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MICROBIOLOGICAL SAFETY DIVISION

**Proceedings of the Review of Programme B15
Poultry Research
MARCH 2004**

Held at the Radisson Grafton Hotel, London, UK

Tuesday 13th January, 2004

Executive Summary

Under the Chairmanship of Professor Geoff Mead over 60 delegates from the poultry industry, academia, and government attended a review of FSA funded research concerning the two major zoonotic pathogens linked to poultry meat, i.e. *Salmonella* and *Campylobacter*.

The main aim of the review was to evaluate each of the research projects funded under the programme and to facilitate discussion on possible future areas of research. The review also evaluated how well the research has met the aims and objectives of the programme's original ROAME, the rationale for the programme. In order to carry out this evaluation process the FSA invited its contractors to present their research to an external panel of experts, chaired by Professor Geoff Mead.

Priorities for future research were discussed at 3 workshop sessions and presented as recommendations to the main group.

Summary of Recommendations

The main findings and recommendations of the workshops were:

Workshop A: Is there a need for a full intervention study to provide evidence for the effect of *Campylobacter* control measures?

Rec 1: An education campaign to change behaviour was more important than an intervention study. This could be informed by behavioural research to investigate barriers to compliance.

Rec 2: A recommended alternative to a full intervention study would be to develop a Quantified Risk Assessment to identify and rank possible risk factors for *Campylobacter* infection, using findings from the Defra funded project: OZ0608: Epidemiological studies and development of practical control measures for *Campylobacter* in broiler flocks. This could be used to identify those intervention measures offering the greatest effect for the least cost to the poultry industry.

Rec 3: A second alternative approach would be to identify on-farm sources of *Campylobacter* using molecular typing techniques to demonstrate a definitive link between environmental sources and flock.

Workshop B: Is there a need for further method development, including typing methods, or are current techniques capable of meeting our needs?

Rec 4: For isolation of *Campylobacter*, the forthcoming ISO method is recommended.

Rec 5: It is recommended that the Agency consider methods used throughout the EU and monitors any new developments to ensure that the most appropriate methods are used in the UK.

Rec 6: Whichever isolation method is used, it is important to standardise the micro-aerophilic and growth temperature conditions used. There is also a need to standardise the transport and storage conditions of isolates.

Rec 7: The development of real-time fluorescent, cost-effective molecular methods needs to be recognised as a tool that can be used by the industry for the rapid detection of *Campylobacter*. There is an urgent research need to validate the real-time fluorescent PCR method that has been developed.

Rec 8: Whichever isolation, detection or typing method is used, it needs to be fit for purpose and needs to be appropriate for the question being asked.

Workshop C: Are there any realistic longer term options for controlling *Campylobacter* e.g. vaccination and competitive exclusion and would further work in these areas be beneficial?

Rec 9: There is a need for a greater understanding of the lag phase of *Campylobacter* growth in broiler flocks.

Rec 10: The use of feed additives such as anti-microbials, bacteriophages and probiotics should be investigated by the Agency.

Rec 11: The protective effect of dietary manipulation to change the composition of the gut flora is another promising area, which should be examined further.

Rec 12: There was the general conclusion that a greater understanding of *Campylobacter* physiology is required to underpin research into identifying long-term intervention measures.

FSA Action Plan

1. Publish the proceedings of the B15 Programme Review (following delegate consultation)
2. Publish the Agency's response to the recommendations of the B15 Programme Review.
3. Draft a new ROAME A for the second phase of the Poultry Programme based on the recommendations of the B15 Poultry Review
4. Consult widely on the draft ROAME A for Programme B15 Poultry Phase II.
5. Publish research requirements from the ROAME A for Programme B15 Poultry Phase II.
6. Provide feedback to the individual contractors on the evaluation of their project by the independent panel of experts so that both the Agency and its contractors benefit from the programme review process.

Introduction

1. The Chairman, Professor Geoff Mead welcomed delegates to the Review of Programme B15 Poultry Research, and invited Dr Kathryn Callaghan to give an overview of the review process.

2. Delegates were informed that the *Review of the Food Standards Agency's Research Portfolio and Research Management Systems* (the Arbuthnott Review), published in July 2001, recommended that each of the Agency's existing research programmes should be reviewed according to a clearly defined timetable to ensure they meet the aims and objectives of the Agency and are providing value for money. In response to this recommendation, the Food Standards Agency (FSA) has undertaken to review all its research programmes by means of a formal independent evaluation. The review is an opportunity for the Agency to take stock of completed research and identify areas that still need addressing. This review covered poultry research funded under Programme B15 Eggs and Poultry.

3. The main aim of the review was to evaluate each of the research projects funded under the programme and to facilitate discussion on possible future areas of research. The review also evaluated how well the research has met the aims and objectives of the programme's original ROAME, the rationale for the programme. In order to carry out this evaluation process the FSA invited its contractors to present their research to an external panel of experts. The panel's experience covered poultry research on a national and international basis, covering veterinary aspects and pathogenic mechanisms of *Salmonella* and *Campylobacter*. The panel members were Professor Geoff Mead (Chairman), Dr Hilde Kruse, Head of the Norwegian Zoonosis Centre, Professor Mac Johnson of the Royal Veterinary College and Dr Nick Sparkes, Head of Avian Science Research Centre, Scottish Agricultural College.

Introduction to programme B15 research on poultry and the Agency's strategy to control *Campylobacter* in chickens.

Presented by Dr Linden Jack, Microbiological Safety Division, Food Standards Agency.

4. The aim of the research funded and managed by the Microbiological Safety Division of the Agency is to provide robust information on the presence, growth, survival and elimination of micro-organisms throughout the food chain, and the extent, distribution, causes and costs of foodborne disease. Within this theme, research is commissioned in support of the Agency's strategy to achieve a reduction in the incidence of food-borne disease by 20% over a five-year period to 2006.

5. In recent years, much effort has been devoted to improving hygiene on poultry farms and throughout the processing, distribution and retail chains. The industry has introduced stringent measures which have reduced the levels of *Salmonella* contamination in raw poultry. However, these control measures have had less effect on *Campylobacter* in poultry and levels of this organism remain high. Research in the B15 poultry programme aims to identify control measures which will reduce the levels of *Salmonella* and *Campylobacter* in chickens.

6. The Agency's target to reduce *Salmonella* in UK produced retail chicken by at least 50% by 2005, was announced at the Agency's launch in April 2000. The *Salmonella* strategy led to the commissioning of research on *Salmonella* control measures on the broiler farm. An Agency survey in 2001 showed that 6% of retail chickens in the UK were contaminated with *Salmonella*, but over 50% were contaminated with *Campylobacter*. The Agency therefore shifted emphasis from

Salmonella to a reduction in the levels of *Campylobacter* and developed a strategy to significantly reduce *Campylobacter* in UK produced chickens on retail sale.

7. The Agency has taken account of many sources of information in the development of the *Campylobacter* strategy. In particular the advice on on-farm measures to control *Campylobacter* in chickens, which the ACMSF submitted to the Agency in September 2002. The Agency commissioned situation reports on various aspects of poultry production covering both *Campylobacter* and *Salmonella*, which helped to inform the strategy. The reports reviewed published and non-published work and provided an up to date assessment of current practices in the UK poultry industry. Discussions with stakeholders were instrumental in developing the strategy and have taken place predominately through a Consultative Group set up by the Agency, which has proved an effective mechanism for gathering information and for exchanging views on various aspects of the strategy.

8. The main focus of the strategy is action on the broiler farm but potential options for control at the slaughterhouse will also be considered. The strategy builds on the excellent efforts made by the industry to introduce measures for controlling *Salmonella* although it recognises that tackling *Campylobacter* presents a new set of challenges. The strategy primarily covers intensively produced, housed chickens (reared for meat). This reflects the fact that the majority of chickens in the UK are produced in this way and also that control in extensively reared flocks will be a lot harder to achieve.

9. The Agency has issued a research requirement for the control of *Campylobacter* in extensively produced chickens and has received a number of expressions of interest. Three new projects have been commissioned to develop guidance on sampling and testing regimes for *Salmonella* and *Campylobacter* in broilers, and to carry out a detailed study to examine thinning and identify measures to reduce the risks associated with the process. In addition, an extension to an existing project will examine the influence of farm management and husbandry practices on the ability to produce *Campylobacter* negative flocks.

Overview of FSA Meat Hygiene research programme

Presented by Mrs Mary Howell, Meat Hygiene Strategy Branch, Food Standards Agency.

10. Mrs Howell explained that white meat production is a process where foodborne pathogens can enter the food chain and, to minimise risk, meat plants have procedures based on HACCP principles. Research managed by the Meat Hygiene Strategy Branch of the Agency aims to provide data to underpin the development, application and verification of HACCP systems, in addition to understanding the risk and management of foodborne pathogens from the farm into and at the slaughterhouse.

11. The meat hygiene research programme is focussing on the following four projects:

- (i) Reduction of microbial contamination of poultry transport crates by improved cleaning and disinfection systems based on better water use. The research aims to improve crate washing by a phased approach:
 - Phase one: identify best operating regime for existing equipment – a test rig is being built to explore ways of improving existing systems
 - Phase two: identify simple improvements

- Phase three: propose a better approach - A guidance document on standard operating procedures will be produced for the UK poultry industry.
- (ii) Physical methods readily adapted to existing commercial processing plants, for reducing numbers of *Campylobacters* and *Salmonellas*, on raw poultry. The research aims to:
- find a physical method or combination of methods for reducing numbers of *Campylobacters* and *Salmonellas* on chicken carcasses
 - ensure that the recommended method(s) can be applied easily to existing poultry processing lines
- (iii) Standardisation of sampling and analysis in poultry abattoirs in support of HACCP-based hygiene strategies. The research aims to determine what methods are used in the industry and following standardisation of a range of tests to assess the suitability of bacterial indicators for HACCP verification in poultry abattoirs.
- (iv) Role of aerosols in carcass microbiology. The aims of the research are to:
- Quantify the contribution of aerosols to carcass contamination in cattle, sheep and poultry slaughterhouses
 - Produce and verify models of the movements of aerosols in slaughterhouses
 - Design and demonstrate methods of reducing carcass contamination by aerosols
 - Produce a final report detailing the contribution of aerosols to contamination and defining methods to reduce the effect.

One further project looking at methods to enumerate *Campylobacter* is currently being negotiated.

Overview of Defra funded research on poultry

Presented by Dr A Morrow, Veterinary Science Unit, Defra.

12. The £150m Defra research budget is directed towards safe, sustainable Agricultural Food production and in protecting the public's interest. Of the total budget, there is significant funding in Animal health and Food borne zoonoses, including *Campylobacter*, *Salmonella*, *E coli*, and *Cryptosporidium*. Funding is directed through leading research centres such as IAH and VLA and through Defra fellowships at the Universities of Liverpool and Cambridge.

13. In its research programmes Defra seeks:
- better diagnosis, detection and surveillance of disease
 - improved forecasting of risks and disease threats
 - better approaches to disease prevention and control

14. There is fundamental work relating to *Campylobacter* on:

The host interaction - OZ0320: Bacterial and Host Genes in *Salmonella* Colonisation (IAH 2002-2005)

Epidemiology - OZ0321: Investigation of the Role of Environmental Contamination in the Epidemiology of *Salmonella* in Egg-Laying Flocks (VLA 2002-2005)

- OZ0608: Epidemiological Studies and Development of Practical Control Measures for *Campylobacter* in Broiler Flocks (VLA 2002-2006)

Strain variation - OZ0604: Characterisation of Strain Variation in *Campylobacter jejuni* (Oxford University 1999-2004)

Marker C.jejuni - OZ0607: An Investigation of the Distinguishing Features of *Campylobacter jejuni* Strains that have Host/Disease Complications (VLA 2001-2004)

Competitive exclusion - OZ0606: Protective Immunity and Competitive Exclusion in Development of Effective Intervention Products for Poultry (VLA 2001-2004)

Defra Veterinary Fellowships:

Liverpool: Epidemiology of food borne zoonoses on farm

Cambridge: Colonisation of chickens with *Campylobacter jejuni*
1999-2004

15. The Veterinary Training and Research Initiative starting this year also includes projects on food borne zoonoses and poultry (£21.5m over 5 years)

SESSION I: HISTORIC RESEARCH OF RELEVANCE TO PROGRAMME B15

Project B03003: The Molecular Epidemiology of *Campylobacters* in Poultry and Poultry Meat and use to Develop Intervention Strategies.

Contractor: VLA; Paper presented by Professor Diane Newell.

16. The project used molecular typing methods to identify environmental sources of *Campylobacter* contamination. The genotyping strategy recommended was:

- *fla* typing in the first instance – as it is cheap and easy
- followed by pulsed field gel electrophoresis (PFGE) – for higher discrimination
- followed by amplified fragment length polymorphism (AFLP) – for highest degree of discrimination

17. Key findings of the project were:

- Puddles and wild birds are significant risk factors for *Campylobacter*.
- Carry over of infection between flocks was a rare event, suggesting that cleaning and disinfection regimes were adequate.
- Vertical transmission was not implicated in the spread of infection.
- Inadequate boot cleaning was a significant risk factor.
- Inadequate crate washing resulted in cross contamination of negative flocks at the processing plant.
- The observed lag phase before the onset of infection could be due to maternal antibodies being passed to progeny.
- Competitive exclusion may be a factor in older birds that did not become positive for *Campylobacter*.

18. The discussion raised a query on what is meant by the term 'unstable environmental strains'. These are strains which have a very low recovery rate from sub-cultured and/ or frozen samples but could be identified in fresh environmental samples, tested prior to freezing and storage.

19. Delegates queried the proportion of *Campylobacter* strains transferred at the processing plant that are pathogenic. It is impossible to say at present how many strains are potentially pathogenic and how many of these survive processing. This is because there are currently no genetic markers of pathogenicity. The mechanisms by which these organisms cause disease are still unknown. Potential virulence properties such as invasiveness and toxin production may be indicators of pathogenicity, but this is unproven.

Project B03005/6/7: A Review of the Measures to Reduce Levels of *Salmonella* and *Campylobacter* in Poultry and Development of an Appropriate Risk Assessment Model.

Contractor: Direct Laboratories; Paper presented by Dr Tony Moore.

20. The project developed a Quantitative Risk Assessment Model for *Salmonella* but there were insufficient published data for a similar model for *Campylobacter* to be developed. Outputs from the model agreed with data on *Salmonella* prevalence in poultry meat showing sound logic had been used in development. A study of testing indicated that only low levels of *Salmonella* were found in poultry meat, demonstrating the implementation of effective control measures by the industry. Poor understanding by industry of control measures effective against *Campylobacter* highlighted the need to identify risk factors for this organism.

Reference:

Parsons, D. J., Orton, T.G., De Souza, J., Moore, A., Jones, R. and Dodd, C.E.R. (2003) Approaches to a whole-chain quantitative risk assessment model for *Salmonella* species in poultry meat: submitted to *International Journal of Food Microbiology*.

Project B03001: Field Studies to Identify and Evaluate Key Intervention Points for *Salmonella* Control during Broiler Production.

Contractor: VLA. Paper presented by Dr Rob Davies.

21. This project demonstrated the role of HACCP and the importance of hatcheries and feedmills in the transmission of *Salmonella* to poultry flocks. Intervention measures were found to be highly effective in reducing *Salmonella* contamination, using critical control points. These include terminal disinfection (particularly at the hatchery and farm), pasteurisation and cooler hygiene at the feedmill. Large integrated feedmills were considered vulnerable to hygiene break points.

22. Vertical transmission of *Campylobacter*, was discussed following the presentation. The consensus amongst researchers is that vertical transmission has, at best, a very minor role and there are far more important horizontal routes of infection which should be considered first.

SESSION II: PROGRAMME B15 COMPLETED RESEARCH

Project B03008: Identify Critical Points for Infection of Live Birds or Contamination of Poultry Carcasses with *Campylobacter* and *Salmonella*.

Contractor: University of Bristol; Paper presented by Professor Tom Humphrey.

23. This project was extended to investigate the hypothesis that husbandry practices may influence flock prevalence, some farmers being able to consistently

produce negative flocks whilst others rarely did so. Possible risk factors for *Campylobacter* were:

- Poor footwear
- Storage of dead birds on farm before disposal
- Untreated water
- Widespread prevalence of *Campylobacter* in the farm environment.
- Thinning of flocks.
- Mixed species farms.
- Puddles, paths and air

24. Chilling and hot water treatments were ineffective in reducing carcass contamination, but drying and freezing were more effective.

Project B03010: Efficacy of Water Disinfection Systems for Broiler Units.

Contractor: University of Aberdeen; Paper presented by Dr Iain Ogden.

25. No *Salmonella* were found in any farms tested. The project found *Campylobacter* in drinking systems (44% of farms tested) and established that positive farms were contaminated recurrently. Cleaning of water systems was considered satisfactory. However, the project did not identify the sequence of transmission of *Campylobacter*, and was to some extent disrupted by the FMD outbreak. It was noted that the sequence of transmission was not an objective of this project although it became a point of interest once *Campylobacter* were found in the drinking water. A major finding was that *Campylobacter* isolates from birds were, in one farm at least, indistinguishable from *Campylobacter* isolates from the drinking water.

26. In the discussion, the Chair raised a point of clarification on the timing of *Campylobacter* contamination of the water source. It was discussed whether the tested water source only became positive for *Campylobacter* after the flock was infected. Each flock and associated water was tested simultaneously so it was not possible to determine which was infected first.

Project B01005: Variations in Virulence of *Campylobacter jejuni* Strains Associated with Poultry and Poultry Meat.

Contractor: VLA; Paper presented by Dr Georgina Manning.

27. The project carried out *fla* and PFGE typing of chicken (80) and human (39) isolates, an *in vitro* assay for invasiveness, and enumeration of strains. Strains were classified low, medium, high and hyper invasive. The majority of strains are low invaders, but of particular note is a hyper invasive strain isolated from the environment (a puddle). Human isolates tend to be more hyper invasive compared to poultry isolates: of the chicken isolates, approx. 3% were hyper invasive, whereas approximately 30% of human isolates were hyper invasive. Processing measures such as Cl₂, O₂ and heat treatment were found to have little effect on invasiveness.

SESSION III: B15 POULTRY RESEARCH CURRENT RESEARCH PORTFOLIO

Project B15003: to Make Recommendations on the Best Practical Procedures to Sample and Test Poultry Flocks for *Salmonella*.

Contractor: Direct Laboratories; Paper presented by Dr Tony Moore.

28. This project will review sampling and testing practices for *Salmonella* including novel test methods under consideration by the UK poultry industry. Laboratory based studies will evaluate the most promising procedures for sensitivity and detection thresholds. A full cost/ benefit analysis will ensure that the recommended procedures will be acceptable on both technical and economic grounds to the UK poultry industry.

Project B15001: *Campylobacter* spp. in Housed Broiler Flocks: the Influence of Flock Health, Performance, Husbandry and Vaccination Against Other Diseases on Susceptibility to Colonisation with *Campylobacter* spp.

Contractor: University of Bristol; Paper presented by Professor Tom Humphrey.

29. The findings from Project B03008 and independent studies in Northern Ireland and Scandinavia demonstrated that farmers differ in their ability to produce *Campylobacter* negative flocks. Furthermore, there was a possible relationship between aspects of bird husbandry and *Campylobacter* colonisation. As the colonisation of broiler flocks is very likely to be multi-factorial there are many possible reasons for farmer to farmer differences. This project will carry out a detailed study to determine the relative roles of the different aspects of flock management, which might influence the entry of *Campylobacter* into broiler flocks and/ or affect the susceptibility of the birds to colonisation.

Project B15004: Measures and Best Practice to Minimise Infection of Remaining Birds with *Campylobacter* when Broiler Flocks are thinned.

Contractor: University of Bristol; Paper presented by Professor Tom Humphrey.

30. Thinning, where a proportion of the flock is removed at 33 to 35 days is widely practised by the UK poultry industry. This is an economic necessity and also allows flexibility of supply. Data suggests that this practice will increase the chances of the remaining birds of a flock becoming *Campylobacter* positive. This project will carry out a risk assessment of the thinning process and will highlight the potential benefits of interventions such as machine catching.

Project B15005: Sampling Regimes and Microbiological Methods for Detecting Thermophilic *Campylobacter* spp. in Poultry on the Farm before Slaughter.

Contractor: University of Bristol; Paper presented by Professor Tom Humphrey.

31. This project will identify optimum sampling and testing regimes including rapid methods. Methods will be evaluated for sensitivity, specificity, cost, and ease of use since they will be used by contract laboratories or chicken farmers without recourse to a specialist laboratory. The project will produce a guidance document specifying sampling plans, on-farm testing and laboratory test methods.

SESSION IV: PROGRAMME B15 - POULTRY RESEARCH WORKSHOPS

32. Delegates were invited to attend one of three concurrent workshops, according to their expertise and interests.

Workshop A: Is there a need for a full intervention study for *Campylobacter* in intensive broiler flocks?

Workshop B: Research methods for *Campylobacter* detection and analysis

Workshop C: Long term intervention strategies for the control of *Campylobacter* in chicken

WORKSHOP REPORTS

Workshop A: Is there a need for a full intervention study for *Campylobacter* in intensive broiler flocks?

Introduction

33. The FSA is considering funding a full-scale intervention study on the effectiveness of on-farm biosecurity control measures to control *Campylobacter*. The workshop discussion centred on the practical difficulties of studying a single intervention measure in isolation and the danger of duplicating existing research.

Key conclusions/recommendations

34. There was general agreement that the most practical approach would be a supportive intervention study investigating the relative effect of withdrawing a single intervention. However, it would be almost impossible to study a single intervention in isolation because of the difficulty of ensuring 100% compliance with the measure.

35. It was suggested that an experimental farm should be used to reduce the number of possible variables and that longitudinal sampling would be essential over at least five flock cycles.

36. Orchestrating such a study against the background of seasonality of *Campylobacter* infection would be extremely difficult. There is also a real danger of duplicating previous work and reiterating existing advice. A wealth of information on general biosecurity guidance already exists.

37. The general view was held that an intervention study would be prohibitively expensive. **It was concluded that an education campaign to change behaviour was more important than an intervention study.**

Recommended alternatives to a full intervention study

38. One approach would be to develop a Quantified Risk Assessment to identify and rank possible risk factors for *Campylobacter* infection, using findings from the Defra funded project: OZ0608: Epidemiological studies and development of practical control measures for *Campylobacter* in broiler flocks. This could be used to identify those intervention measures offering the best cost/benefit ratio.

39. An alternative approach would be to identify on-farm sources of *Campylobacter* using molecular typing techniques to demonstrate a definitive link between environmental sources and flock. This could help inform the ranking of risk factors and demonstrate the importance of interventions.

40. Farmer behaviour and operational culture was viewed as critical to success of interventions. Farmers need to be educated in the use of control measures and they

need incentives. All who work on the farm need to understand why it is important that intervention measures are carried out properly and be motivated to do it every time. It was suggested that social science studies were a way of analysing farmer behaviour and psychological barriers to compliance.

Workshop B: Research methods for *Campylobacter* detection and analysis

Introduction

41. The FSA and other organisations have funded research to develop methods to isolate and detect *Campylobacter*, from conventional isolation methods to rapid typing methods. It is timely to take stock of the methods available and to consider whether what we have developed is adequate for current needs or whether there are research needs that still have to be addressed. The discussion focused on isolation, detection and typing methods for *Campylobacter*.

Key conclusions/recommendations

42. **Isolation methods:** For isolation of *Campylobacter*, the group recommended using the forthcoming ISO method¹. Future modifications to the ISO method, to be introduced in the near future, will improve the method (eg. the inclusion of Bolton Broth). It was noted that rapid methods (kits) are used to some extent while the uptake of molecular methods is hampered by the cost (although they are getting cheaper) and the slow throughput.

43. There is a need for the Agency to consider methods used throughout the EU and monitor any new developments to ensure that the most appropriate methods are used in the UK.

44. Whichever isolation method is used, it is important to standardise the micro-aerophilic and growth temperature conditions used (other variables such as broths are less important). There is also a need to standardise the transport and storage conditions of isolates.

45. **Detection Methods:** The discussion on detection methods concluded that there continues to be a need to speciate *Campylobacter* to help address the lack of knowledge about the organism.

46. The development of real-time fluorescent molecular methods should be recognised as a tool that can be used by the industry for the rapid detection of *Campylobacter*. There is an urgent research need to validate the real-time fluorescent PCR method that has been developed.

47. **Typing Methods:** A range of typing methods are available, e.g. AFLP², PFGE³, MLST⁴, and it was concluded that there is no identified need for further method development. There was a general consensus for the following:

¹ Current method published by ISO (International Organisation for Standardisation), ISO 6579, Microbiology of food and animal feeding stuffs - Horizontal method for the detection of *Salmonella* spp.

² Amplified Fragment Length Polymorphism

³ Pulsed Field Gel Electrophoresis

⁴ Multi-Locus Sequence Typing

- i. There continues to be a need to harmonise the typing methods in current use, by both the research community and the industry.
- ii. Typing methods need to be sequence based.
- iii. Typing methods are now readily available for use by both the research community (to more clearly define the epidemiology of *Campylobacter*) and the industry (for environmental monitoring) and their use should be encouraged.

48. The audience was in total agreement in that whichever isolation, detection or typing method is used, it needs to be fit for purpose and needs to be appropriate for the question being asked.

Workshop C: Long term intervention strategies for the control of *Campylobacter* in chicken.

Introduction

49. There is a large body of research on long term intervention measures such as vaccination of poultry and competitive exclusion. The aim of this workshop was to discuss whether there was sufficient evidence to suggest further work would be either beneficial or unlikely to produce a practical solution for the UK poultry industry.

Key conclusions/recommendations

50. The general view was held that there is a need for a greater understanding of the lag phase of *Campylobacter* growth in broiler flocks. It was suggested that the level of infection in broiler flocks could be significantly reduced by extending the lag phase. An understanding of the nature of the lag phase could also drive the development of anti-microbial compounds and competitive exclusion products. The eventual aim would be to extend the lag phase to the end of the growing period in the flock cycle.

51. It was noted that host susceptibility to *Campylobacter* infection could vary with different breeds of chicken and that this should be investigated further.

52. A vaccine for use against *Campylobacter* is likely to use a genetically modified component. But current concern surrounding GM should not prohibit further work in this area as future opinion may change.

53. The use of feed additives such as anti-microbials, bacteriophages and probiotics should be investigated by the Agency. Possible legal constraints should not affect/prohibit or restrict ongoing work in this area as there may be a case for amending the existing legislation if a potentially useful product is discovered with real benefits in reducing incidence of *Campylobacter* or improving aspects of safety and quality of production.

54. The protective effect of dietary manipulation to change the composition of the gut flora is another promising area, which should be examined further.

55. In addition, the delivery of feed, i.e. the feeding regime and method of storage should be considered further.

56. There was the general conclusion that a greater understanding of *Campylobacter* physiology is required to underpin research into identifying long-term intervention measures.

CLOSED REVIEW

57. Professor Geoff Mead chaired the closed review. An independent expert panel consisting of Dr Nick Sparkes, Dr Hilde Kruse and Professor Mac Johnston evaluated each reviewed research project for scientific quality and policy ranking/value for money. The panel was also invited to evaluate the B15 Poultry programme as a whole. Contractors will be informed of the panel's evaluation separately.

Programme

8.30 – 9.10	Registration Tea/coffee Reception
9.15 – 9.25	Chair's opening remarks Professor Geoff Mead
9.25 – 9.40	Introduction to Programme B15's research on poultry and the Agency's <i>Campylobacter</i> Strategy Dr Linden Jack, FSA
9.40 – 9.55	Overview of FSA Meat Hygiene Research Programme Mary Howell, FSA
9.55 – 10.10	Overview of Defra funded research on poultry Alex Morrow, Defra

Session I: Historic research of relevance to Programme B15

10.10 – 10.30	Project B03003: The molecular epidemiology of <i>Campylobacters</i> in poultry and poultry meat and use to develop intervention strategies Professor Diane Newell, VLA
10.30 – 10.45	Project B03005/6/7: A review of the measures to reduce levels of <i>Salmonella</i> and <i>Campylobacter</i> in poultry and development of an appropriate risk assessment model Dr Tony Moore, Direct Laboratories
10.45 – 11.00	Project B03001: Field studies to identify and evaluate key intervention points for <i>Salmonella</i> control during broiler production Dr Rob Davies, VLA
11.00 – 11.15	Open discussion
11.15 – 11.30	Morning Coffee/Tea

Session II: B15 Poultry Research – Phase I (now completed)

11.30 – 11.45	B03008 Identify critical points for infection of live birds or contamination of poultry carcasses with <i>Campylobacter</i> & <i>Salmonella</i> Professor Tom Humphrey, University of Bristol
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11.45 – 12.00	B03010 Efficiency of Water Disinfection systems in Broiler Systems Dr Iain Ogden, University of Aberdeen
12.00 – 12.15	B01005 Variations in virulence of <i>Campylobacter jejuni</i> strains associated with poultry and poultry meat Professor Diane Newell, VLA
12.15 – 12.30	Open discussion
12.30 – 1.30	Lunch

Session III: B15 Poultry Research – Phase II

1.30 – 2.15	Current research portfolio covering sampling regimes/ microbiological methods for <i>Campylobacter</i> and <i>Salmonella</i> in poultry, best practice for thinning, and risk factors for colonisation Professor Tom Humphrey, University of Bristol Dr Tony Moore, Direct Laboratories
2.15 – 2.30	Open discussion

Session IV: B15 Poultry Research Workshop

2.30 – 3.15	Workshop session to discuss future research
3.15 – 3.45	Afternoon Tea
3.45 – 4.15	Workshop Reports Reporters to summarise the discussion and table any recommendations from the workshop groups
4.15 – 4.30	Final discussion and chair's summing up
4.30	Close of open review
4.30 – 5.30	Closed review for independent panel of experts only

ORIGINAL ROAME A**STRATEGIC RESEARCH SPECIAL EMPHASIS PROGRAMME:
ASSESSING AND MANAGING THE HAZARDS AND RISKS FROM
Campylobacter spp. AND *Salmonella* spp. IN POULTRY FROM FARM TO FORK****1 RATIONALE**

1. Foodborne pathogenic micro-organisms have always posed a serious threat to human health. The extent and severity of disease caused by foodborne pathogens has changed considerably over time and continues to change as problems are identified and dealt with and as new problems arise.

2. A considerable body of information on foodborne pathogenic micro-organisms exists as a result of many decades of research activity. Current microbiological food safety measures from processing to regulation are based on the information derived from this scientific endeavour. However, although many protective measures have been developed for many hazardous foods and foodborne pathogenic micro-organisms, changes and developments in preservation techniques and processing have expanded the potential for foodborne infection to occur. The parallel evolution of foodborne micro-organisms, in some cases apparently in direct response to changed or newly introduced food processing methods, adds to the changing picture and the potential for human infection to occur.

3. There is therefore an ongoing need to evaluate the relative threat to human health of both known and emerging foodborne pathogenic micro-organisms in an ever changing and evolving food production and processing environment.

4. *Campylobacter* spp. and *Salmonella* spp. are currently the most commonly reported cause of acute gastrointestinal infection in the UK. In its 1993 Interim Report on *Campylobacter*, the Advisory Committee on the Microbiological Safety of Food concluded that, among other things, "The sources and routes of transmission of *Campylobacter* infection are not yet fully understood, but there is strong circumstantial evidence to suggest one major source is poultry, transmission being either directly through consumption of under cooked chicken or by cross contamination of other foods in the kitchen". As a result a number of research projects in this area were commissioned by MAFF, DH and other funding bodies. In 1996, the committee published its "Report on Poultry Meat". One of the key conclusions of the committee was that pathogen carriage rates can be substantially reduced by appropriate action, that this is crucially dependent upon each link in the chain receiving appropriate attention and that the application of HACCP principles is the key management regime through which significant improvements can be achieved.

5. Before one can perform a satisfactory HACCP study, one needs to know in detail the nature of the hazards and risks involved. Current research addresses many aspects of *Campylobacter* and *Salmonella* in poultry but, to the best of our

knowledge an integrated in-depth study of the hazards and risks throughout the whole food chain from "farm to fork" has not yet been undertaken. Such an integrated study could highlight new risks and hazards, or indeed new opportunities for control, that might not appear obvious from studies on individual parts of the chain.

POLICY OBJECTIVES

6. To determine whether new approaches to the production and processing of poultry can be devised, and implemented from farm to fork, to reduce the infection of poultry products with the foodborne pathogens *Salmonella* and *Campylobacter* at the point of consumption. To consider existing and new techniques in the context of the current industry structure, levels, routes and sources of infection, and the food safety demands of the consumer, to determine the need for, and value of, implementing new industrial codes of practise and/or legislation.

SCIENTIFIC OBJECTIVES

7. The following scientific objectives have been identified to achieve the policy objective set out in paragraph 5.

- To determine the points at which *Salmonella* spp. and *Campylobacter* spp. enter the poultry production chain in order to determine where intervention provides the greatest potential for protection of the production chain from infection with these pathogens.
- To assess how specific food handling and production processes affect the survival or growth and toxin production of *Campylobacter* spp. and *Salmonella* spp.
- To develop practical techniques that will be used by government and industry, and consumers to manage the risks and hazards arising from *Campylobacter* spp. and *Salmonella* spp. in poultry and poultry products. Special emphasis will be placed on identifying control methods that are not currently available if they offer specific advantages.

1.1 ALTERNATIVE RESEARCH MEANS

9. The overall policy objectives of producing safe food and providing support to enforcement authorities could be in part achieved by utilising existing information on control strategies such as HACCP and similar systems. However, the extent to which such controls can be applied and the effectiveness of these controls depend upon research of the kind proposed here in order that they can be targeted effectively. The research programme therefore offers the most appropriate means of achieving the policy objectives since it will fulfil MAFF's current obligation to the UK consumer and food industry within the confines of existing legislation.

10. There are alternative approaches to those which will be taken within this research programme. However, it is not possible to investigate all avenues of research in order to address the policy objectives of this research programme. Research in the programme is therefore focused upon those avenues which, given the current state of scientific understanding, offers the greatest opportunity of a successful achievement of the programme's aims. The decisions on the approaches

to be adopted are made based upon widespread discussion, the advice of experts and advisory groups, and on research commissioned through open competition appraised through peer review.

2 ALTERNATIVE SOURCE OF RESEARCH RESULTS

11. There is a considerable amount of work ongoing elsewhere in the world. However, it is not always clear how relevant the data generated is to the UK population and the UK food industry since there are significant structural differences and unique features. Nevertheless, these data are taken into account when commissioning new research. It is intended that this programme should draw significantly upon scientific data already available and to utilise this to address at least part of the scientific objectives of the research programme.

12. Publicly funded UK research is closely co-ordinated and so this avenue does not offer alternative sources of data. Industry offers an alternative source. Industry research is taken into account where the data is made publicly available. Some industry research may be addressing some issues being researched within the MAFF programme but not be publicly available. In addition, where possible, participation in European Union research programmes in this area will be sought.

2.1 REASONS FOR MAFF TO FUND THE RESEARCH

13. The main responsibilities for protecting the food supply from microbiological hazards lie with the food industry and the enforcement authorities. However, the Ministry has specific aims targeted at protecting the health of the UK consumer, and promoting the competitiveness of the UK food production industry. In terms of microbiological food safety, these aims are more specifically to ensure that food is microbiologically safe at the point of consumption and that consumers have access to information on how to handle and prepare foods safely in the home. These aims are underpinned by statutory obligations placed upon the Ministry through the Food Safety Act 1990 which implies an obligation to ensure that the food supply is not unfit or injurious to health due to the presence of pathogenic microorganisms or their toxins. In order to do this MAFF needs to act on sound scientific information which is provided by this and related research programmes. In addition, as the ED, and other bodies such as the Codex Alimentarius Commission, lay down standards for pathogenic micro-organisms in food, the UK will require its own knowledge base to ensure that any such standards do not prejudice the UK consumer or industry.

ANNEX III

Programme B03 & B15: Poultry Projects						
PROG CODE	FSA CODE	TITLE	START	END	PROJECT OFFICER	CONTRACTOR
B15	B01005	Variations in virulence of <i>Campylobacter jejuni</i> strains associated with poultry and poultry meat	01-Apr-98	31-Mar-01		Veterinary Laboratories Agency
B03	B03001	Field studies to identify and evaluate key intervention points for <i>Salmonella</i> control during broiler production	01-Jul-99	30-Jun-00		Veterinary Laboratories Agency
B03	B03003	The molecular epidemiology of <i>Campylobacters</i> in poultry and poultry meat and use to develop Intervention studies	01-Apr-97	31-Mar-00		Veterinary Laboratories Agency
B03	B03005/6/7	A review of measures to reduce levels of <i>Salmonella</i> and <i>Campylobacter</i> in poultry and development of an appropriate risk assessment model	01-Sep-98	31-Aug-99		ADAS/Silsoe/ university of Nottingham
B15	B03008	Identify critical points for infection of live birds or contamination of poultry carcasses with <i>Campylobacter</i> & <i>Salmonella</i>	01-Nov-99	30-Nov-02	Linden Jack	PHLS
B15	B03010	Efficiency of Water Disinfection systems in Broiler Systems	01-Oct-99	30-Jun-02		University of Aberdeen
B15	B15001	<i>Campylobacter</i> spp in housed broiler flocks: the influence of flock health, performance, husbandry and vaccination against other diseases on susceptibility to colonisation with <i>Campylobacter</i> spp	01-Jun-03	31-May-05	Ian Smith	University of Bristol
B15	B15003	To make recommendations on the best practical procedures to sample and test poultry flocks for <i>Salmonella</i> .	01-Nov-03	31-Aug-04	Ian Smith	Direct Laboratories

B15	B15004	Measures and best practice to minimise infection of remaining birds with <i>Campylobacter</i> when broiler flocks are thinned.	01-Jan-04	Jan 06?	Ian Smith	University of Bristol
B15	B15005	Sampling regimes and microbiological methods for detecting thermophilic <i>Campylobacter</i> spp. in poultry on the farm.	02-Jan-04	June 05?	Ian Smith	University of Bristol
	Projects to be reviewed by panel members					
	Current Projects for financial yrs 03/04 & 04/05 - provided for information only					

ANNEX IV

Delegate list for FSA B15 Poultry Research Programme Review

Forename	Surname	Organisation
Clare	Aldus	Institute of Food Research
David	Alexander	Food Standards Agency
Viv	Allen	University of Bristol
Harry	Bailie	Department for Environment Food and Rural Affairs
Phil	Banks	Department for Environment Food and Rural Affairs
Paul	Barrow	Institute of Animal Health
Chris	Bayliss	Campden and Chorleywood Food Research Association
Andrea	Belcher	Food Standards Agency
Charles	Bourns	National Farmers Union
Mark	Breslin	Veterinary Laboratories Agency
Paul	Bullen	Department for Environment Food and Rural Affairs
Márie	Burnett	British Poultry Council
Kathryn	Callaghan	Food Standards Agency
Ian	Connerton	University of Nottingham
Paul	Cook	Food Standards Agency
Janet	Corry	University of Bristol
Rob	Davies	Veterinary Laboratories Agency
Helen	Davison	Veterinary Laboratories Agency
Daniel	Díaz-Fiunte	Food Standards Agency
Jane	Downes	Meat Hygiene Service
Kirsten	Dunbar	Food Standards Agency Northern Ireland
Ellis	Evans	Food Standards Agency
Fressie	Fernandez	University of Bristol
David	Garwes	Department for Environment Food and Rural Affairs
Keith	Gooderham	Veterinary Consultant
Bill	Haddon	Citrox Ltd
Jake	Hancock	Soil Association
Carol	Hole	University of Bristol
Jane	Horne	Food Standards Agency Scotland
Mary	Howell	Food Standards Agency
Tom	Humphrey	University of Bristol
Mike	Hutchinson	Direct Laboratories
Linden	Jack	Food Standards Agency

Mac	Johnston	Royal Veterinary College, ACMSF
Michael	Jones	Institute of Animal Health
Frieda	Jorgensen	University of Bristol
Hilde	Kruse	Norwegian Zoonosis Centre
Alan	Lyne	ADAS
Bernard	Mackey	University of Reading
Gerry	MacManus	Department of Agriculture and Rural Development
Martin	Maiden	University of Oxford
Georgina	Manning	Veterinary Laboratories Agency
Geoff	Mead	Consultant
Patrick	Miller	Food Standards Agency
Tony	Moore	Direct Laboratories
Alex	Morrow	Department for Environment Food and Rural Affairs
Diane	Newell	Veterinary Laboratories Agency
Iain	Ogden	University of Aberdeen
Florence	Opesan	Food Standards Agency
Heddwyn	Owen	ADAS
Robert	Owen	Health Protection Agency
David	Parsons	Silsoe Research Institute
Mike	Peck	Institute of Food Research
Helen	Prangley	Food Standards Agency
Anne	Ridley	Veterinary Laboratories Agency
Henry	Smith	Health Protection Agency
Ian	Smith	Food Standards Agency
Robert	Smith	CDSC, National Public Health Service for Wales
Nick	Sparkes	Scottish Agricultural College
Colin	Spedding	Assured Chicken Production
Alan	Speight	Food Solutions Assoc. Ltd
Chris	Thorns	Veterinary Laboratories Agency
Dave	Tinker	Silsoe Research Institute
Huw	Tyson	Biotechnology and Biological Sciences Research Council
David	Wareing	Dynal Biotech Ltd
Robert	Westhead	Food Standards Agency
Gary	Wyatt	Institute of Food Research