Campylobacter.
- Campylobacter forms part of the bacterial population of the microflora.
- C. jejuni* is regarded as a commensal of the intestinal flora of chickens, which leads to a predominantly asymptomatic colonisation of the gut, particularly the caecum.
- Beside the lower intestine being the main reservoir, Campylobacter may be detected in several internal organs such as liver and spleen.
- Both meat and laying type chickens are colonized. *C. jejuni* can also be found in other poultry species such as turkeys, Muscovy and Pekin ducks, and mammalian hosts. Beside poultry, a vast variety of wild birds, such as gulls, corvids, waterfowl and passerines are also susceptible for Campylobacter and may act as vectors for transmission especially to poultry flocks.
- Some recent papers suggest Campylobacter as a candidate enteric pathogen.
- We mainly consider Campylobacter in the context of zoonoses because as few as 10-500 bacteria can result in gastrointestinal illness in people whilst chickens appear unaffected.

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Where do we find Campylobacter in the chicken?



- Campylobacter has NOT historically been considered a pathogen of chicken with the exception of vibronic hepatitis.

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Campylobacter and the Chicken




- The uptake of the pathogen by poultry species from the environment usually occurs between the age of two to four weeks.
- Maternal antibodies seem to have an influence on the onset of colonisation reducing the likelihood of early colonisation. However, birds younger than three weeks can be colonized successfully in the case of high environmental exposure.
- Horizontal transmission within the flock occurs predominantly via shedding birds and contaminated litter. Feed and water may be sources of recurring infections.
- There is not considered significant vertical transmission from breeder parents.

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How does Campylobacter enter a house??

1. Feed?
2. Water?
3. Insects?
4. Airborne?
5. Equipment?
6. People?
7. Litter?
8. Thinning?
9. Carryover from last flock?

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Campylobacter and the Chicken



- The *C. jejuni*-prevalence within a flock is almost 100% after introduction.
- Multi-strain colonisation is possible within one flock.
- Human and avian isolates may differ in their ability to colonize chickens.
- Possible reasons may be genetic diversity between strains which may also affect the innate and eventually also the acquired immune response in the very early phase of colonisation.
- The response of the immune system in the first three days may significantly affect the outcome of Campylobacter colonisation and infection.

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Campylobacter and the Chicken

- Understanding the immune system and the interaction with Campylobacter strain will be key in preventing Campylobacter colonisation. This may allow the implementation of better control strategies for example sustainable vaccines, or feed/water additives that can prevent colonisation through affecting the way that the organism interacts with the host and the immune system.
- Stress and the effect on the immune system and subsequent colonisation.

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Crowshall Veterinary Services LLP Vaccination or NOT??

- Vaccination is a well established and effective method to combat various microbes in poultry.
- A commercial vaccine against *Campylobacter* in chickens has not yet been developed.
- There are three areas to overcome in developing a *Campylobacter* vaccine
 - the identification of novel cross-protection-inducing antigens – there are many strains and a vaccine will need to protect against the pathogenic ones that exist now but also those that develop in the future
 - the induction of a rapid, potent immune response, - colonisation occurs very rapidly so the immune response will also need to be very rapid and the right aspect critical to *Campylobacter* control will need to be stimulated
 - the development of novel adjuvants to further stimulate immunity against *Campylobacter* – the vaccine will need to stimulate the right location in the chickens body (ie in the gut)



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Crowshall Veterinary Services LLP Phages

- Use of bacteriophages has been considered for use in processing plants
- Some *Campylobacter* can quickly become resistant to phages
- Consumer perception issues
- Legislative issues to overcome- adulteration



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How does the bacteria get from the chicken to the consumer?

- A high percentage of broiler flocks are infected with *Campylobacter*- the figure can exceed 80% and there is a seasonal increase in the incidence of *Campylobacter* (higher in summer)
- The level of *Campylobacter* can be very high with sometimes millions of bacteria being reported per gram of faeces or from neck flap samples taken post EV
- The *Campylobacter* is in the gut of the bird
- When we process birds we do so with fast line speeds where carcasses regularly contact each other and equipment, in an environment with a lot of water which can aid as a transport system.
- The carcasses are passed through a scald tank, (scum layer can form). *Campylobacter* can theoretically enter the lungs during scalding.
- During the plucking process *Campylobacter* can enter the feather follicles
- During evisceration, intestines can be ineffectively removed, can spill faecal contents - plant evisceration equipment and carcasses can be contaminated.
- Carcass contamination can occur internally and externally.

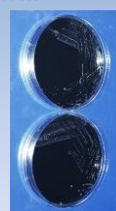


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Crowshall Veterinary Services LLP How do we diagnose *Campylobacter*?

- Samples are taken –
 - Processing plant typically neck flaps
 - On farm- bootswabs
- Samples are subjected to microbiological culture techniques- enriched using bolton broth for 24 hours at 41.5°C then plated on to two solid media in a microaerophilic atmosphere for 48 hours at 41.5°C, then gram stains, phase contrast etc
- Good specificity but poor sensitivity particularly for farm samples
- New techniques needed to improve sensitivity so that we can understand the significance of intervention strategies
 - Optisense
 - AFBI PCR
 - Robotic Nose



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Campylobacter gram stain

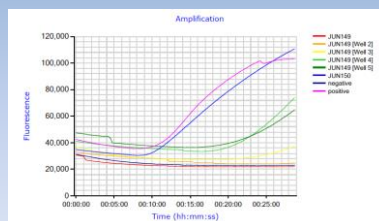


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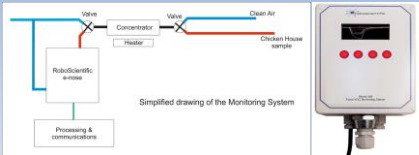
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Optigene Technology- Isothermal PCR



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VOC Detection



Simplified drawing of the Monitoring System

reboScientific

Cellular Systems

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How do we control *Campylobacter*?

- On Farm
 - Now- Biosecurity interventions and stress reduction (farm, catching, transport)
 - Future- in feed or drinking water additives aimed at preventing colonisation?
 - Future- vaccination?
- Plant
 - Minimise carcass to carcass contact (line speeds)
 - Minimise contamination of scald tank water
 - Optimise washing of birds
 - Optimise evisceration process to limit ingesta coming into contact with carcass
 - Plant down time and cleansing and disinfection (hygiene)- biofilms
 - Temperature control post EV- chill down speed, temperature stability
 - MAP (high oxygen)
 - New technologies- Sonos steam, Rapid surface chilling
 - Reduce risk of consumer coming into contact with the chicken- ovenable packaging
 - Future use of chemicals- acids, chlorine??
 - Future use of phages??

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Food Standards Agency food.gov.uk

ACT ON FARM
2 JULY 2015

#ACTonFarm

Food Standards Agency

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NFU

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ON-FARM, WHAT CAN WE DO?

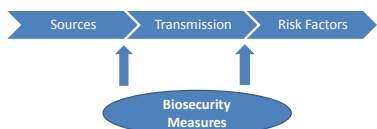
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MUHAMMED MALIKI
MOY PARK

Campylobacter and Farm Biosecurity

Biosecurity is the sum of comprehensive preventive measures in order to prevent entry of *Campylobacter* into poultry flocks reared in containment houses. These measures shall prevent release of *Campylobacter* from already infected flocks to the environment (air, soil, or water) and to other poultry houses.

Biosecurity measures will reduce the possibility of introducing *Campylobacter* to the live chickens in poultry houses. Thereby, the risk of contaminating the poultry meat during slaughter and processing will be greatly reduced. Biosecurity measures aim to block all transmission routes.



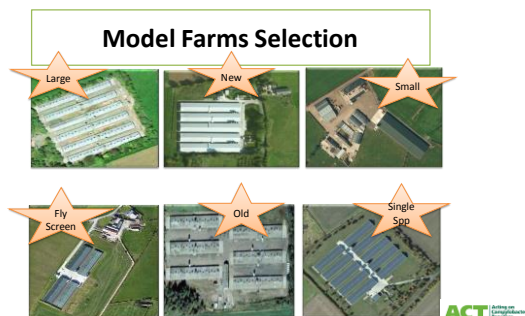
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Model Farms Project



- Sept 2011- Sep 2013
- 16 farms
- Geographically dispersed
- 1,749 batches
- Crops at 6 week intervals

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Model Farm Biosecurity Protocols

- Red Tractor Biosecurity standards (**Red Tractor Assured**)
- Campylobacter/biosecurity training for all staff
- Only poultry farmer & essential visitors only (Vets, Technical & Area managers) and **NO EXTERNAL VISITORS**
- Farmers & Catchers Compliance- Auditing

Shed Biosecurity :

- Each poultry house was considered as a separate unit.
- Physical Barriers with shed specific boots
- Shed specific clothing (**Coats- boiler suits- robust washable aprons over boiler suits**)
- Shed specific equipment (**no shared equipment**)
- Only outside foot dips & must be lidded
- Hand washers and sanitizers are easily reachable from both sides of the barrier.

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Testing

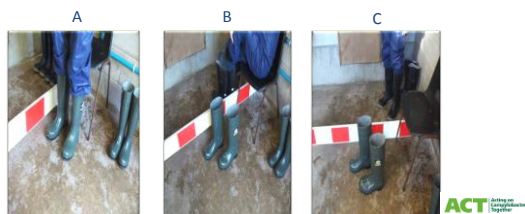
- All raw materials (Chicks- feed- bedding- Water supply) tested for Campylobacter (ALL CLEAR)!
- Caecal testing in factory – to monitor on farm results
- Neck skin at exit from chill – monitor results against the FSA target
- Labs Ring Trial – FSA

Data Recording

- Caecal and neck skin campylobacter results at thin and clear.
- Campylobacter enumeration of randomly selected control farms
- Number of visitors per shed per crop
- Number of days sheds are empty
- Days from thin to depopulation
- Compliance Reports from Farm managers and Catcher leader

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Change boots between houses



Actions on Farm

- Keep the doors locked
- Hygiene barrier at the door of each poultry house
 - change of the clothes / overalls
 - change of the boots
 - hand washing and disinfecting
- Always use hygiene barriers correctly
- Disinfectant boot dips- only outside and must be lidded
- Keep visitors to a minimum
- Protective clothes and boots for visitors

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Actions on Farm

- Feed, water and litter hygiene
- Regular control for pests and rodents
- No direct or indirect contact
 - between poultry and wild birds
- Rules for bringing day old chicks into the house, loading and transporting birds
- Cleaning and disinfecting between each flock
- Health and management (litter quality)



"Realistically at the moment we cannot eradicate campylobacter, however a good farm biosecurity standard will help us as industry to reduce the number of flocks that become positive and within those, reduce the overall levels of infection".



As an industry have we increased / improved biosecurity sufficiently under the increased pressure and focus surrounding campylobacter

1. We have done more than what was required
2. We have reacted sufficiently
3. We haven't done enough

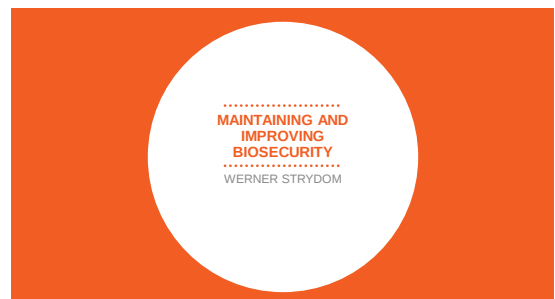
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Can improved biosecurity deliver the 2015 FSA and Industry target during summer months or will we always struggle to keep flocks negative when the temperature increases.

1. Yes, if best practice is followed
2. No, we will always struggle

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Farmer Incentives

Maintaining and improving biosecurity
No thinning

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Farmer Incentives

Payment to farmers to incentivize best practice and reward for negative houses

- 1) Improving biosecurity
- 2) No thinning

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Farmer Incentives

Split into 2 x regions supplying 3 x different processing plants.

- 1) Tested 24 hrs pre thin, if –ve, tested 24hrs pre de-pop.
- 2) No thinning: Tested 72 hrs pre de-pop + 1 x hse 24hrs before de-pop
- 3) As 1, same region as 2, but thinning (to act as control)

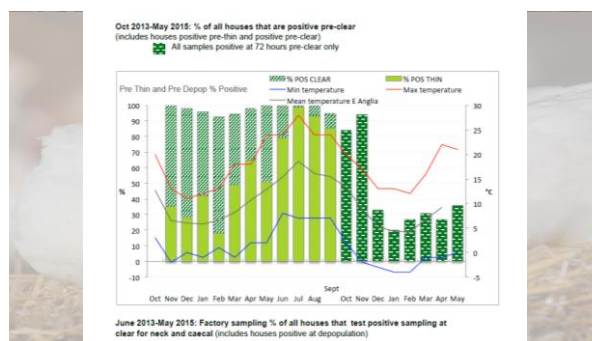
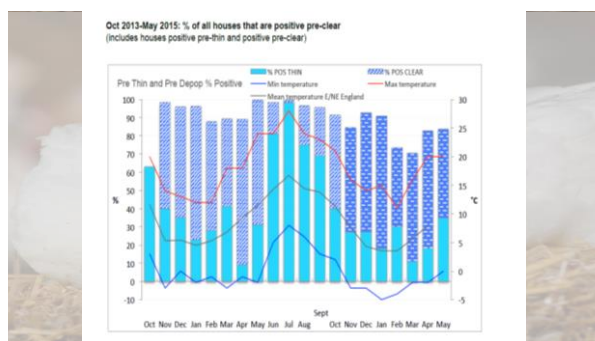
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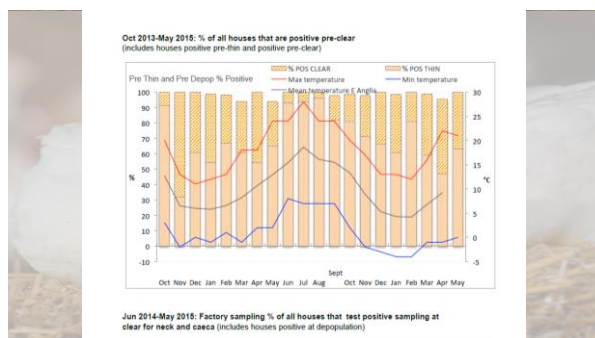
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Farmer Incentives

Region 1 = 51 farms (1.65m)
Region 2 = 39 farms (745k)
Region 3 = 38 farms (670k)

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Farmer Incentives

Region 1: Payment in April £10600
 Region 2: Payment April £2475
 Region 3: No cash incentive

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Farmer Incentives

As a farmer would you be:

1. More likely to follow good biosecurity
2. Really improve and follow good biosecurity
3. Make no difference

If you were paid a cash incentive

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Farmer Incentives

How much do you think should be paid/hse to make you fully enforce all biosecurity protocols ?

1. Less than £50
2. More than £50
3. Will do it anyway

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CAMPYLOBACTER: A POSITIVE FORCE FOR CHANGE

WERNER STRYDOM
 HOOK2SISTERS

.....
**INNOVATIVE
 INTERVENTIONS ON
 FARM – FEED TRIALS**

 SIMON WILLIAMS
 AKESO BIOMEDICAL



Presentation by Dr. Simon Williams
 ACT on Farm
 July 2, 2015

Question One

Would you use a feed additive if you could reduce the levels of Campylobacter in your flock by 10-100 fold?

1. Yes
2. No



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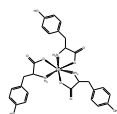
Prevention of Campylobacteriosis

- A new class of feed additive has been discovered that prevents Campylobacter from colonizing the GI tract of chicken
- Discovered at Nottingham University, UK
- Feed additives are Iron (III) Complexes ("Fe3C")
- Mechanism of action has been elucidated



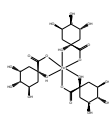
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Lead Products: TYPLEX™ and Q-PLEX™ Feed Additives made from Natural Products



TYPLEX
 A Complex of Iron and Tyrosine

Tyrosine is a natural amino acid, present in all animals, and is an authorized EU feed additive



Q-PLEX
 A Complex of Iron and Quinic acid

Quinic acid is a natural product obtained from cinchona bark and coffee beans

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Question Two

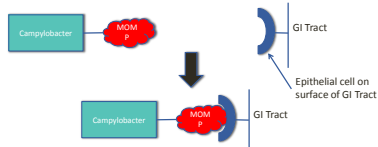
Do you know the mechanism that Campylobacter uses to infect poultry?

1. Yes
2. No



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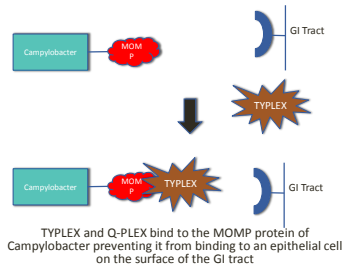
How does Campylobacter infect poultry?



- Campylobacter infects poultry by binding to the GI tract
- A protein on the surface of Campylobacter, called MOMP, binds to epithelial cells on the surface of the GI tract

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How do TYPLEX and Q-PLEX stop Campylobacter infecting poultry?



TYPLEX and Q-PLEX bind to the MOMP protein of Campylobacter preventing it from binding to an epithelial cell on the surface of the GI tract

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Initial Study with Q-PLEX and TYPLEX

- Pen Trial (280 birds) – April 2, 2015 to May 14, 2015
- Q-PLEX and TYPLEX
 - Positive and negative controls
 - Tested Q-PLEX in water and/or feed; TYPLEX in water
- Protocol
 - Continuous administration for safety: day 0 – 42
 - Broiler litter infected with dirty litter at day 21
- Assess Impact on Birds
 - Fecal and caecal samples tested for Campylobacter at day 42
 - Recorded weight gain
 - Monitored health (blood testing/haematology)



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Question Three

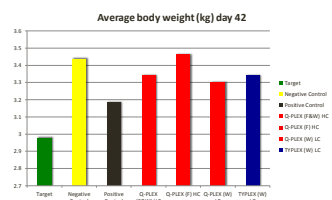
Do you think reducing Campylobacter in a flock will help with performance such as weight gain and MFCR?

1. Yes
2. No



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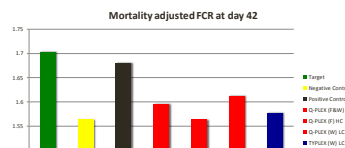
Initial Study Results: Bird Health



Birds challenged with Campylobacter-infected litter and treated with Q-PLEX and TYPLEX had body weights similar to birds not infected

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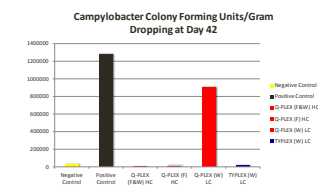
Initial Study Results: Mortality Adjusted Feed Conversion Ratio



Birds challenged with Campylobacter-infected litter and treated with Q-PLEX and TYPLEX had Mortality Adjusted FCR similar to birds not infected

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Initial Study Results: Campylobacter Levels



Campylobacter levels in bird droppings at Day 42 were similar to the negative control when birds were treated with Q-PLEX in feed or with TYPLEX

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Question Four

Would you use a feed additive if you could improve performance and reduce the levels of Campylobacter in your flock by 10-100 fold?

1. Yes
2. No

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ON-FARM TESTING –
WHY SHOULD WE
TEST?

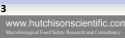
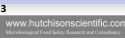
MIKE HUTCHISON
HUTCHISON SCIENTIFIC
MALCOLM TAYLOR
AGI-FOOD BIOSCIENCES
INSTITUTE

FSA Project FS101123:



A new on-farm *Campylobacter* testing provision covering the independent broiler farming sector across UK (England, Wales, Scotland and Northern Ireland).

Gary Ford¹, Malcolm Taylor², Mike Hutchison³



AND UK poultry farmers and processors

On-farm testing – why should we test? This work draws upon outputs from several FSA funded research projects:

FSA Project M01060



Development of a rapid on-farm test for *Campylobacter*

M. Taylor¹, H. Ball², M. Hutchison³, R. Madden¹ and F. Young¹.

¹Food Science Branch, SAFSD, ²Bacteriology Branch, VSD, **AFBI**, Belfast, Northern Ireland.

³Hutchison Scientific Ltd, Cheddar, Somerset. UK



Briefly :

Original remit : A *Campylobacter* on-farm test

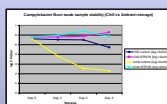
- FSA wanted the poultry industry to have a **rapid accurate test**
- Determine flock campylobacter colonisation status
- Culture across industry may not be as reliable as hoped
- Present UK poultry house infection status largely unknown



These points raised in 2011 have now been largely resolved

Sample matrix / culture

- Tunika boot swab optimal sampling matrix (better than hair nets) (sample range of faeces, caeca, caecal dropping, Cloacal swab, dust, litter or ventral swab as compared with culture ISO-EN 10272-2:2006).
- Culture within 48 hr, essential storage 4°C (logistics ?)
- RTPCR (AFBI test) at least 4 days at 21°C (weeks)



Evaluation of Number of Campylobacter Assays (RTPCR optimal Campylobacter assay AFBI test)

- **Lateral flow devices** (GLISA Singlepath[®]), ImmunoCard STAT! CAMPY[®], Moredun Scientific)
- **Isothermal DNA assay** (Eiken Chemical, Loopamp[®] Campylobacter)
- **RTPCR DNA assay** (QIAGEN (mericon[™] Campylobacter spp)
- **Optimal assay** shown to be RTPCR (specificity, sensitivity, cost practicality, ease of use) QIAGEN DX extraction & mericon Campylobacter spp Pathogen detection kit.
- **AFBI test validated** (specificity, sensitivity, reproducibility, correlation with culture)

AFBI Test Boot swab sample kits

- **Kit contents:**
 - 1x addressed postage paid large letter tear proof envelope
 - 1x pair Tunika boot swabs
 - 1x sample bag with a unique code
 - 1x instructions
- **Equipment required not in the kit**
 - Tyvek overshoes (or equivalent)
 - Pen for labelling sample bags with farm, house number and sampling date



On-farm screening farm staff



- Screening to identify house *Campylobacter* status for other FSA projects with Campden & Bristol (for a number of slaughterhouse intervention studies)
- Trialled at NFU Independent Farms with no previous testing history (9 Farmers, 17 farms, 94 houses)
- Participation in the *Campylobacter* culture proficiency testing of neck flaps
- Definition of assay cut-off (n=147)
- Model farms studies (house status correlates with neck flap culture)
- Industry projects that include microbiological monitoring shared data
- Results texted directly to farmers and emailed to processors

Benefits of doing the on farm tests?

Now Application to independent broiler farming sector

- **Integrators:**
 - extensive campylobacter trials
 - commitment to campylobacter reduction
 - Raising the profile of campylobacter.
- **Independents broiler farmers:**
 - excluded prior to this project
 - NFU/independent producers requested help
 - *Campylobacter* incidence benchmarking, crop information/ correlation with campylobacter broiler house incidence
 - Statistical analysis and identification of trends
- **Driving towards industry-run national *Campylobacter* test results database**

Campylobacter testing independent broiler farming sector across UK

- Recruitment of 233 farms (E 78%, S 14%, NI 6%, W 4%)
- Distribution of 5600 sampling kits
- Testing of ~4200 samples
- 1-3 crops
- 24 hr reporting by SMS text
- Establishment of a web-based farmer interface
- Input of crop questionnaire
- Statistical analysis correlating *Campylobacter* status

ACT-NFU web based farmer interface

General approach:

- FSA-funded original study (M01056) looked at lots of different factors that might influence campylobacters in chicken
- In essence collected information relating to farming (small amount of data) and processing (the majority of the information)
- Statistical analyses to see if there were risk factors that could predict flock status

Data collection questionnaires

- **Farm infrastructure**
 - Postcode, Red tractor number, distance from plant, number of houses
- **Flock farming conditions (15 Qs)**
 - Breed, gender, time house empty, previously thinned
- **Plant infrastructure (42 Qs)**
 - Stun method, plucker banks, chiller water spray, effectiveness indicators
- **Flock processing conditions (19 Qs)**
 - Scald tank temp, line speed, line stopped, crispy neck skins
- **Processing conditions on day (7 Qs)**
 - Days since chillers cleaned, EV/cropping effectiveness

Systems established to collect data:

- Plants have a choice of using paper or web forms

In summary

- What's happening on farm is 3½ times more important than what happens in the S/H
- Enthusiastic response from NFU members
- Feed withdrawal
- Litter wetness



ON-FARM TESTING – WHY SHOULD WE TEST?

PHIL HAMMOND
CROWSHALL VETERINARY
SERVICES



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“REAL TIME”

CAMPYLOBACTER MONITORING

Early Disease Monitoring & Detection on the Farm



reboscientific



Cellular
Systems



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Question:

Have you heard of the robotic nose technology in the context of the campylobacter monitoring?

1. Yes
2. No



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Early Disease Monitoring & Detection on the Farm

The Challenge faced today:-

- A lack of timely knowledge of infection
- Unable to respond immediately to an infection and to isolate it
- Unable to accurately classify the status of flocks
- Limited ability to identify the causes of infection and prevent future re-occurrences
- Too little data
- In many respects the poultry industry is “flying blind”



reboscientific



Cellular
Systems





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Early Disease Monitoring & Detection on the Farm

The Proposed Solution:

- **Round-the-clock / real-time** detection of Campylobacter & other diseases
- **Data** allowing quick isolation & improved bio-security
- **Status** allowing scheduling of flocks into clean / infected prior to processing
- **Collation of data** allowing the identification of "how / why / when / where" the disease develops
- **Instant and accurate knowledge** of the status of flocks



Crowshall Veterinary Services LLP

Early Disease Monitoring & Detection on the Farm

The Short-Term Benefits:-

- Availability of factual information on disease prevalence and infection patterns

The Long-Term Benefits:-

- Allow improvements in flock management & processing leading to the better quality birds entering the food chain



Crowshall Veterinary Services LLP

The RoboScientific Technology

Based upon the RoboScientific electronic nose

- **Volatile Organic Compounds (VOCs)** are detected at very low levels
- **Unique Profiles** are used to develop a "Fingerprint" of the VOCs associated with infected birds in the chicken house
- **Constant Analysis** of the house atmosphere – sampled; concentrated; and released - every 15 or 30 minutes
- **Output** - an immediate "Red / Green" signal to local site management (or "pinged" to a smart phone off site)
- **Raw measurement data** retained and stored on computer



Crowshall Veterinary Services LLP

The RoboScientific Technology

The technology has been trialed and used for:

- Fruit & Vegetable; monitoring for quality, ripeness and spoilage
- Health screening; Cancers; Tuberculosis; Diabetes etc. (and soon for Bovine TB and other poultry diseases)
- Proof of Principle – successful, TSB funded feasibility study, detecting Campylobacter from the VOCs given off from samples of chicken faeces/litter
- Supported by numerous scientific papers



Crowshall Veterinary Services LLP

The RoboScientific Technology



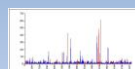
A typical RoboScientific instrument; the model 307 electronic nose



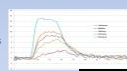
Crowshall Veterinary Services LLP

The RoboScientific Technology – The Process

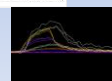
Take air samples and list target VOCs using gas chromatography



Develop polymer sensors that are sensitive to those target VOCs



Measure response of the new sensors to air samples under investigation

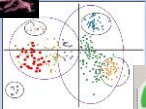
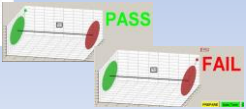


Crowshall Veterinary Services LLP

The RoboScientific Technology – The Process



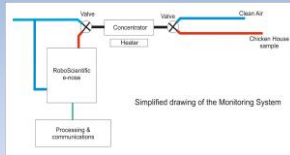
The presence of the Campylobacter bacteria gives rise to low level clusters of VOCs which, following processing, can be grouped onto a map which can be simplified to a "Yes / No" response

reboScientific **Cellular Systems** **ACT** Acting on Campylobacter Together

Crowshall Veterinary Services LLP

The RoboScientific Technology – The System




Air from the poultry house is pumped continuously into the concentrator. After a time the air flow stops and the concentrator is heated to release the VOCs into the e-nose for analysis. The system is then flushed with fresh air and the process starts again

reboScientific **Cellular Systems** **ACT** Acting on Campylobacter Together

Crowshall Veterinary Services LLP

Early Disease Monitoring & Detection on the Farm

The system offers:

- Real-time detection allowing quick isolation & bio-security
- Provide data allowing the separation of flocks into clean/infected allowing scheduling before processing & treatment for some diseases
- Collates Data allowing management to identify "how/why/when/where" infection starts and develops
- Ready available Data instant and accurate knowledge of the status of flocks

Successful implementation of this system would provide data to management, to help improve the quality and disease status of birds

reboScientific **Cellular Systems** **ACT** Acting on Campylobacter Together

Crowshall Veterinary Services LLP

Early Disease Monitoring & Detection on the Farm

Questions?

Can you detect Campylobacter at differing levels?
Yes, we have detected differing levels at one producer, confirming a positive house that they thought was negative!

Could you use the system to detect other organisms?
Yes, bacteria and fungi
And, while not carried, potentially also poultry pathogens

reboScientific **Cellular Systems** **ACT** Acting on Campylobacter Together



Food Standards Agency food.gov.uk

ACT ON FARM
2 JULY 2015

#ACTonFarm

Food Standards Agency **ACT** Acting on Campylobacter Together **NFU**

.....

ON-FARM TESTING – WHY SHOULD WE TEST?

.....

MICHAEL ANDREOU
OPTISENSE

Campylobacter Testing Outside the Lab

ACT On Farm Conference

Michael Andreou, 2nd July 2015, National Motorcycle Museum, Coventry



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Company Overview

- Established in 1998, contract R&D and small-scale production
- Design / manufacture analytical instruments & sensor systems
- Working towards **ISO 9001:2008** and **ISO 13485:2012**
- Several developments of real-time PCR instruments

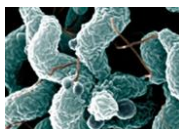
- JV **OptiGene** formed in 2008 with GeneSys Biotech
 - Advanced molecular detection (DNA/RNA)
 - Exploit advantages of isothermal amplification
 - De-skill sample preparation and instrument use
 - Enable testing at point of application



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Isothermal Amplification of DNA & RNA

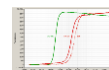
- Detection of bacteria and viruses at a genetic level
- Several methods available but **LAMP** preferred
- Single temperature reaction
 - Low power consumption
 - Compact and portable equipment
- Extremely specific
 - Simple sample preparation
 - Robust assays
- Rapid operation
 - 20 minutes or less amplification for 'clean' samples



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OptiGene Technology

- Instrumentation
 - Genie® II**
 - Genie® III**
 - Genie® HotBlock**
- Reagents
 - World's fastest isothermal enzyme
 - Lyophilisation (freeze-drying)
 - Full test kits
- Supporting products
 - Reaction tubes (strips)
 - Assay design software



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Fields of Application

- Clinical diagnostics
 - Detection of antibiotic resistance & MRSA (Germany, Amplex Diagnostics)
 - Detection of Ebola virus (Japan, Toshiba Healthcare)
- Plant health
 - Detection of *Chalara*, Ash Dieback (Forestry Commission)
 - Port of entry inspection (Heathrow Airport)
- Food safety and authentication
- Environmental monitoring
- Veterinary medicine
- Biosecurity



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Development of Campylobacter Test

- Innovate UK (TSB) "Nutrition for Life"
 - On-farm detection of *Campylobacter* from boot swab
 - Bernard Matthews, Cranberry Foods, Fera, OptiSense
- Step 1: Sample extraction
 - Simple collection of bacteria from boot swab
 - Concentration by antibody beads
- Step 2: Sample processing
 - Antibody wash
 - Lysis: release of DNA from cells
- Step 3: DNA amplification
 - LAMP assay



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OptiGene Pre-Production *Campylobacter* Test Kit

- Practical sample extraction
 - No concentration
 - Simpler sample pot
- Efficient cell lysis
 - “Lyse & LAMP” method
- Multiple tests per run
 - 6 samples (boot swabs) plus controls
- OptiGene *Campylobacter* LAMP assay
 - Faster
 - Detect *C. jejuni*, *C. coli* and *C. lari*
 - Freeze dried in reaction tubes

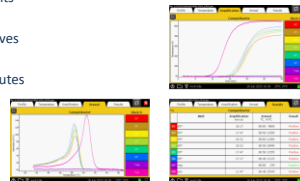


121



OptiGene Pre-Production Test Kit - Results

- Sensitivity
 - Performance using DNA comparable to qPCR
 - Some inhibition from contaminants
- Specificity
 - Extremely robust - no false positives
- Speed
 - Single swab tested within 45 minutes
 - 6 swabs tested in 1 hour
- Usability
 - Compact / portable
 - Easy to perform



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OptiGene Production *Campylobacter* Test Kit

- Custom sample collection pot
 - Reduce manufacturing cost
 - Homogenize AND dispense
- Simplified operating protocol
 - RALF: no resuspension
 - Most fiddly step removed
- Automated result calling
 - Not dependent on operator
 - Semi-quantitative (Hi, Med, Lo, Neg)
- Method validation



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OptiGene *Campylobacter* Test - FAQs

- How much expertise / training is required?
 - No knowledge or experience of molecular diagnostics needed
 - < ½ day basic training with hands-on instruction
- What will a test kit consist of?
 - All consumables and reagents to process up to 6 boot swabs
- How much will a test kit cost?
 - No more than £60 with quantity discounts
- How much does the equipment cost?
 - **Genie® II** list price £8,500
 - **Genie® III** list price £6,500
 - **Genie® HotBlock / Mini HotBlock** list price £500
 - Potential of reagent-rental model with sufficient volume of tests

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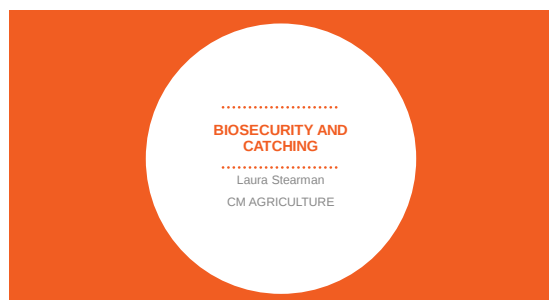
Delegate Question

Where would you expect an 'on-farm' rapid test for *Campylobacter* to be performed?

1. Poultry farm
2. Processing plant
3. Veterinary practice / local laboratory
4. Central laboratory

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ACT Antimicrobial Resistance
Threats
Prevention

Biosecurity

- Personnel
- Clothing/PPE
- Site Entry
- House Entry
- Catching
- Departing
- Maintaining the Standards
- What could the future hold?

CM. AGRICULTURE

ACT Antimicrobial Resistance
Threats
Prevention

Personnel

- No contact with poultry/avian species outside of work
- Training
- Who is responsible?
 - Foreman
 - Farm Manager

CM. AGRICULTURE

ACT Antimicrobial Resistance
Threats
Prevention

Clothing / PPE

- **CLEAN**
 - Must be clean for each site
- Hi Viz T Shirt (Orange / Yellow)
- Hi Viz Striped Trousers
- Steel Toe Capped Boots (Dippable)
- Gloves (not mandatory)
- Hi Viz Fleece
- Hi Viz Waterproof Coat / Trousers Moffet Driver
- Masks
- **QUESTION – ARE CATCHERS ARRIVING CLEAN**

CM. AGRICULTURE

ACT Antimicrobial Resistance
Threats
Prevention

Site Entry

- Arrive at least 10 minutes prior to start time
- Wash and disinfect wheels / wheel arches
 - Vehicles must be clean and tidy
- Sign visitor book (as a team)
- Park vehicle out of the way
- Say hello to the farm staff
- Put on clean boots and clothing
- Wash and sanitise hands
- **IS THERE A FEEDBACK MECHANISM IN PLACE**

CM. AGRICULTURE

ACT Antimicrobial Resistance
Threats
Prevention

House Entry

- Farm manager to place a fresh foot dip outside the catching doors
- All catching personnel must wear clean clothes, clean footwear and high visibility clothing
- Moffet/forklift ignition off
- Sanitise hands
- Enter house via double doors using foot dip
- Use foot dip and sanitise hands on exit
- **ARE FOOTDIPS MADE AVAILABLE AT CATCHING?**

CM. AGRICULTURE



Catching

- Catchers should observe bird welfare and health and safety at all times
- Follow house entry procedures
- Hands washed prior to breaks / exit
- Modules placed with care



Departing

- Removing curtains
- Filling up Moffet
- Changing clothes
- Cleaning boots
- Sweeping out van
- Signing out of the visitors book

- DO YOU REGARD THE VAN LEAVING CLEAN AS IMPORTANT?



Maintaining the Standards

- Training
 - Health and safety
 - Bio security
 - Welfare
 - Manual Handling
- Communication
- Audits – Internal and External



What could the future hold?

- More mechanisation
- Redesigned forklifts
- Clothing
- Footwear
- Facilities on site

- DO YOU PROVIDE A REST AREA BIG ENOUGH FOR THE CATCHERS TO USE?



C&D OF CRATES MODULES

JANE DOWNES
VETERINARY CONSULTANT

Question

Is live bird transport always clean of visible faecal material on arrival at the farm?

Transport = crates, modules trailers and curtains



- Inspection
- Re-wash
- Re-sanitize
- Storage
- Micro testing
- Loading



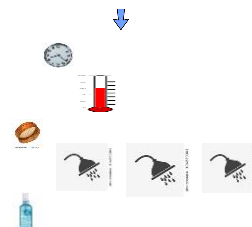
Trailers and Curtains

- Remove gross debris
- Power hose - positioning and structure temperature and kit
- Drain – put vehicle on slope
- Sanitize – after water had drained
- Inspect - to agreed standard
- Load – clean with dirty ?
- Standing – away from recontamination



What is your cleaning system?

- Invert
- Soak time
- Soak temperature
- Soak filter
- Spray wash
- Sanitizer



On-farm removal of debris

driver responsibility, weight over weigh bridge and disposal costs

On-line removal of debris –

brushes on auto load

Spray wash cabinet

Structure, nozzles, water pressure, sanitizer

Inspection –

Can you inspect the lower rails that come into contact with litter?
How do you assess cleanliness

Storage –

Not in puddles; away from spray



Campylobacter testing?

If the birds are negative for Campylobacter the crates will be negative.

Test for TVCs when sanitizer has had maximum time to work.
Best at farm before loading.

Clean live bird transport reduces risk of recycling any disease.

Use Results of testing

Example

Where is the faecal material on the crate?



Is it in a similar place on dirty crates?

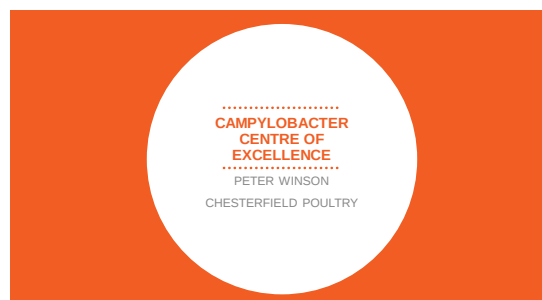


May identify which nozzles are not working

Do not use dirty transport for thinning

Use the risk assessment to establish where you should look to improve.

Thanks to all the suppliers and retailers who co-operated with this work stream



Fighting Campylobacter

At Chesterfield poultry Ltd.



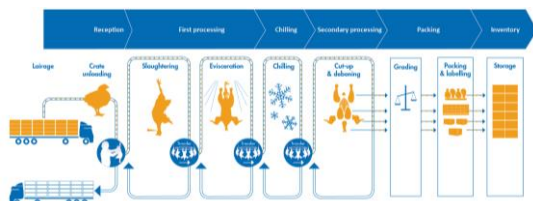
Background for choosing the facility in Thorne

- There are very few purpose-built processing factories in the World Thorne was an opportunity to get it right
- We have been able to design a completely new facility incorporating the latest technology and thinking
- In Thorne we get a plant that can process 12,000 large birds per hour
- With BAADER LINCO as our strategic processing partner, we establish a "show plant" intended to be a development site with ground-breaking innovations for years to come





Factory work-flow



Preventing the level from rising

Objective

- Not allowing the farm level of surface contamination to increase
- Throughout the process, work practices will be designed to reduce this level, to what is acceptable to our customers and the FSA

How to do

- Campylobacter reduction thought process applied to the design and layout
- Danish experts in planning team
- Denmark is a center of excellence for campylobacter reduction!
- Preventing cross contamination is one step to help eliminate foodborne illness



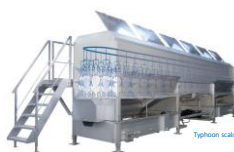
Preventing the level from rising

- The Live Bird Handling System is designed to prevent cross contamination between farms
 - Unique module design
 - Unique drawer design
- Effective washing and disinfection system



Preventing the level from rising

- Straight slaughterline from point of shackling through stunner and killer
- Breast comforter in place to prevent live birds from flapping
- Pre-washing in Typhoon scalders prior to traditional scalding by immersion



Preventing the level from rising

- Picking - benefits of air extraction preventing room contamination with atomised feather follicles
 - Continual warm clean water used within the pickers
 - Effective picking without squeezing birds



Preventing the level from rising

- 3 separate scald tanks
 - Special tank design
 - No foam to cross contaminate on exit





Preventing the level from rising

- Evisceration machine with easy release, interchangeable spoons to prevent intestines splitting and contaminating multiple carcasses
 - Mechanical damages will lead to increased activity of micro organisms and enzymes



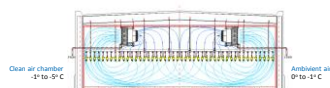
Preventing the level from rising

- New effective horizontal in- and outside bird washer
 - With just 1 liter of water in I/O washer you can Reduce TVC from 100.000 to 10.000/g
- Provision for more washing if the results from washing are not acceptable



Preventing the level from rising

- Clean air chiller, uniform and effective chilling to all birds
 - Built-in air filters to capture bacteria
 - Chills the bird from the inside out
 - Protects the skin, wings and drumsticks from freezing as freezing will cause cell wall to burst and initiate bacteriological growth
 - Creates a balance in heat transfer between the in- and outside of the chicken, thus keeping the skin cold and dry
 - Single tier air chiller preventing birds dripping onto each other



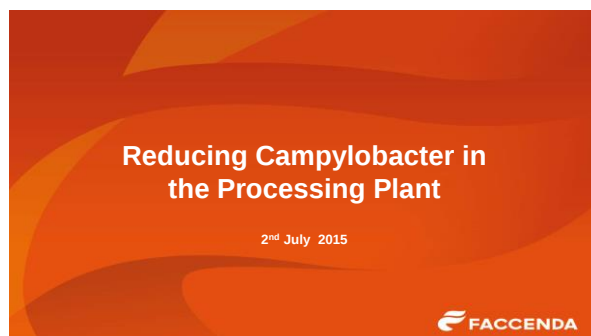
Preventing the level from rising

- Fully automated processes, reducing the risk of cross contamination
- Layout is designed with sufficient space to allow additions of new technology as the are developed.
- Work surfaces designed for easy and effective cleaning



Thank you





Campylobacter and the Supply Chain

Faccenda Foods Campylobacter Reduction Action Plan has focused improvements through the whole Supply Chain:

- ✓ Agriculture – Bio Security
- ✓ Catching Operations – Hygiene
- ✓ Slaughterhouse Process Hygiene
- ✓ Novel Processing Interventions
- ✓ Packaging (consumer protection)
- ✓ Labelling (and consumer education)
- ✓ Testing Programme – Farms and Products

Faccenda Foods Campylobacter Action Plan

Multi Hurdle approach will be essential if we are to achieve the 2015 Reduction Target

BUT

Without a new, Novel Intervention the Modelling work indicates we are unlikely to achieve this

Faccenda Foods Campylobacter Action Plan

Faccenda Foods Campylobacter Action Plan has focused improvements through the whole Supply Chain:

- ✓ Agriculture – Bio Security
- ✓ Catching Operations – Hygiene
- ✓ **Slaughterhouse Process Hygiene**
- ✓ **Novel Processing Interventions**
- ✓ **Packaging (consumer protection)**
- ✓ Labelling (and consumer education)
- ✓ Testing Programme – Farms and Products

Faccenda Foods Campylobacter Action Plan

Optimisation of Slaughterhouse Hygiene

Innovation with Novel Process Interventions

Protection through Packaging



Faccenda Foods Campylobacter Action Plan

Optimisation of Slaughterhouse Hygiene

Live bird Crates and Modules

Multi Stage Carcase Washing

Neck Skin Trimming



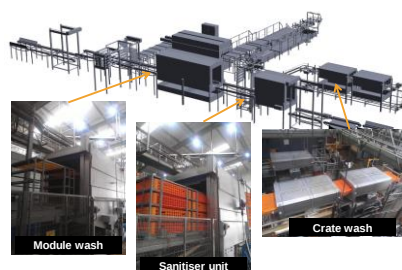
Live bird Crates and Modules

Live bird crate and module cleaning and disinfection

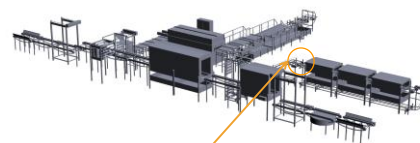
- Optimize to ensure Campylobacter are not transferred back to our farms on this equipment.
- Investment in new equipment and a more efficient layout.
- Trials with new technology for final decontamination of Crates - SonoSteam



Faccenda Foods Campylobacter Action Plan



Intake and Crate Washing



SonoSteam
when food safety matters



Live bird Crates and Modules



Faccenda Foods Campylobacter Action Plan

Innovation with Novel Process Interventions

Application of Heat - SonoSteam



Application of Cold - Rapid Surface Chilling & Surface Blast Chilling



SonoSteam Technology

SonoSteam
when food safety matters

SonoSteam

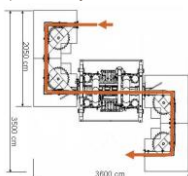


SONOSTEAM

Process Chamber



Example of Layout



SonoSteam Technology

SonoSteam®

The nozzle is driven by steam and releases steam and ultrasound simultaneously

Steam - Kills microorganisms

Ultra Sound - Catalyses and optimises the process.

Very short process time (1.5 secs) so no unacceptable denaturation of the skin



SonoSteam

- ✓ Our aim is to achieve a minimum 1 log (90%) reduction in Campylobacter count on the Breast, Back and Neck skins.
- ✓ SonoSteam process must not adversely affect the **raw appearance** (consumer acceptance) and **physical properties** of the Skin (risk of increased rejections in Trussing or Cut Up operations), nor the **cooked** (organoleptic) performance.
- ✓ SonoSteam applied as part of our integrated evisceration and washing process
- ✓ Full scale In Line equipment and last operation before the birds are transferred into the In Line Air Chilling process.



SonoSteam

- ✓ Weekly Trials January to June.
- ✓ Focus on optimizing the set up of the re-designed Process Chamber – new "inside treatment" for best Neck Skin results.
- ✓ Successful use of On Farm PCR testing to select sheds with highest levels of Campylobacter colonization – this works!
- ✓ Testing at Day 0 and Day 5



SonoSteam Trial Programme

- ✓ The SonoSteam process typically achieved a Campylobacter reduction on **BREAST SKIN** of 0.85 to 0.95 log over 2 sequences of trials (Control Day 0 vs SonoSteam Day 5).
- ✓ The SonoSteam process was more difficult to optimise to achieve a consistent Campylobacter reduction on **NECK SKIN**.
- ✓ Latest trial sequence averaged a 0.80 log reduction for Neck Skin (Control Day 0 vs SonoSteam Day 5).



SonoSteam Trial Programme

- ✓ Completed our own Consumer Acceptance tests based on blind coded samples. Over 40 individual assessments.
- ✓ Raw appearance, cooked appearance, cooked performance - **no statistically significant differences** between the results for Control and SonoSteam birds.
- ✓ Campden BRI consumer acceptance testing in mid July.



SonoSteam

Key Questions

- ✓ Is SonoSteam easy to install and operate? **YES**
- ✓ Is it the "Silver Bullet" by itself? **NO**
- ✓ Does it deliver all the Success Criteria? **NOT YET**
- ✓ Does it have an important part to play as one of a series of interventions throughout the supply chain? **YES**
- ✓ What are the next steps with SonoSteam?
CONTINUOUS RUNNING "SONOSTEAM PLUS"



SonoSteam – Next Steps

Continuous Running – now implemented

"SonoSteam Plus"

- to combine the current SonoSteam process with another intervention:
- ✓ 2 stage thermal process, 1st stage focussed on **Neck Skin** and 2nd Stage the current SonoSteam application
Both stages can be SonoSteam
- ✓ SonoSteam process and high Oxygen MAP storage.



Faccenda Foods Campylobacter Action Plan

Innovation with Novel Process Interventions

Application of Heat - Secondary Scalding



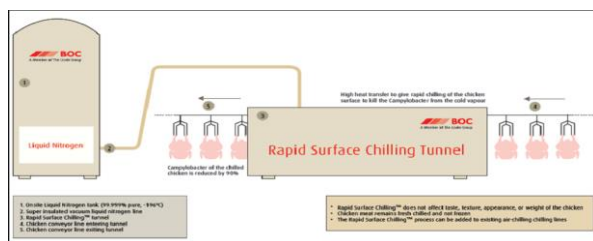
Faccenda Foods Campylobacter Action Plan

Innovation with Novel Process Interventions

Application of Cold - Rapid Surface Chilling



Innovation – BOC & Rapid Surface Chilling



Innovation – BOC & Rapid Surface Chilling



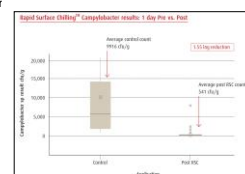
Innovation – BOC & Rapid Surface Chilling



Innovation – BOC & Rapid Surface Chilling

- Off line trials conducted on line speeds up to 6,000 birds per hour
- Compliant with the Poultry Meat Marketing Regulations
- Initial trial results validated by the FSA showed an average 1 log (90%) reduction in Campylobacter counts
- Read more about Rapid Surface Chilling trials and progress online: www.boonline.co.uk/campylobacter

Watch the video



Faccenda Foods Campylobacter Action Plan

Innovation with Novel Process Interventions

Application of Cold - Surface Blast Chilling



Faccenda Foods Campylobacter Action Plan

Protection through Packaging

Leak proof packaging – we don't want Campylobacter on the outside of our packs



Faccenda Foods Campylobacter Action Plan

Protection through Packaging

Use of High Oxygen MAP – does this enhance the die off of Campylobacter during shelf life?

Trials to link birds from the SonoSteam process with High Oxygen MAP storage.

Faccenda Foods Campylobacter Action Plan

Protection through Packaging

Roast in the Bag packaging systems -

- Fantastic convenience
- Consistent cooked product quality
- Recognised Food Safety benefits





Faccenda Foods Campylobacter Action Plan

Summary -

Our Campylobacter Reduction Action Plans **must** deliver improvements through the **whole** Supply Chain.

In Primary Processing the key focus is on

Optimisation of Slaughterhouse Hygiene

Innovation with Novel Process Interventions

Protection through Packaging



Faccenda Foods Campylobacter Action Plan

Summary-

We have seen unprecedented **collaborative Industry working** across a wide range of projects and interventions.

Significant **resource and financial investments** have been made as we deliver improvements and validate key new interventions.

We continue to strive to achieve the 2015 Reduction Target.



Background

Tackling Campylobacter is a shared responsibility, and consumers have roles to play.

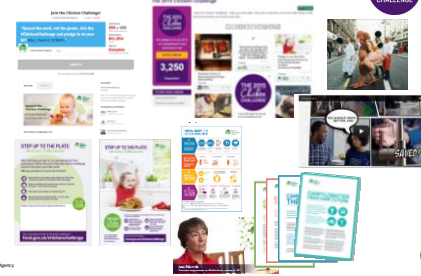
This Food Safety Week we launched the Chicken Challenge – an initiative to engage consumers in our target of halving foodborne Campylobacter by the end of 2015.



© 2015 Food Standards Agency



Campaign Assets



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The headlines

Our total estimated campaign reach across TV, radio, press, partnerships and social media was 33 million people.

33% of UK adults recalled Food Safety Week activity. (Following the Q4 retail survey release, this recall rose to 37%.)

It's working. Awareness of Campylobacter rose to 42% among those who recall Food Safety Week activity, compared to 31% among those who did not.

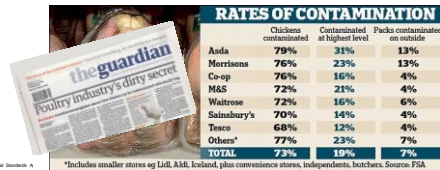
Source – campaign tracking survey, 2000+ participants, Jan 2015

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The other headlines...

The retail survey made the Campylobacter issue visible to consumers for the first time. We are about to publish the first full year's figures. We anticipate further media interest.



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CONSUMER AWARENESS

SUE DAVIES
WHICH?

Which?

ACT on Farm Consumer awareness

Sue Davies
Chief Policy Adviser

Which?

A long standing issue

1996

How safe is chicken?

2010

How safe is supermarket chicken?

Which?

Consumer awareness

- 2010 survey of 1000 people:
 - 56% thought Salmonella was the main cause of food poisoning
 - 2% said it was Campylobacter
 - 73% washed their chicken before cooking it.

Which?

Hitting the headlines

Which?

Which? Make Chicken Safe Campaign

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CAMPAIGN ASKS

- We want supermarkets, the Food Standards Agency and the chicken processing industry to make our chicken safe by:
 - 1) Immediately setting out the action they will individually and collectively take to bring Campylobacter levels under control
 - 2) Making public the results of Campylobacter testing.

Which? Make Chicken Safe Campaign

Which?



Campylobacter - awareness & concern

Which?

- Only a third (33%) said they had heard of Campylobacter, compared to 94% being aware of Salmonella and a similar percentage (92%) of E. coli.

Salmonella	94%
E. coli	92%
Listeria	72%
Staphylococcus	55%
Campylobacter	33%
Clostridium perfringens	15%

Campylobacter - awareness & concern

Which?

Which? survey November 2014 :

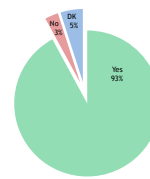
- Nearly 9 in 10 said that they assume the food they buy from supermarkets won't make them ill.
- Three quarters (76%) trust that the fresh chicken supermarkets stock is safe to eat.
- But the majority were unaware of the levels of contamination - 6 in 10 thought it was lower than found.
- Three quarters (77%) said that these levels were too high.

Base: all respondents (2701) Population, on behalf of Which?, surveyed 2701 UK adults online between 21st and 23rd November 2014. Data were weighted to be demographically representative of all UK adults.

Consumer expectations of transparency

Which?

9 in 10 people think that food businesses should be required by law to display their hygiene rating/food hygiene information system certificate.



Q8. Do you think that food businesses should be required by law to display their hygiene rating/food hygiene information system certificate? Base: all respondents (2701)

Where are we now?

Which?

- Campylobacter and chicken safety is getting greater attention
- Levels are still far too high
- Need to see real improvements
- Evidence for interventions from farm to fork is now clearer - but a mixed response
- Consumers need to be aware of the risk - but shouldn't have to take so much of the responsibility
- Consumer acceptability is also important (eg. blast surface chilling vs chlorine treatments)
- Companies need to be transparent about the steps they are taking - and about levels
- FSA must continue with its survey - but also be clearer about what action is needed
- If a voluntary approach still fails to achieve real change, EU legislation is needed.

