THE STATUS OF NEW ZEALAND'S FOOD

Report on the NZFSA-ESR Science Contract 2006-2007

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Report on the NZFSA-ESR Science Contract 2006-2007

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PREFACE

The work of both the New Zealand Food Safety Authority (NZFSA) and ESR is inextricably linked with the health, wealth, and well-being of New Zealanders. Food is a staple part of this country's economy, and a safe food supply is vital to protect (and indeed promote) public health. These core facts form the basis of the NZFSA-ESR partnership, with scientists in both organisations working together to help secure a healthy nation. All of the projects described in this report were developed jointly by experts in each of our organisations, an approach that is synergistic in terms of scientific resources and outputs, and representative of the partnership approach that we strive to make increasingly effective.

The risk management framework in which our activities are integrated components is increasingly recognised internationally. Our risk profiling and risk ranking activities are highly regarded internationally and benefit from an active interface with NZFSA in their planning and peer review. We regard our scientific reports as "the gold standard" and take pride in their content and contribution to helping the NZFSA prioritise their food safety measures. No fewer than seven comprehensively researched risk profiles were published this year, covering topics as diverse as *Listeria monocytogenes* in low moisture cheese, *Clostridium botulinum* in honey, Ciguatoxins in seafood and *Campylobacter jejuni/coli* in red meat, poultry and offal.

The exceptionally high incidence of campylobacteriosis reported among New Zealanders is a major focal point of research, essential to support and inform efforts to reduce the burden of disease. This is all the more pertinent now given the aim of the NZFSA to reduce the burden of foodborne *Campylobacter* infection by 50% by 2012. Continued efforts to improve statistical models of the infection to help target interventions where they would be most effective were undertaken and have received a welcome boost from a Cross-Departmental Research Programme grant in which ESR is a proud participant. Our in-depth analysis of on-farm risk factors will provide valuable input to these efforts. In time, we would also hope to benefit from studies aimed at better understanding the ability of the organism to recover from environmental stresses including osmotic pressure and freezing, now in their second year. The resources directed by the NZFSA (and indeed in independent research conducted at ESR) to campylobacteriosis highlight our joint determination to tackle the burden of disease.

Naturally, *Campylobacter* is not the only foodborne pathogen of concern to New Zealanders. Norovirus infections are also highly prevalent and with approximately 40% of these cases being initiated by contaminated foods (especially shellfish) this too requires attention. The NZFSA have invested for some time in ESR analytical capability development that has resulted in an IANZ-accredited molecular assay for detecting the pathogen in shellfish. Its efficacy was proven in a study involving 36 oyster samples, of which eight were found to harbor the virus: seven of these had been imported from Korea. The value of such assays to the NZFSA for public health protection should be self-evident.

Similarly, ESR has been working on improved analytical methods for other enteric pathogens such as *Yersinia* and *Vibrio* spp. Such developmental work is often challenging, yet to coin a pertinent phrase "the proof of the pudding is in the eating" and PCR-based approaches have been developed for these organisms. Although at different stages of validation, the assays have so far indicated pathogenic *Vibrio parahaemolyticus* in native shellfish and demonstrated the presence of pathogenic *Yersinia enterocolitica* strains in pork. The latter

assay has now been successfully adapted for screening raw milk and is being used in an extensive nationwide survey of this foodstuff.

The value of molecular typing methods to track the progress of microbial infections in populations came to special prominence when the high-resolution method based on analysing whole genome differences with Pulsed-Field Gel Electrophoresis (PFGE) was used to demonstrate that pathogenic *E. coli* O157 strains implicated in a common-source outbreak in the USA were not, as first thought, identical with those recovered from meat originating from New Zealand. Given the draconian measures (including trade barriers) sometimes imposed by authorities where imported goods are proved to be a source of human infections, the value of this work should not be underestimated.

Pathogenic microorganisms do not encompass every threat to human health in foods and ESR's chemical food safety programme continues to contribute to NZFSA regulatory activity. In this contract period, a wide-ranging review of the potential risks from naturally occurring toxins in New Zealand crops was produced, providing in general a reassurance that risks to human health from this source were low. Similarly, while a survey of plant-based foods for pesticide residues detected such compounds in some 45% of samples, only two exceeded the defined maximum residue limit (MRL), itself a level that incorporates a high margin of safety. Monitoring in this way continues to affirm New Zealand produces safe goods and reassures exporters who rely upon the reputation of New Zealand as a clean, green food producer as an important selling point.

Ironically, it is not only the presence of a hazard in foods that must be considered in food safety. The low levels of essential trace elements such as iodine in the New Zealand food supply, as proven in the authoritative Total Diet Survey completed last year, is also of concern. Informing any decision on fortification of a particular food demands data on chemical behavior during processing. Results from iodised salt in bread that demonstrate levels of iodine remain stable after the baking process will help regulators decide on dietary components suitable for fortification.

Globalisation is emerging as a major food safety issue and it is essential that our homegrown products are safe for our domestic consumers and those in importing countries. It is equally essential that imported foods are fit for our consumption. Some of the examples above highlight the need to constantly develop and improve assays and approaches. Increasingly agencies are networking and collaborating with counterparts overseas, to help and learn from one another. Both ESR and the NZFSA are engaged in active collaboration with research institutes abroad and we at ESR are determined to use our participation in European projects such as MoniQA, Food-FRENZ and ProSafeBeef, to the benefit of New Zealand and the NZFSA. In my experience, the benefits of collaboration are clear for all to see: indeed, they are highly evident in this report. I look forward to further developments in the ESR-NZFSA partnership.

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September 2007

1 INTRODUCTION

The primary purpose of the Food Safety Programme is to provide the New Zealand Food Safety Authority (NZFSA) with information (experimental, monitoring and derived from the scientific literature and expertise of ESR's Food Safety Programme members) to help them to identify and quantify food safety hazards, assess, manage and communicate (to key stakeholders) risks, develop food standards as appropriate and evaluate health outcomes. The Programme is designed to be flexible, to enable the NZFSA to call upon ESR Food Group's wide range of capabilities when needed, so as to assist in achieving the goal of ensuring safe food for both domestic and international consumers.

The Programme is divided into six Science Service Descriptions:

- Microbiological Risk Profiling
- Microbiological Food Safety
- Chemical Food Safety
- Current Awareness and Risk Communication
- Emergency Response
- NZFSA/HPO Technical Support

The 2006-2007 Food Safety Programme was based on Service Descriptions as a means of consolidating like work to introduce organisational tidiness. But, more importantly, it facilitates implementation of a risk management framework by NZFSA for administration of food safety in New Zealand. Qualitative and quantitative risk assessments are central to this approach.

The current report summarises activities carried out under the six Science Service Descriptions during the year July 2006 to June 2007.

2 MICROBIOLOGICAL RISK PROFILING

The New Zealand Food Safety Authority utilises a "regulatory model" that adopts a risk-based approach to food safety. This means, in general, that effort and resources are applied to issues that constitute the greatest risk. However, market access, consumer perceptions and other issues can also have an influence on science needs. The purpose of the Microbiological Risk Profiling Science Service is to provide scientific information that supports this risk-based approach, and also to direct the other scientific food safety activities of ESR.

This Science Service contributes to the risk assessment and management of food safety issues by providing:

- Risk Profiles of food/hazard combinations to provide current status and context to risk managers for decision making;
- Identification of new data and information needed for future risk profiles and effective risk management of food safety issues;
- Direction for research activity to provide that data and information, either within this Service or others.
- Other reports that provide scientific information for risk management of priority food safety issues.

The development of risk-based activities to support risk management decision making is proceeding well. The Risk Profiles are the building blocks of such an approach. As these are finalised and added to the website library, a coherent picture of the food safety issues facing New Zealanders is being created. These Profiles also identify areas of work that are needed to fill data gaps.

The components of this Science Service during 2006-2007 were:

- Risk Profiles
- Risk Ranking: DALYs – Development of a Single Metric

2.1 Risk Profiles

The purpose of a risk profile is to provide a systematic collection of contextual information relevant to a food/hazard combination, such as *Campylobacter* in poultry, so that risk managers can make decisions and, if necessary, take further action. A risk profile can be regarded as providing a decision tool between the identification of a real or perceived food safety issue and a variety of actions, including the commissioning of a quantitative risk assessment, or immediate risk management activity.

A further seven Risk Profiles were completed during 2006-2007, with drafts of five more Profiles and other documents delivered to the NZFSA and/or stakeholder groups for comment.

The additional completed Risk Profiles were:

Lake RJ, Hudson JA, Cressey PJ, Gilbert S. (2004) Risk profile: Listeria monocytogenes *in low moisture cheese. ESR Client Report FW0440. Christchurch: ESR*

Lake RJ, Hudson JA, Cressey PJ, Gilbert S. (2004) Risk profile: Campylobacter jejuni/coli *in mammalian and poultry offals. ESR Client Report FW0465. Christchurch: ESR.*

Lake RJ, Hudson JA, Cressey PJ, Gilbert S. (2004) Risk profile: Campylobacter jejuni/coli *in red meat. ESR Client Report FW0485. Christchurch: ESR.*

Lake RJ, Hudson JA, Cressey PJ, Gilbert S. (2004) Risk profile: Campylobacter jejuni/coli *in poultry (whole and pieces). ESR Client Report FW04100. Christchurch: ESR* (this is an update of an earlier risk profile).

Gilbert S, Lake RJ, Hudson JA, Cressey PJ. (2006) Risk profile: Clostridium botulinum *in ready-to-eat smoked seafood in sealed packaging. ESR Client Report FW0625. Christchurch: ESR.*

Gilbert S, Lake RJ, Hudson JA, Cressey PJ. (2006) Risk profile: Clostridium botulinum *in honey. ESR Client Report FW05115. Christchurch: ESR.*

Cressey PJ, Gilbert S, Lake RJ. (2007) Risk profile: Ciguatoxins in seafood. ESR Client Report FW0701. Christchurch: ESR.

Five further Risk Profiles are currently undergoing NZFSA or external peer review prior to being finalised:

Gilbert S, Lake RJ, Hudson JA, Cressey PJ. (2005) Risk profile: Shiga toxin-producing Escherichia coli *in raw milk. ESR Client Report FW0612. Christchurch: ESR.*

Gilbert S, Lake RJ, Hudson JA, Cressey PJ. (2006) Risk profile: Shiga toxin-producing Escherichia coli *in uncooked comminuted fermented meat products. ESR Client Report FW0611. Christchurch: ESR* (this is an update of an earlier risk profile).

Lake RJ, Gilbert S, Hudson JA, Cressey PJ. (2007) Risk profile: Toxoplasma gondii *in red meat and meat products. ESR Client Report FW06106. Christchurch: ESR* (this is an update of an earlier risk profile).

Gilbert S, Lake RJ, Hudson JA, Cressey PJ. (2007) Risk profile: Cryptosporidium *spp. in shellfish. ESR Client Report FW0720. Christchurch: ESR.*

McIntyre L, Cressey PJ, Lake RJ. (2007) Discussion document on pathogens in fruit and vegetables in New Zealand. ESR Client Report FW0737. Christchurch: ESR.

Completed Risk Profiles are available on the New Zealand Food Safety Authority website at http://www.nzfsa.govt.nz/science-technology/risk-profiles/index.htm.

2.2 Risk Ranking: DALYs – Development of a Single Metric

This report contributes to a project with the following goal:

- The development of a single metric of risk ranking that can be applied to both chemical and microbiological hazards, and is applicable to the varied risk ranking needs of the NZFSA.

From 2002 – 2005 the risk ranking project, conducted by ESR for the NZFSA, developed a process, and used expert opinion to produce severity and incidence estimates for a number of food/(microbiological) hazard combinations.

An initial report from this project in the current year (FW06109) discussed the available metric options, and chose the disability adjusted life year (DALY) as the most appropriate single metric. The fundamental calculation for DALYs is:

$$DALY = YLL + YLD$$

YLL is the number of years of life lost due to mortality and YLD is the number of years lived with a disability, weighted with a factor between 0 and 1 for the severity of the disability (d).

The YLL due to a specific disease in a specified population is calculated by the summation of all fatal cases (n) due to the health outcomes (l) of that specific disease, each case multiplied by the expected individual life span (e) at the age of death.

$$YLL = \sum_{l} n_l \times e_l$$

YLD is calculated by accumulation over all health outcomes (l), the product of the number of cases (n), the duration of the illness (t) and the severity weight (w) of a specific disease. It should be noted that the calculation for YLL implicitly includes a severity weight factor. The severity weight or disability weight factors are in the range zero to one, with the severity weight for death being equal to one.

$$YLD = \sum_{l} n_l \times t_l \times w_l$$

Information on the incidence of illness and death is derived from clinical, epidemiological and surveillance studies, whereas information on severity weights is typically derived from elicitation of special panels, preferably from the general population.

The approach used in developing DALY estimates for New Zealand has been strongly guided by an approach used for the Netherlands in 2006. Further guidance was found in specific Dutch estimates for *Campylobacter* and shiga-toxin producing *Escherichia coli* (STEC).

For this project, development of DALY estimates for the following illnesses was carried out:

- Campylobacteriosis
- Salmonellosis
- Listeriosis (invasive, perinatal and non-perinatal)
- Infection with STEC
- Yersiniosis
- Infection with Norovirus

A significant proportion of these illnesses are caused by foodborne transmission of the pathogens. Of the six potentially foodborne microbial diseases examined in the current exercise the highest ranked issue, according to the DALY approach is campylobacteriosis, followed by norovirus infection, perinatal listeriosis, salmonellosis, yersiniosis, STEC infection and acquired (non-perinatal) listeriosis. DALY values are summarised in Table 1.

Table 1: Mean YLD, YLL, DALYs and foodborne DALYs for potentially foodborne infectious intestinal diseases in New Zealand

Disease	YLD	YLL	DALYs	Foodborne DALYs (5^{th}-95^{th} percentile)
Campylobacteriosis	1506	48	1554	880 (586-1174)
Norovirus infection	530	6	536	210 (51-462)
Listeriosis, perinatal	0.5	228	229	195 (110-290)
Salmonellosis	140	46	186	111 (68-177)
Yersiniosis	64	29	93	52 (24-85)
STEC infection	18	73	91	35 (24-70)
Listeriosis, acquired	5	21	26	22 (8-45)

However, estimates associated with different organisms vary widely in their degree of associated uncertainty. For example, the model used to calculate DALYs associated with norovirus infection generates a 95% confidence interval for the total number of gastroenteritis cases that spans three orders of magnitude, while the total range of mean DALY values for all diseases considered only covers two orders of magnitude.

Lake R. (2006) Risk ranking: Development of a single metric for risk ranking by the NZFSA. ESR Client Report FW06109. Christchurch: ESR.

Cressey P, Lake R. (2007) Risk ranking: Estimates of the burden of foodborne disease for New Zealand. ESR Client Report FW0724. Christchurch: ESR.

3 MICROBIOLOGICAL FOOD SAFETY

The aim of this Science Service is to improve food safety in New Zealand by providing information on the microbiological quality of our foods, assessing the risks posed by microbiological hazards in foods, identifying efficiencies in controlling those risks and contributing to the overarching risk management goals of NZFSA.

Ongoing monitoring and surveillance of current, emerging or potential food microbiological safety issues may include testing a range of selected foods from the retail market or validating methods used within food businesses to assess food safety and hygiene. Where new hazards emerge, new methods may need to be developed to detect them, as part of this programme.

Results of projects can be used to advise on potential hazards, the risk to human health posed by them, and methods of control. This may in turn lead to new or revised regulatory standards, and other regulatory risk management activities such as development of codes of practice (COPs) for industry, provision of food safety resources for use in consumer education campaigns, or advice to food producers to change their methods or practices.

Specific work areas included in the 2006-2007 year were:

- Incorporation of Risk Models for *Campylobacter* in Poultry and Red Meat into the Comparative Exposure Model
- On-farm Risk Factors for *Campylobacter* Contamination of Poultry
- Secondary Processing of Poultry
- Potential Re-growth of *Salmonella* from Contaminated Pet Chews
- Review of Notified Salmonellosis Outbreak Data as a Source of Information for Attribution
- Domestic Food Handling
- Bakery Products - Microbiological Quality
- Growth of *L. monocytogenes* in Refrigerated Foods under Non-static Temperature Conditions
- L. Mono in RTE Salads - Exposure Assessment to *Listeria monocytogenes* via Deli Ready-to-eat Salads (with Dressings)
- Murine Norovirus (MNV-1) – a Suitable Surrogate for Human Norovirus?
- Norovirus Detection in Shellfish
- Pasteurisation Risk Model
- *Vibrio parahaemolyticus* and *Vibrio vulnificus* in North Island Commercially Harvested Oysters (*Crassostrea gigas*)
- VNC - Resuscitation of Putative Viable but Non-culturable Foodborne Bacteria of Significance to New Zealand
- Yersinia in Meat: Analytical Development and Survey
- PulseNet Aotearoa (New Zealand) - Implementation and Optimisation

In addition, two projects carried over from the 2005-2006 year were completed in the 2006-2007 year:

- PFGE Typing of Human Case and Food Isolates of *E. coli* O157:H7 in New Zealand
- Survey of *Salmonella* Contamination of Retail Eggs

3.1 Incorporation of Risk Models for *Campylobacter* in Poultry and Red Meat into the Comparative Exposure Model

The goal of this project is to assist risk management of campylobacteriosis in New Zealand by contributing to the assessment of the relative importance of exposure sources. The objective was to integrate existing ESR models for *Campylobacter* in poultry and red meat into a comparative exposure model in order to increase the rigour of the comparative assessment.

During the period 2004-2006 ESR developed two quantitative risk models assessing the exposure of New Zealanders to *Campylobacter,* one each for poultry and red meat. The comparative exposure model is a preliminary version developed by the Modelling Group of the Enteric Zoonotic Diseases Scientific Steering Committee. This model iteratively allows a variety of exposures (animal faeces, undercooked poultry or red meat, cross contamination from poultry or red meat, three types of drinking water, freshwater during recreational activity) to occur according to the estimated probability of their occurrence.

The relatively simple modelling approach taken in the food parts of the comparative exposure model was refined using data and approaches derived from the poultry and red meat models. These changes to the preliminary comparative exposure model have markedly reduced the estimated number of exposures resulting in infection from both cross contamination from poultry, and from undercooking of poultry.

Untreated and poorly treated drinking water, along with recreational swimming, have gained in relative importance as a result of these changes.

While the changes made to the model should make estimates of consumer exposure to *Campylobacter* via poultry and red meat more certain, other exposure routes in the model need similar attention before reasonable conclusions can be drawn. Improvements to the modelling of the other channels are planned for the CDRP funded project "*Campylobacter* in food and the environment, examining the link with public health" scheduled to commence in July 2007.

Lake R, Bayne G. (2007) Comparative exposure model: Incorporation of Campylobacter *in poultry and red meat. ESR Client Report FW0734. Christchurch: ESR.*

3.2 On-farm Risk Factors for *Campylobacter* Contamination of Poultry

The project had two components during the 2006-2007 year; an initial review of the literature related to on-farm risk factors for *Campylobacter*, and an assessment of risk factors on a sample of New Zealand broiler farms.

Literature Review

The literature review was intended to contribute to the identification of on-farm risk factors for *Campylobacter* contamination of poultry flocks in New Zealand, that offer opportunities for risk management. The preparation of this report was followed by farm visits during early 2007.

The literature review covers three topics:

1. Review of the scientific literature regarding on-farm risk factors for *Campylobacter* infection in broilers.
2. Overview of broiler farming in New Zealand, a national perspective collated from information supplied by major poultry producers.
3. Review of biosecurity material in production manuals from the four major New Zealand poultry producers, with respect to *Campylobacter* control.

This review indicates that *Campylobacter* infection in broilers may have multiple sources, and identifying ways of preventing such infection may be difficult. Vertical transmission appears unlikely to be important, while thinning practices appear to be worthy of further investigation, despite not being identified as a risk factor in a New Zealand case control study. All New Zealand broiler farms practice thinning.

The broiler information supplied by industry on a farm-by-farm basis suggest areas for further examination during farm visits. Many farms have their own water bore or well, which may be affected by ground water quality, particularly as chlorination does not always seem to be effective. A majority of farms have other livestock either on the broiler farm or adjacent farms. Almost all farms have multiple sheds. The geographical location of broiler farms can be compared with other data relevant to *Campylobacter*, such as groundwater or freshwater contamination.

The information in this report is a first step towards identifying risk factors for *Campylobacter* contamination in broiler on farms in New Zealand. This project will now augment this information with further data from industry sources and farm visits.

Objective 3 of this project compared the biosecurity practices and procedures documented by the companies with specific reference to those procedures considered important for *Campylobacter* control.

The company biosecurity manuals vary in their detail and what they cover. Two of the companies have very comprehensive manuals and one company has a very brief manual. No attempt has been made to assess the efficacy of the procedures in the manuals or how well they are implemented.

Most of the biosecurity issues that have been identified in various reviews have been included to some degree or another in the manuals of three of the companies. In reviewing the literature nothing new or innovative has been identified that isn't covered to some degree in one or other of the company's manuals. The one exception to this is recent work on fly control in Denmark

Overseas studies emphasise that good biosecurity will reduce the prevalence in the off peak season, but biosecurity alone will not guarantee freedom nor does it seem particularly effective during the peak season.

Survey of Broiler Farms

The survey of broiler farms was not complete at the time of publication of the current report. A summary of this study will be included in the 2007-2008 Annual Report.

Hudson JA, Cressey P, Lake R, Marks D, Tebje-Kelly J. (2007) On-farm factors for Campylobacter *contamination of broilers: Literature review and overview of broiler farming and biosecurity in New Zealand. ESR Client Report FW0679. Christchurch: ESR.*

Lake R, Paulin S, Marks D, Tebje-Kelly J. (2007) On-farm factors for Campylobacter *contamination of broilers: Survey of broiler farms in New Zealand. ESR Client Report FW0767. Christchurch: ESR.*

3.3 Secondary Processing of Poultry

The *Campylobacter* in poultry quantitative risk model developed by ESR from 2004 – 2006 predicts a contamination prevalence at the retail level that is lower than results derived from surveys of contamination in retail poultry. It was suggested that this may be due to two possible causes:

- That the prevalence of infected flocks was higher than the 34% estimate available at the time of the model construction; or
- That cross contamination of bacteria between poultry carcasses and portions during secondary processing plays a more important role than had been incorporated into the model.

The secondary processing of poultry report describes improvements made to the quantitative risk model for *Campylobacter* in poultry. The focus is on the secondary processing of poultry carcasses to the point of retail sale to domestic or food service users.

Campylobacter prevalence data at entry to primary processing and count data at the end of primary processing has been made available from the poultry industry for the period December 2006 to February 2007. The flock prevalence entering primary processing was 77% compared to the 34% that was used to generate results from the 2006 risk model. Using a higher flock prevalence estimate, the primary processing model does appear to predict contamination prevalence and counts at the end of the spin chiller with reasonable accuracy.

ESR staff have visited secondary processing plants to observe practices used during processing. From these observations three key changes have been incorporated in the secondary processing module of the model:

1. The proportion of product that can be considered to be cooked by the production sector before purchase has been included in the model. This proportion of product will have little or no risk of *Campylobacter* contamination and so will ameliorate the overall risk in the poultry food chain.
2. The potential for cross contamination during secondary processing has been increased compared to the original model by allowing some of the carcasses that in the previous model were protected from contamination ("population 1") to become contaminated.

3. Cross contamination during secondary processing is now modelled as an overall change in numbers and prevalence due to movement of bacteria, instead of attempting to model the multiplicity of single and multi-step physical processes where cross contamination may occur. Input parameters can be changed should better information on transfer occurrence and rates become available.

The information in this report indicates that the flock prevalence used as a primary input into the model is linearly related to the predicted prevalence of contamination at the end of the chiller. This results from the way in which cross contamination during primary processing has been modelled i.e. cross contamination affects a relatively small proportion of carcasses. Using the higher figures for flock prevalence (approximately 70%), as derived from data supplied by PIANZ, the post-chiller prevalence of contamination is similar to that observed in both the PIANZ data and studies of retail poultry meat. This suggests that cross contamination during secondary processing has a less dramatic effect on the prevalence of contamination at retail than the flock prevalence entering primary processing.

The predicted numbers of bacteria on contaminated carcasses post-chill predicted by the model is now in good agreement with the new data from PIANZ.

A number of opportunities to improve the secondary processing module have been identified. Given the complexity of this part of the food chain, involving a wide variety of products and processes, it could be argued that detailed modelling of individual elements within the secondary processing module is not pursued to a great extent.

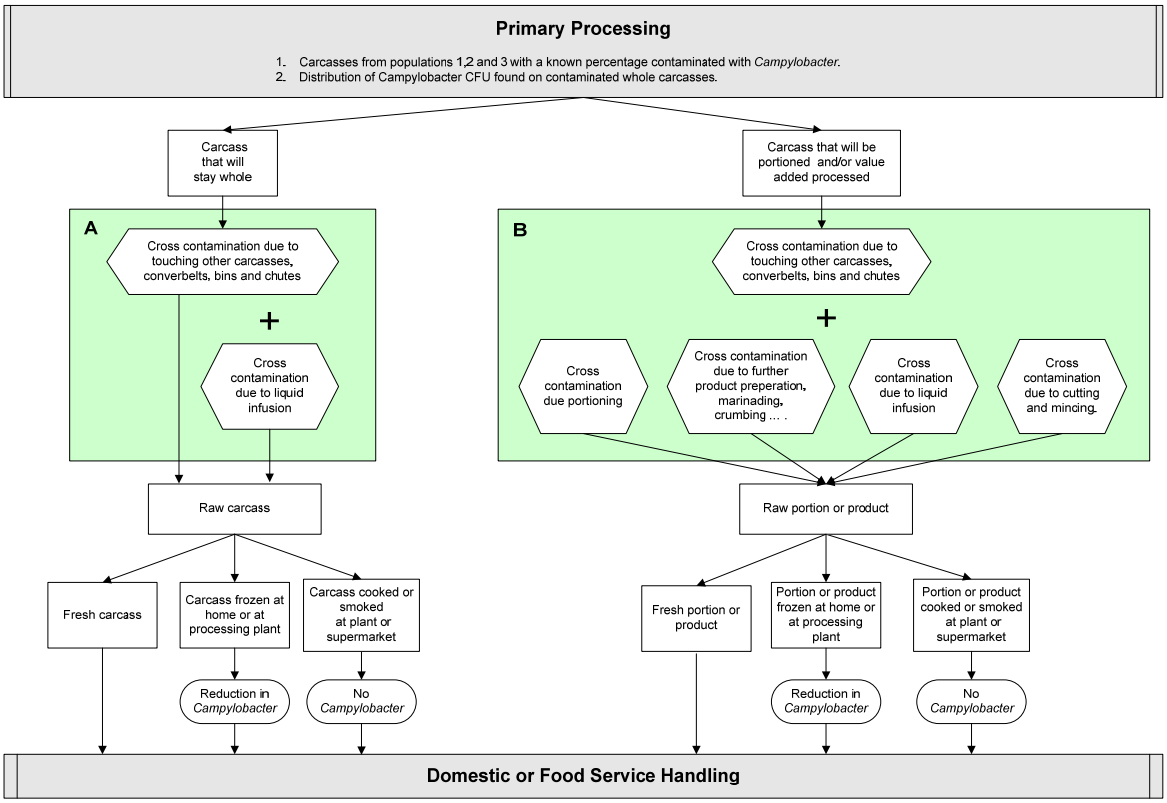
The changes in the model during this project have caused a small increase in the predicted numbers of cases of illness compared to the previous version. Although the two versions of the model should not be compared in detail, the overall conclusion from this revised model remains the same as before - that the predicted numbers of illnesses from transmission of *Campylobacter* in poultry in New Zealand are a significant proportion of the estimated burden of illness.

Addendum

Updated information from PIANZ on product channels including the proportion of birds that are rotisserie cooked at supermarkets became available after completion of this report. Rotisserie birds represent 8% of all chicken production. Assuming that these birds are cooked properly, and thus do not contribute to the risk of exposure, means that the number of predicted illnesses is reduced by approximately 8%. The inclusion of this additional information does not change the overall conclusions of this report.

Lake RJ, Horn B, McIntyre L. (2007) Secondary processing of poultry: Effect on Campylobacter *contamination. ESR Client Report FW0750. Christchurch: ESR.*

Figure 1: Model structure for secondary processing of poultry



3.4 Potential Re-growth of *Salmonella* from Contaminated Pet Chews

The aim of this project was to investigate the potential for *Salmonella* transfer from contaminated pet chews to a handler's hand and re-growth of *Salmonella* on pet chews moistened with artificial dog saliva.

Sixteen packs of *Salmonella* contaminated pet chews from a previous study were used to conduct the hand transfer and re-growth experiments. Dynabeads® anti-*Salmonella* was used to concentrate *Salmonella* cells from pre-enriched culture followed by selective enrichment and plating to determine the presence/absence of *Salmonella*. *Salmonella* was enumerated by direct spread plating of rinsate. Transfer of <10 CFU of *Salmonella* by hand was demonstrated in one sample. Re-growth of *Salmonella* on pet chews was not observed after re-hydration for up to 72 hours with artificial dog saliva electrolyte. The pH of the electrolyte (9.78) is sufficiently high that it could be inhibiting the re-growth of *Salmonella*. Counts of <2 to 300 CFU of *Salmonella* were enumerated from the moistened pet chews. *Salmonella* survived for at least 279 days on some pet chews.

It was concluded that contaminated pet chews can transfer *Salmonella* cells to a person's hand but salmonellae are unlikely to grow over time on pet chews moistened with dog saliva electrolyte. While dog saliva may inhibits growth of *Salmonella* on partially eaten pet chews, *Salmonella* could survive and be ingested by pets as well as transferred to a person's hand when feeding pets.

Wong TL. (2007) Salmonella *from pet chews: Transmission by hand and potential re-growth following rehydration with artificial dog saliva. ESR Client Report FW0781. Christchurch: ESR.*

3.5 Review of Notified Salmonellosis Outbreak Data as a Source of Information for Attribution

Accumulated information on outbreaks of a particular illness provides one means of assigning attribution i.e. identifying sources and vehicles of infection, and their relative importance. In New Zealand, outbreaks of many infectious illnesses are reported by public health units via the notifiable diseases reporting system, and collated by a dedicated module of the EpiSurv database administered by ESR.

Salmonellosis is a notifiable disease in New Zealand. During 2005 there were 1,383 notified cases of salmonellosis, and most isolates were *S.* Typhimurium (ESR, 2006). The number of reported outbreaks of this illness are generally between 25 and 35 per year. Between September 1997 and December 2006 there were a total of 251 outbreaks associated with *Salmonella* recorded in EpiSurv, involving 1,601 confirmed or probable cases. This data set represents an opportunity to identify sources of *Salmonella* infections in New Zealand, and has been analysed for attribution purposes in this report.

The proportion of New Zealand outbreaks of salmonellosis for which there is strong evidence to identify a source or vehicle (28/251, 11.1%) is lower than for outbreaks in the UK. The proportion is similar to outbreaks investigated in Sweden, but these were not specifically outbreaks of salmonellosis. The strength of evidence for associating US outbreaks with vehicles in an analysis of CDC (US Centers for Disease Control and Prevention) data by CSPI (Center for Science in the Public Interest) is unknown. Eggs are a commonly identified vehicle for *Salmonella* outbreaks overseas, however *Salmonella* types associated with eggs are not endemic in New Zealand.

For the outbreaks where a type is identified, *S*. Typhimurium is by far the most common type. There were 15 outbreaks involving *S*. Typhi or *S*. Paratyphi during the time period 1997 - 2006. The suspected modes of transmission for 6 of these outbreaks involved overseas travel and infection was apparently acquired outside New Zealand. Person-to-person transmission was reported for a further four of these outbreaks.

The information provided in outbreak records appears reasonably complete, although in many instances the vehicle and mode of transmission information is suspected rather than confirmed. For nearly half the outbreaks a serovar or phage type is not currently recorded, and more complete information of this type would enhance the data considerably.

The numbers of people involved in salmonellosis outbreaks in New Zealand are generally small (average of 6 confirmed or probable cases per outbreak). The most commonly reported setting is the household, followed by food vendors and events. Foodborne is the most commonly reported mode of transmission, and the available evidence is most often "strong" for outbreaks associated with foodborne transmission. Despite evidence that foodborne transmission is important, the wide variety of suspected foods makes attributing risk very difficult. This is also the case for the outbreaks in which a vehicle has been identified from "strong" evidence.

For risk attribution and management, the most useful signal from this analysis appears to be the importance of infected food handlers. These were identified in 12 of the 28 outbreaks in which there was reasonable evidence to indicate a source. All but one of these 12 outbreaks occurred in a food vendor or event setting.

Overall, the picture that emerges for salmonellosis outbreaks is that the etiology is hugely varied, although foodborne transmission is suggested for 40% of outbreaks, amongst which infected food handlers account for perhaps half of these.

King N, Lake R. (2007) Review of notified salmonellosis outbreak data as a source of information for attribution. ESR Client Report FW06114. Christchurch: ESR.

3.6 Domestic Food Handling

A significant proportion of foodborne illness is thought to be caused by unsafe food handling practices in the home. This project was initiated to provide information on domestic handling of meat and poultry in New Zealand. The information is needed to support risk management by the New Zealand Food Safety Authority, particularly the development of quantitative risk models to assess potential interventions. The project was begun in 2004 - 2005.

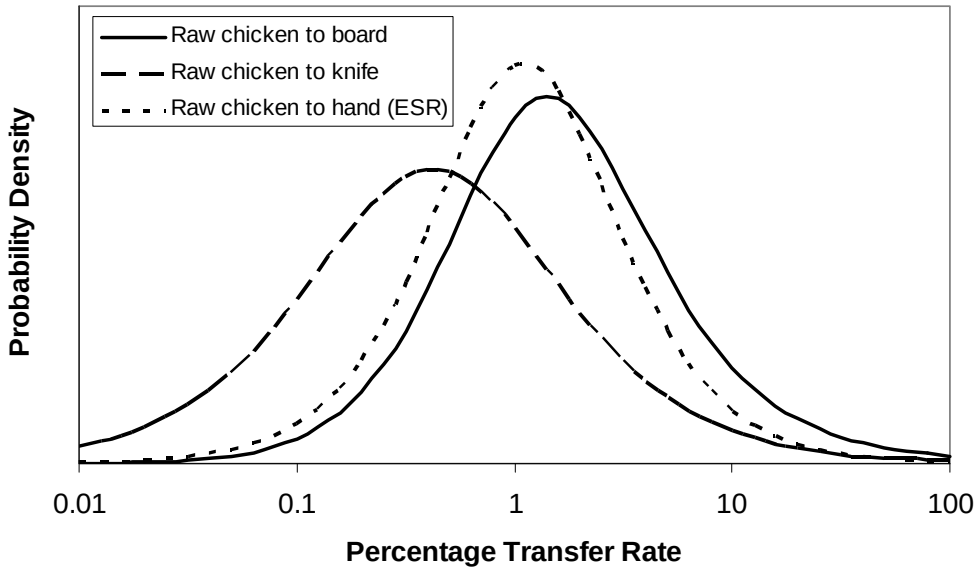
The principal components of the project carried out during 2006-2007 were:

- Project scoping meeting with NZFSA on 9 August 2006, followed by provision of protocols of transfer rate experiments for NZFSA review;
- Provision of information to the Foodsafe Partnership and NZFSA about transport temperatures for meat and poultry;
- Further transfer rate experiments for *Campylobacter* from poultry to surfaces and secondary foods (two experimental series);
- Transfer rate experiments for *Campylobacter* from poultry to surfaces in the barbecue situation; and,
- Transfer rate experiments for *Salmonella* from poultry to surfaces in the barbecue situation.

The transfer rate experiments provide information on the likelihood of bacterial transfer, and when it does occur, a distribution for the percentage of bacteria transferred. Typical distribution curves are shown in Figure 2. The data are obtained from replicate experiments by several different operators, to simulate the variability for these processes in the general population. Results are presented for individual steps, as well as overall multi-step processes that may result in ingestion of cells.

A small number of transfer rate experiments have shown that, while the average transfer rates of *Campylobacter* are low, high rates of transfer do occur. Despite low average transfer rates for individual step, cross contamination from poultry via single or two step processes can result in the ingestion of cells, leading to a risk of infection. These results will help to better quantify the risk of cross contamination in the domestic kitchen.

Figure 2: Distributions of transfer rates for *Campylobacter* from raw chicken to hands, plastic chopping board or knife.



Wong TL, Gilbert S, Lake R, Horn B. (2007) Domestic food practices in New Zealand. 2006-2007 project report. ESR Client Report FW0740. Christchurch: ESR.

3.7 Bakery Products - Microbiological Quality

From January to April 2007, 126 bakery products were collected by Health Protection Officers and submitted to ESR for microbiological analysis. Another 124 bakery products were collected in June and July 2007. Of these, 126 samples were cream-filled, 120 were custard-filled and 4 contained both cream and custard. Fifty samples were collected from Auckland, 52 from each of Wellington and Christchurch and 48 samples were collected from each of Hamilton and Dunedin. All samples were analysed for faecal coliforms, *Escherichia coli*, *Bacillus cereus*, coagulase-positive staphylococci and *Salmonella*. Most (245 and 249) samples were also tested for pH and water activity respectively.

When compared with limits listed in 'Guidelines for the Microbiological Examination of Ready-to-eat Foods' (Food Standards Australia New Zealand, 2001), 217 of the 250 samples (87%) were considered to be of good microbiological quality with acceptable levels of *E. coli, B. cereus*, coagulase-positive staphylococci and *Salmonella* spp. Of the remaining 33 samples, 24 were of marginal quality, 6 were unsatisfactory and three were potentially infectious. All samples had water activities of at least 0.98. There was no significant difference between the summer and winter results for most analytes but there were significant differences, at the 95% level, for faecal coliforms in cream-filled products and *B. cereus* in custard-filled products. Most (88%) samples had pH values ≥6.0.

Cream- and custard-filled products had similar proportions of samples of satisfactory microbiological quality. Dunedin had the highest rate of satisfactory results followed by Auckland, Wellington and Hamilton. Christchurch had the lowest rate of satisfactory results.

Compared to two UK surveys involving much larger sample numbers, New Zealand has higher rates of unacceptable *B. cereus* results, higher rate of unacceptable staphylococci results, similar rates of unacceptable *E. coli* results in cream-filled products and lower rates of unacceptable *E. coli* in custard-filled products.

Cornelius A. (2007) Bakery products: Microbiological quality (Summer). ESR Client Report FW0736. Christchurch: ESR.

Cornelius A. (2007) Bakery products: Microbiological quality. ESR Client Report FW0786. Christchurch: ESR.

3.8 Growth of *L. monocytogenes* in Refrigerated Foods under Non-static Temperature Conditions

This project encountered some technical problems and is still being completed. A summary of this study will be included in the 2007-2008 Annual Report.

3.9 L. Mono in RTE Salads - Exposure Assessment to *Listeria monocytogenes* via Deli Ready-to-eat Salads (with Dressings)

A national quantitative survey of *Listeria monocytogenes* and other *Listeria* species in ready-to-eat (RTE) salads (with dressings) from retail outlets was undertaken in New Zealand from February 2006 to February 2007. The aim was to determine:

- The prevalence, numbers and genotypes of this pathogen in RTE salads;
- Whether pH and temperature hurdles are adequate in controlling listerial growth in the salads; and
- The management of shelf life of salads by suppliers and retailers.

Three hundred and two RTE salad samples were purchased from four main cities in New Zealand (Auckland, Wellington, Christchurch and Dunedin). RTE salads included bean, pasta, potato, pulse/seed, rice, seafood-based, coleslaw and miscellaneous (other salad varieties containing dressing from the delicatessen retail outlets that did not fit with the described designations). Salads under the various designations may also contain small amounts of cooked meats, cooked eggs, spices and fresh herbs.

All salads were enriched in buffered *Listeria* selective broth and screened for presence of *Listeria* spp. on PALCAM and ALOA solid media. *Listeria* spp were enumerated by spread plating sample homogenate onto PALCAM agar. The prevalence of *Listeria* spp. in RTE salads was 7.0% (95% confidence interval, 4.6 – 10.8) of which 4.6% (2.6 - 7.7) were contaminated with *Listeria monocytogenes.* One sample of coleslaw contained 100 CFU g^{-1} of *L. monocytogenes* while another contained 30 CFU g^{-1}. The remaining twelve samples produced a <10 CFU g^{-1} count of *L. monocytogenes*. Samples positive for other *Listeria* spp. also had a <10 CFU g^{-1} count.

Genotyping of the *L. monocytogenes* isolates by PFGE using two restriction enzymes, *Asc*I and *Apa*I, showed three patterns from the RTE salads were indistinguishable from human non-perinatal *L. monocytogenes* isolates archived in PulseNet Aotearoa. The PFGE patterns also showed that one salad producer could have one genotype that has colonised in its plant. Cross-contamination by a delicatessen was also demonstrated.

Temperature and pH hurdles recorded from the salads showed that these parameters were only partially adequate (using a temperature of 5ºC and pH 4.6 as hurdle references) in controlling *Listeria* spp. from growing in RTE salads over the shelf life at retail. Better control of these hurdles by the suppliers and the retailers could assist in preventing the potential re-growth of *Listeria* spp. in RTE salads.

Information gathered indicated that the shelf life of most salads on display was for 1-2 days, but expiry dates on bulk salad packages suggested that the shelf-life recommended by suppliers could stretch up to 24 days for certain salad varieties. This is acceptable provided the pH is optimally controlled, i.e. ≤ pH 4.6. Therefore any failure to control the hurdles adequately at retail and in the home of the consumer would be compounded by the extended shelf life of most salads from the date of manufacture.

The data gathered in this study will be useful for any future revision of the *L. monocytogenes* in RTE salads risk profile. A regulatory decision to feed back information to the RTE salad supplier and retailer sectors could also improve the hurdle control needed to prevent potential *Listeria* regrowth in salads.

Wong TL. (2007) Prevalence of Listeria monocytogenes *and other* Listeria *species in ready-to-eat salads (with dressings) from retail outlets in New Zealand. ESR Client Report FW0749. Christchurch: ESR.*

3.10 Murine Norovirus (MNV-1) – a Suitable Surrogate for Human Norovirus?

The objective of this study was to determine the heat stability of murine norovirus (MuNoV) at commercial heat processing temperatures (63^{o}C and 72^{o}C), and compare the results with those for hepatitis A virus (HAV). Viruses were tested in both water and a proteinaceous matrix (whole milk) to determine whether the protein would protect virus from heat inactivation. Samples were taken at time intervals up to 10 min. Results were obtained by both culture and real time RT-PCR for both viruses. Human Norovirus (HuNoV) GI and GII strains were also included in the experiments and were assayed by real-time RT-PCR. Culture results were compared with the real-time PCR results obtained for HAV and MuNoV. It was not possible to deduce the effect of heating on HuNoV infectivity.

MuNoV and HAV showed similar reductions in infectivity over time. Until robust methods for determination of HuNoV infectivity are developed, it will not be possible to measure or compare the effectiveness of other HuNoV surrogates. However, HuNoV GI and GII strains showed lower log reductions in RT-PCR titre following heat treatment than either MuNoV or HAV, which may indicate that these viruses are less susceptible to heat than either HAV or MuNoV. No significant protective effect was observed for any virus when exposed to heat in a milk matrix. No differences in heat tolerance were observed between MuNoV or HAV. We concluded that, for heat inactivation studies at 63^{o}C and 72^{o}C, MuNoV was as suitable as HAV as a surrogate for HuNoV. Our recommendation from this study was that the potential of murine norovirus (MuNoV) as a surrogate for human norovirus (HuNoV) should be further investigated to determine its properties when exposed to parameters such as drying, disinfection and UV and also when in a shellfish matrix.

Greening GE.(2006) Viruses used as surrogates for norovirus. Review paper. ESR Client Report FW06102. Keneperu: ESR.

Hewitt J, Greening GE (2007). Murine norovirus (MuNoV) - a suitable surrogate for norovirus, ESR Client Report FW0768. Keneperu: ESR.

3.11 Norovirus Detection in Shellfish

IANZ auditors audited the Norovirus detection in shellfish method and the ESR Environmental and Food Virology Laboratory staff and procedures in February 2007. Three Corrective Action Reports (CARs) and a few recommendations were recorded. These have been addressed by ESR, and subsequently accepted and cleared by IANZ. The relevant IANZ Committee and the IANZ Board have approved the accreditation. The Laboratory has been awarded IANZ accreditation for Norovirus and is now awaiting certification.

From 1 July 2006 to 30 June 2007, 36 shellfish samples were submitted to ESR and tested for norovirus using the IANZ accredited ESR method. This method includes dissection of shellfish digestive gland tissue followed by a proteinase K digestion step, extraction of viral RNA from the tissue digest and analysis of the RNA in separate norovirus-specific GI and GII real-time RT-PCR assays. The methodology has been described elsewhere (Greening & Hewitt, 2006.) The 36 samples received during the 12 month period were sourced from New Zealand (13), Korea (13) and Australia (10). Of these, 8 samples were associated directly with outbreaks, and 7/8 of these were imported from Korea. The other outbreak-related sample submitted to ESR was mussels from New Zealand, which tested negative for norovirus. A further 6 samples from Korea were submitted in association with norovirus outbreak investigations. Other non-outbreak related samples were submitted for environmental surveillance.

A total of 19/36 (53%) were positive and 17/36 (47%) samples were negative for either GI and/or GII norovirus. No samples were positive for NV GI only, 8 samples (22%) were positive for NV GII only and 11 samples (11/36, 31%) were positive for both norovirus GI and GII.

Quantitation calculations were carried out using calibration curves to convert the average Ct values from the four replicates analysed per norovirus genogroup to counts of viral copies. Samples from Korea had levels of NV GII ranging between 91-219 RTPCRU copies/gram, whilst the New Zealand shellfish had levels between 154-3652 RTPCRU/gram, which equates to approx 10^2 and 10^2-10^3 NV copies per g of gut from oyster and tuatua respectively (approx 1 g gut per sample). Other samples with 2 or less replicates testing positive for norovirus were considered to have norovirus levels too low to provide meaningful quantification.

Greening GE, Hewitt J. (2006) Improved methods for recovery and detection of norovirus in shellfish and foods. NZFSA analytical development: Validation Report. ESR Client Report FW0653. Keneperu: ESR.

3.12 Pasteurisation Risk Model

The NZFSA is in the process of defining the level of consumer safety currently provided by pasteurisation of milk in New Zealand, as part of a risk assessment project that will facilitate the introduction of new dairy technologies and processes. The risk assessment work will also identiify a baseline level of consumer protection against which dairy products made from raw milk ingredients can be assessed.

ESR is contributing to this risk model. In 2006-2007, expansions and improvements included an increased range of microbial hazards with associated growth and dose/response models (with the exception of *Yersinia enterocolitica*, for which no dose/response model exists).

In the model, an initial temperature and number of bacteria present are assigned. The growth potential of hazards in the foods is considered during transport home from the point of purchase and during refrigerated storage in the home. The number of bacteria in the food at consumption is combined with serving size data to estimate exposure. Dose-response relationships translate the exposure into estimated numbers of cases.

Lake R, Bayne G, Hudson JA, Cressey P. (2007) Pasteurisation risk model: Development of domestic consumption model 2006-2007. ESR Client Report FW0718. Christchurch: ESR.

3.13 Vibrio parahaemolyticus and Vibrio vulnificus in North Island Commercially Harvested Oysters (Crassostrea gigas)

Vibrio parahaemolyticus and *V. vulnificus* are natural inhabitants of inshore marine waters and can contaminate seafood. They grow when temperatures are between 8 and 43°C. *V. parahaemolyticus* can only grow when the NaCl concentration is between 0.5 and 10%. *V. vulnificus* has a narrower range for growth of 0.5 to 5% NaCl. Temperatures below 5°C have been shown to kill *V. parahaemolyticus* but *V. vulnificus* appears to have more variable sensitivity to low temperatures. The presence and density of *V. parahaemolyticus* and *V. vulnificus* in coastal waters and oysters is dependent on the combination of temperature and salinity. Similarly, outbreaks of infection caused by *V. parahaemolyticus* and *V. vulnificus* coincide with environmental conditions that are conducive to the growth of these pathogens. From overseas studies it appears that the increased incidence of infections caused by *V. parahaemolyticus* and *V. vulnificus* relate to climate change rather than adaptation. The emergence of pandemic strains, such as *V. parahaemolyticus* O3:K6, may be contributing to higher hospitalisation rates although there is no evidence in the literature that these strains can cause illness more frequently at lower doses.

The goal of the project was to adapt the *V. parahaemolyticus* multiplex real-time PCR developed by the US FDA for use in New Zealand. This PCR detects the *Tlh* gene, which is present in all *V. parahaemolyticus* isolates, *Tdh* and *Trh* genes, which are associated with potentially pathogenic isolates, and an internal control. It was initially hoped that two multiplex real-time PCR could be developed that collectively detected the three *V. parahaemolyticus* genes, the internal control and the *V. vulnificus* specific gene *VvhA*. However, that was not possible and four separate real-time PCR reactions (without any internal control) were found to be required. The primer and probe sets produced the desired real-time PCR results for the twelve *Vibrio* strains tested. Some non-specific products were seen when conventional PCR was used.

In an experiment designed to establish the sensitivity of the entire enrichment, PCR and culture method, *V. parahaemolyticus* was detected by PCR, and isolated by culture, from all tubes regardless of the inoculum. This indicated that the oysters used for the experiment contained >11 MPN/g naturally occurring *V. parahaemolyticus*. Information on the sensitivity of the entire method for *V. parahaemolyticus* is therefore not available. The enrichment and *V. vulnificus* real-time and conventional PCR methods produced comparable MPN results to the CFU added before enrichment but the culture step was found to be less sensitive. It was also noted in this experiment that the PCR and/or enrichment were suppressed when 10 g of oyster homogenate was used.

Naturally occurring *V. parahaemolyticus* was also detected in all PCR tubes and almost all culture tubes in a second experiment which investigated the sensitivity of the PCR and culture steps. The pattern of positive PCR results suggests that meaningful results were still available for *Tdh* and *VvhA*. The real-time PCR of these targets have sensitivities of as few as 84 and 1.9×10^2 CFU per PCR respectively. Conventional PCR tests were less sensitive with many of the tubes positive by real-time PCR producing negative results by conventional PCR. No *V. vulnificus* was isolated in this experiment indicating a culture sensitivity of greater than 9.5×10^2 CFU per plate. These real-time PCR and culture results are acceptable given that higher target bacterial numbers would be expected after enrichment.

A multiple tube enrichment, real-time PCR and culture method is under development for enumerating *V. parahaemolyticus* and *V. vulnificus* from oysters. Additional work to confirm the sensitivity of the *Tlh* and *Trh* real-time PCR and the entire *V. parahaemolyticus* enrichment, real-time PCR and culture method will be carried out in the second year of the project. This project has demonstrated that potentially pathogenic *V. parahaemolyticus* are present naturally in New Zealand oysters.

Cornelius A. (2007) Vibrio parahaemolyticus *and* Vibrio vulnificus *in North Island Commercially Harvested Oysters (*Crassostrea gigas*). (Interim Report). ESR Client Report FW0766. Christchurch: ESR.*

3.14 VNC - Resuscitation of Putative Viable but Non-culturable Foodborne Bacteria of Significance to New Zealand

Viable non-culturable (VNC) cells have been established for *Salmonella*, *Listeria*, *Campylobacter* and *E.coli* 0157:H7 in microcosms containing 13% NaCl. This saline environment mimics a state in which the organism would be under physiological stress from desiccation. The length of time taken for the microcosms to become VNC is temperature dependent.

Several resuscitation methods have been tested on VNC microcosms of *E.coli* 0157:H7, *Listeria*, and *Salmonella*. None of these has been successful in restoring culturability to VNC cells. Ongoing work will focus on evaluation of a range of other resuscitation methods.

1. ***Establishing viable non-culturable cells in microcosms***

VNC cells have been generated in 13% NaCl microcosms (Makino *et al*., 2000) for the following bacterial species: *E. coli* O157:H7 (NZRM 3647),

S. Typhimurium (NZRM 3970),
S. Brandenburg (NZRM 3684),
L. monocytogenes (NZRM 3450 & outbreak strain 2000/47),
C. jejuni (Massey strains P145A and P110B).

Microcosms incubated at 37°C generated VNCs the fastest (within days), followed by incubation at room temperature (within weeks), and then followed by incubation at 4°C (within months). For future recovery experiments, VNCs will be generated in 13% NaCl at 37°C and at room temperature.

A BacLight fluorescent live/dead staining assay (Invitrogen) was used in conjunction with plate counting as the method to determine that microcosms had become VNC.

2. ***Monitoring VNC by Q-PCR***

Treatment of cultures with propidium monoazide (PMA) prior to Q-PCR is a published method for distinguishing viable cell numbers from total bacterial cell numbers in a culture (Nocker *et al*., 2006). The PMA methodology using naked DNA as well as isopropanol-killed bacteria gave similar results to those found in Nocker *et al*. (2006). The PMA method removes a large portion, but does not completely remove exposed DNA (either naked or from isopropanol-killed bacteria). Therefore, the method is not appropriate for quantifying VNC.

It was decided to discontinue molecular methods for monitoring VNC and non-molecular methods of plate counting and BacLight fluorescent live/dead staining will be used in future experiments.

3. ***Recovery of viable non-culturable cells in microcosms by heat shock***

E. coli O157:H7, *S.* Typhimurium, *S.* Brandenburg and *L. monocytogenes* VNC cells generated in 13% NaCl microcosms were subjected to 55°C and 80°C heat shocks (Gupte *et al*., 2003). Heat shocks at 55°C and 80°C did not resuscitate these VNCs.

4. ***Alternative recovery methods for viable non-culturable cells***

The following alternative recovery methods were also attempted with *E. coli* O157:H7, *S.* Typhimurium and *S.* Brandenburg:

1) Recovery in minimal medium (M9; Wong *et al*. 2004))
2) Recovery in rich medium (Columbia blood)
3) Recovery on soft agar
4) Recovery in a microaerophillic environment (Reissbrodt *et al*. 2002)
5) Recovery with an antioxidant (sodium pyruvate; Reissbrodt *et al*. 2000)

Of the above, only sodium pyruvate was successful at improving culturability. At best, 5-fold more bacteria were recovered on plates supplemented with sodium pyruvate. This small improvement in culturability more likely reflects enhanced culturability of injured cells and not recovery of VNCs.

5. ***Future recovery methods to be tested for viable non-culturable cells***

The following alternative recovery methods will be attempted with VNCs of *E. coli* O157:H7, *S.* Typhimurium, *S.* Brandenburg, *L. monocytogenes and C. jejuni*:

1) Recovery with a siderophore (Ferrioxamine E; Reissbrodt *et al*. 2000)
2) Recovery in a low oxygen tension environment (Oxyrase; Reissbrodt *et al*. 2002)
3) Recovery by cell wall cleavage (lysozyme; Keep *et al*. 2006)
4) Recovery with an enterobacteraciae-produced autoinducer (Baxcell/Bugro; Reissbrodt *et al*. 2002, Voigt *et al*. 2006)
5) Recovery after treatment in an acid environment (to mimic the gut)

3.15 Yersinia in Meat: Analytical Development and Survey

The agreed 2006–2007 work plan for *Yersinia* was subject to a number of variations, primarily due to a previously unencountered PCR methodology issue, which produced false-negative results for the preliminary detection of *Y. enterocolitica* in several bulk enrichment broths. This necessitated the temporary discontinuation of the survey to investigate the issue further. Subsequent work to improve sample quality (ultimately achieved by the inclusion of a sample clean-up step using a commercially available DNA purification kit) eliminated this problem.

During the second half of the year reprioritisation resulted in a switch in activities to the validation of a raw milk PCR method for *Y. enterocolitica* to support a national raw milk survey. The method was satisfactorily validated for raw milk.

A paper based on previous development of the PCR method was prepared and submitted to the International Journal of Food Microbiology for publication. This has subsequently been accepted subject to minor corrections.

Detection, isolation and enumeration of *Yersinia enterocolitica* on raw pork

The methods available for the isolation of *Yersinia enterocolitica* from foods are generally considered to less than optimal. We describe here an improved method for the detection and enumeration of *Y. enterocolitica* containing the pYV virulence plasmid (*Ye*P+) in meat. The method uses a multiplex PCR targeting the *ail* and *virF* genes to with the PCR detecting *Y. enterocolitica*-containing tubes after enrichment. Enumeration was achieved using the most-probable number (MPN) method. A presumptive result was available within 24 h of sample receipt, and *Ye*P+ isolates confirmed within four days. The presence/absence and MPN methods were evaluated in a pilot survey of 34 raw pork meats purchased from retail outlets in Christchurch, New Zealand. *Ye*P+ was detected by PCR on 32%, and *Ye*P+ isolates obtained from 18% of these samples. *Ye*P+ were present at densities ranging from 0.30 to 5.42 MPN/cm^2. This improved method for the detection and enumeration of *Ye*P+ from meat samples will be used by us in more extensive microbiological surveys to provide data for exposure assessment, and is amenable for use in outbreak investigations.

Hudson JA, King NJ, Cornelius AJ, Bigwood T, Thom K, Monson S. (2007) Detection, isolation and enumeration of Yersinia enterocolitica *on raw pork. International Journal of Food Microbiology (in press).*

3.16 PulseNet Aotearoa (New Zealand) - Implementation and Optimisation

Fifty (50) *Campylobacter* isolates collected by Massey University during epidemiological studies part-funded by NZFSA have been analysed using *Sma*I and *Kpn*I according to standard PulseNet protocols. These 50 isolates can be differentiated into 34 different *Sma*I types and 44 different *Kpn*I types. Five pairs of isolates have indistinguishable *Sma*I:*Kpn*I types.

The PulseNet Aotearoa (New Zealand) *Campylobacter* database contains 1921 isolates from human (555, 29%), bovine (307, 16%), poultry (466, 24%), ovine (264, 14%), environmental (172, 9.0%), wild life (72, 3.7%), porcine (34, 1.8%), cooked meat (1, 0.05%), and unknown (50, 2.6%) sources. There are 33 serotype complexes, 286 *Sma*I types and 358 *Kpn*I types recorded in the database. Of the 1921 isolates 1488 have been analysed using Penner serotyping, 1868 by *Sma*I PFGE typing and 1005 by *Kpn*I PFGE typing. Penner serotyping has the highest rate of untypable isolates (11%) followed by *Kpn*I (2.6%) and *Sma*I (1.0%) PFGE typing. *Kpn*I PFGE typing has the highest diversity index (0.37) followed by *Sma*I PFGE typing (0.15) and Penner serotyping (0.025).

The PulseNet Aotearoa (New Zealand) STEC database contains 729 isolates; 401 (55%) were isolated from humans, 311 (43%) from animal sources, 2 (0.27%) from the environment and 15 (2.1%) from unknown sources. Most of these isolates have been analysed using *Xba*I (728, 99.9%) and serotyped for at least O-antigens (698, 95.7%). Fewer (259, 35.5%) have been analysed using *Bln*I. There are 28 O-antigen serotypes, 327 *Xba*I types and 160 *Bln*I types represented in the database. *Bln*I PFGE typing has the highest diversity index (0.62) followed by *Xba*I PFGE typing (0.45) and O-antigen serotyping (0.0016).

Cornelius A. (2007) Pulsenet Aotearoa (New Zealand) – Implementation and optimization. ESR Client Report FW0763. Christchurch: ESR.

3.17 PFGE Typing of Human Case and Food Isolates of *E. coli* O157:H7 in New Zealand

From March to September 2006, 25 isolates were uploaded to the PulseNet USA *E. coli* O157:H7 pulsed field gel electrophoresis (PFGE) database with the *Xba*I:*Bln*I pattern EXHX01.0074:EXHA26.0569. Although this pattern is relatively common in the US database, this number of isolates suggests a potential common source outbreak. USDA-FSIS found *E. coli* O157:H7 isolates from two US meat-processing plants with two similar *Xba*I:*Bln*I patterns (EXHX01.0074:EXHA26.0569 and EXHX01.1401:EXHA26.0569). One common link between these meat-processing plants is that both sourced some of their meat from New Zealand.

As a consequence of the isolations in the US, in April 2006 the NZFSA and, independently, ESR (PulseNet Aotearoa) received an urgent request from the USDA-FSIS and US-CDC, requesting information on the prevalence of this pattern amongst New Zealand *E. coli* O157:H7 isolates.

As the New Zealand database contained only limited data, responding to this request required the analysis by PFGE of over 200 additional isolates. Comparisons were made with the *Xba*I profiles of 203 human isolates and 229 meat isolates.

Of these, 12 human isolates and three meat isolates had *Xba*I patterns that were indistinguishable from the US pattern EXHX01.0074. *Bln*I profiles were generated for these isolates and all differed from the USA pattern EXHA26.0569. No isolates were identified with the XbaI pattern EXHX01.1401.

Consistent with US database, the *Xba*I pattern EXHX01.0074 appears relatively common in New Zealand isolates (5.9%). Furthermore it appears relatively stable having been isolated over at least five years, with no appreciable genetic changes.

A further 10 human and 34 meat isolates, mostly with similar *Xba*I profiles, were genotyped using *Bln*I. Two of the meat isolates had *Bln*I patterns that were indistinguishable from the USA pattern EXHA26.0569. Their *Xba*I profiles however differed from the USA pattern.

All of the New Zealand isolates were distinguishable from the USA patterns EXHX01.0074:EXHA26.0569, and EXHX01.1401:EXHA26.0569. Thus there is no evidence to indicate that the *E. coli* O157:H7 isolates recovered from the US meat-processing plant came from New Zealand meat.

Cornelius A, Gilpin B, Nicol C. (2006) PFGE typing of human case and food isolates of E. coli *O157:H7 in New Zealand. ESR Client Report FW06101. Christchurch: ESR.*

3.18 Survey of *Salmonella* Contamination of Retail Eggs

This survey assessed the presence of *Salmonella* in and on eggs available through retail outlets in Auckland and Christchurch.

A total of 514 sample units of eggs were tested over a twelve-month period. Samples were retail packs of at least six eggs and were representative of the three production systems (cage, free range and barn). All samples were purchased and analysed within their stated shelf life.

Fifty different brands or sub-brands were identified. Twenty-eight of the sample units were in unlabelled cartons.

One egg from each sample unit was tested quantitatively for surface contamination and the remaining eggs from each retail pack were tested qualitatively for *Salmonella* species (3,710 eggs).

Salmonella was isolated from nine shell surface samples (overall prevalence 1.8%). All isolates were identified as *Salmonella* Infantis and all were from cage laid eggs (3.6% of cage laid eggs). Levels of *Salmonella* on eight of the samples were <5 MPN/egg and the other sample had a count of 44 MPN/egg. *Salmonella* positive samples were from four different brands and identified brands originated from three different farms.

No egg contents were positive for *Salmonella*.

Although the difference in prevalence between free-range and barn production was considered statistically significant, the number of barn egg samples was insufficient (and

positive rate in cage eggs too low) to demonstrate a statistically significant difference between cage and barn production.

The results of this survey are consistent with two previous studies in indicating an absence of internal contamination of New Zealand eggs and enumeration tests have shown that the number of *Salmonella* present on the surface of contaminated eggs is low.

The pilot study suggests that, in New Zealand, the risk to consumers from *Salmonella* in eggs is low. Food handling practices which minimise the possibility of cross contamination from shells should be a routine component of GHP.

Wilson MW. (2007) Survey of Retail Eggs for Salmonella. ESR Client Report FW0779. ESR: Auckland.

4 CHEMICAL FOOD SAFETY

International food chemical safety issues, such as dioxins in Belgian foods, genetically modified foods (GMFs), chloropropanols in soy-based foods and acrylamide, continue to reinforce regulatory interest in this area.

Food chemical safety issues can represent a risk to both public health and trade, both of which are key responsibilities of the NZFSA.

Chemical components of food can be a risk to public health in two ways – due to the presence of too much (toxicity) or due to presence of too little (inadequate nutrition). Food-associated chemical hazards (agricultural compound residues, dioxins, heavy metals like lead and mercury, natural toxins, certain vitamins and minerals) can represent both acute (single meal/day) and chronic (long term/monthly/yearly) risks to public health.

The ESR/NZFSA risk-based Chemical Food Safety Science Service aims to provide up-to-date information on the concentration of chemical contaminants and nutrients in our food supply, associated dietary intakes and assessments of potential risk.

The food chemical surveillance undertaken by ESR for the NZFSA should continue to confirm that New Zealand foods are generally very safe. However, in some instances the scientific work of ESR may identify issues that lead to NZFSA regulatory activities such as targeted compliance monitoring, food recalls, review of food regulations, encouraging industry to adopt safer food manufacturing processes and providing advice to consumers.

An on-going commitment to risk-based chemical monitoring is important as it also enables chemical food safety trends to be identified, and the success of short and long-term risk management/communication strategies to be assessed. Risk-based monitoring of chemical hazards throughout the food chain will continue to be an important regulatory activity in New Zealand.

Projects included in this Science Service in 2006-2007 were:

- NZTDS (New Zealand Total Diet Survey)
- FRSP 06/07 (Food Residues Surveillance Programme)
- WHO Global Environment Monitoring System/ Food
- Genetically Modified Food Analysis
- Fortification Overages of the Food Supply
- Improving Mercury Exposure Assessments
- Iodine Retention in Processed Foods
- Scoping Risk from Natural Toxins in New Zealand Crop Plants
- Stochastic Risk Models for Chemical Food Safety Issues

4.1 NZTDS (New Zealand Total Diet Survey)

The New Zealand Total Diet Survey (NZTDS) is a flagship project for the NZFSA and internationally acknowledged by the World Health Organization (WHO). The NZTDS is undertaken to assess the exposure of the New Zealand population to chemical residues, contaminant elements and selected nutrients. It is a key chemical risk assessment tool. Representative foods ready-for-consumption (i.e. cooked, peeled etc) are analysed for levels of specific agricultural compounds (pesticides and herbicides), contaminant elements (arsenic, lead, cadmium, mercury) and nutrients (iodine, selenium, iron, sodium). These measured levels are used to estimate exposure for different age-sex population groups by means of simulated diets. These estimated dietary exposures are then compared to international standards (ADIs, PTWIs, RDIs). Trends over time are also identified and comparisons made with other countries where comparable data are available. NZTDS data feed into the WHO Global Environmental Monitoring Systems (GEMS/Food) programme and where appropriate, data is provided to the New Zealand Food Composition Database.

New Zealand is committed to an ongoing programme of TDS work, with a 5-year cycle. In this first year of the new cycle, key recommendations and issues identified in the NZTDS review of 05/06 with NZFSA were discussed and actioned, as necessary. Meetings with NZFSA were held to assist in overall design development in preparation for planning of the next NZTDS. The timeframe for the next NZTDS was set and it is anticipated that sampling will commence in 2009. Necessary steps and actions prior to sampling have also been identified. Included in this strategic planning process were discussions with NZFSA about requirements for on-line database capture of sampling and analytical data for the next NZTDS.

The NZTDS project is also aimed at maintaining and extending New Zealand's capability and expertise in regards to Total Diet Studies and chemical risk assessment. To that end, Dr Richard Vannoort (ESR) and Cherie Flynn (NZFSA) had key involvement with at the 4th WHO International Total Diet Survey Workshop in Beijing, People's Republic of China, October 2006, including organising and leading training of week one of the workshop. Both were specifically involved after formal WHO invitations.

Key note presentations prepared and given by Dr Vannoort were:

- Objectives and Overview of TDS training course
- Where and How to start a Total Diet Study
- TDS Project timeline
- Sample Operating Procedures
- Sampling in a Total Diet Study
- Sampling Plan
- Sample preparation in a Total Diet Study
- 2003/04 New Zealand Total Diet Survey – key Contaminant Findings
- 2003/04 New Zealand Total Diet Survey – key Nutrient Findings

Key note presentations by Mrs Flynn were:

- Risk Analysis Paradigm
- Why do a Total Diet Study
- The 2003/04 New Zealand Total Diet Survey – Planning, Design and Release
- Iodine fortification in New Zealand

- Future Directions for New Zealand's Total Diet Survey

Fuller details of the presentations and the report prepared by Dr Vannoort on the TDS training course can be found in the WHO report:
http://www.who.int/foodsafety/chem/meetings/tds_beijing06/en/index.html

4.2 FRSP 06/07 (Food Residue Surveillance Programme)

FRSP 2005-2006:

The 2005/06 New Zealand Food Residue Surveillance Programme (NZFRSP) is part of an on-going agricultural compound food residue surveillance programme initiated in 2003/04 by NZFSA to verify the effectiveness of regulatory measures on the use of agricultural compounds and resulting residues.

Primary plant, animal, seafood and related products were selected on the basis of likely residues, lack of NZFSA information about actual residues, food consumption and other intelligence. In this third year of the programme, eight foods were sampled (number of samples per food type in brackets):

- Cabbages (48),
- Carrots (48),
- Celery (48),
- Cucumbers (48),
- Onions (48),
- Plums (48),
- Pumpkins (48), and
- Wheat (50)

The eight fruit and vegetable commodities were sampled from wholesale and retail outlets at each of four locations (Auckland, Palmerston North, Christchurch and Dunedin). Wheat samples from the 2006 harvest were obtained from grain mills and consolidators in Christchurch (2), Tauranga and Ashburton.

The 386 plant-based food samples were analysed, as received, by a multi-residue agricultural compound screen covering 215 compounds, including organochlorine and organophosphorus pesticides, fungicides, herbicides and plant growth regulators. Six of the plant-based food samples (totalling 288 samples, but not cabbages or wheat), were also analysed for dithiocarbamate fungicides (DTCs).

Out of a total of 83,326 agricultural chemical/food results, 276 (0.3%) had detectable residues.

Five agricultural chemical residues (chlorothalonil [55], iprodione [45], pirimiphos methyl [34], dithiocarbamates [31], and difenoconazole [17]) accounted for 182 (66%) of the 276 different residue/food results detected. The other residues most often detected were methamidiphos (11), indoxacarb (11), and metalaxyl (9). A total of 33 different agricultural chemical residues were detected out of 216 screened for (215 by multi-residue, and DTCs screened as a group separately).

Of the 386 plant-based food samples analysed, the 32 imported foods (four samples of wheat and 28 of plums) included 30 samples (93.8%) with detectable residues, while the 354 domestic foods (all cabbages, carrots, celery, onions, pumpkins, most of the wheat and about half of the plums) included 145 samples (41%) with detectable residues. The one hundred and seventy-five (175) different plant-based food samples with detectable agricultural chemicals out of the 386 analysed in total is equivalent to 45%.

Of the 175 different plant-based food samples with detectable residues, cabbages had a total of nine residues detected, carrots (1), celery (106), cucumbers (52), onions (11), plums (57), pumpkins (0), and wheat (36).

The individual samples with the most different residues were celery (one sample with nine different residues, two with five, two with four, seven with three and 23 with two), cucumber (two with five, two with four, one with three, and eight with two) and plums (one with three and 11 with two). A complete summary of the number of different residues on samples is shown in Table 2.

Table 2: Summary of plant-based foods in 2005/06 NZFRSP with multiple residues per sample

Food	Total samples	Number of residues detected per sample						
		0	**1**	**2**	**3**	**4**	**5**	**>= 6**
Cabbages	48	41	5	2				
Carrots	48	47	1					
Celery	48	1	12	23	7	2	2	1
Cucumbers	48	20	15	8	1	2	2	
Onions	48	37	11					
Plums	48	4	32	11	1			
Pumpkins	48	45	2	1				
Wheat	50	16	32	2				
Total samples	**386**	**211**	**110**	**47**	**9**	**4**	**4**	**1**
Total residues	**276**	**0**	**110**	**94**	**27**	**16**	**20**	**9**

Twenty-two individual food samples out of the 386 plant-based foods in the 2005/06 NZFRSP (5.7%) exceeded the maximum residue limit (MRL). Of these 22 samples, three exceeded the MRL where one was specifically defined (pendamethalin in NZ carrots 0.06 mg/kg, where the NZ MRL for carrots is 0.05 mg/kg; and methamidiphos in NZ cucumbers 0.33 mg/kg and 0.26 mg/kg; with the NZ MRL for fruiting vegetables being 0.2 mg/kg).

The other twenty results were all in excess of the default NZ MRL of 0.1 mg/kg, and so could be considered 'technical non-compliances'. The technical non-compliances in NZ celery were acephate (0.44 mg/kg); chlorpropham (0.11 mg/kg), difenoconazole (eight from 0.10 – 0.42 mg/kg); methamidiphos (0.21 and 0.27 mg/kg); methiocarb (0.18 and 0.26 mg/kg); pirimiphos methyl (0.63 mg/kg); and trifloxystrobin (0.12, 0.12, 0.24 mg/kg); The other 'technical non-compliance' was iprodione (0.11mg/kg) in a sample of NZ cucumbers.

FRSP 06/07:

The FRSP 06/07 analyses involved some late season sampling in June 2007, consequently the study is still in progress and will be reported in full in the 2007-2008 Annual Report.

Sampling was carried out in September-October 2006, January-February 2007, and a late sampling for some mandarins in June 2007. A total of 48 samples of each commodity, domestic and imported, if available, were collected for:

- Beans, green
- Cauliflower
- Mandarins
- Peaches
- Spinach
- Apricots
- Raspberries
- Tomatoes

All foods analysed for a multi-residue pesticide screen and also for dithiocarbamates, with the exception of cauliflower, which were not analysed for dithiocarbamates. Results for the first two sampling periods have been reported to the NZFSA and are available from their website:
http://www.nzfsa.govt.nz/science/research-projects/food-residues-surveillance-programme/results/2007/index.htm

Vannoort R. (2007) New Zealand Food Residue Surveillance Programme. Consolidated results report for 2005/06 for plant-based foods. ESR Client Report FW0713. Christchurch: ESR.

4.3 WHO Global Environment Monitoring System/ Food

The joint UNEP/FAO/WHO Food Contamination Monitoring and Assessment Programme, commonly known as GEMS/Food, was initiated in 1976 and is a major component of the Global Environmental Monitoring System (GEMS). Now administered by WHO, the GEMS umbrella also encompasses health-related monitoring of air, water, and human tissues and fluids. The main objectives of the GEMS/Food programme are:

- To collect data on levels of certain chemicals in individual foods and in total diet samples and to evaluate these data, review trends and produce and disseminate summaries, thus encouraging appropriate food control and resource management measures.
- To obtain estimates of the intake via food of specific chemicals, with a view to combining these data with those from other sources and thus enabling the total intake of the contaminant to be estimated.
- To provide technical co-operation with the governments of countries wishing to initiate and strengthen food contaminant monitoring programmes.
- To provide the joint FAO/WHO Codex Alimentarius Commission with information on the level of contaminants in food to support and accelerate its work on international standards for contaminants in foods.

Since 1978, participating organisations in approximately 70 countries have submitted information under the GEMS/Food programme on estimated daily intakes and levels in foods for a list of priority food contaminants. New Zealand is now a leader in initiatives related to the GEMS/Food programme.

During the 2006-2007 year the New Zealand Collaborating Centre audited New Zealand data submitted during the previous project year and available on the Internet (see http://sight.who.int/). All New Zealand data were found to present and correct.

The New Zealand Collaborating Centre continues to contribute monitoring data to GEMS/Food on a regular basis. Data contributed this year included:

- Concentrations of pesticides in selected commodities from the 2005-2006 Food Residue Surveillance Programme;
- Concentration data from import monitoring of aflatoxins in nuts and nut butter, metals (cadmium, copper and selenium) in crustaceans, and chloropropanols in soy sauce;
- Concentrations of mercury in New Zealand fish;
- Concentrations of copper in New Zealand wine; and
- Concentrations of sulphur dioxide in New Zealand wine.

During 2006-2007 ESR again negotiated with WHO to expand the range of food contaminants in the GEMS/Food database to accommodate further New Zealand data and provide a fuller representation of the status of the New Zealand food supply.

Further discussions were held during the year with various groups within the NZFSA concerning accessing a wider range of food contaminant data for submission to WHO. Areas discussed were residues in animals, residues in dairy products, and a range of chemical contaminants in imported foods.

An annual report for the 2006-2007 year and a proposed work plan for the 2007-2008 have been drafted for submission to the WHO Regional Office for the Western Pacific in Manila.

4.4 Genetically Modified Food Analysis

Stakeholder concern over the presence of genetically modified material in foods continues to be an issue in New Zealand. Current Food Standards Australia New Zealand (FSANZ) labeling standards require compliance by notification of the presence of GM components present in foods if above certain levels. The NZFSA has a surveillance/monitoring programme in place to ensure compliance with labeling requirements. To support this it is necessary to have a robust testing system available for detection of genetically modified material in complex food matrices. ESR currently has the only IANZ Accredited Laboratory for detection of GM components in foods in New Zealand.

The report covers the work undertaken by ESR during the period July 2006 to June 2007.

The contracted project was designed to:

(i) Provide analyses to assist the NZFSA in monitoring compliance with the FSANZ labelling standard for Genetically Modified Food.

- Two samples of rice were provided by the NZFSA for analysis during the project period.

As only two samples were provided for analysis during the contract period the remainder of the contracted work focused on capability maintenance and development.

(ii) *Enable the ongoing development of optimized methodologies and capability for the detection of genetically modified material within complex food matrices.*

Capability maintenance and development was addressed in the following areas:

- ESR continued to perform at a satisfactory level in an international proficiency programme for the detection of GM ingredients in food.
- Prior to provision of samples for testing by the NZFSA an assay was developed to detect GM material in rice tissue.
- As a result of issues identified during the testing of rice samples supplied by NZFSA the rice assay system was further developed. Reference DNA was obtained for a GM rice event, allowing a limit of detection for rice material to be established for the assay. To improve the sensitivity of the assay an alternative method of extraction of DNA from rice, that gave higher yields of DNA per gram tissue, was assessed but was found to be of no benefit.
- The TaqMan-chemistry real-time detection assay system developed during the 2005/06 contract period was further developed by the design of a new nos3' assay able to detect known GM corn and soy events. This assay was also successfully used to test rice samples provided by NZFSA, in parallel with the current IANZ accredited assay system.

Podivinsky E. (2007) Genetically modified food analysis and capability development. ESR Client Report FW0770. Christchurch: ESR.

4.5 Fortification Overage of the Food Supply

The aim of the project was to assess levels of vitamin C and zinc in a range of food types, and selenium in infant formulae; and to compare these to average levels claimed on product labels, and in the case of selenium in infant formula, to the mandatory minimum and maximum levels in the Standard 2.91 of the Food Standards Code. This information will assist in the development of food standards relating to nutrient fortification. The project follows similar projects assessing levels of folate and iron (2005) and vitamin A, vitamin D and calcium (2006).

Vitamin C and zinc

Approximately 225 samples from forty five different food products were purchased between November 2006 and March 2007 from Auckland, Christchurch or Wellington retail outlets and analysed for vitamin C or zinc. Vitamin C content was determined using an acid extraction, oxidation and derivatisation and analysis by high performance liquid chromatography with fluorescence detection. The variability between 5 batches of 25 food products, as measured in terms of CV, ranged from 1-60% with 40% of samples giving a CV of greater than 25%. Samples for zinc analysis were acid digested with nitric and

hydrochloric acid and analysed by ICP-MS. The variability of zinc content between batches, as measured by CV, ranged from 3-42 %.

In assessing the data, an overage or underage was defined as being where the label claim did not correspond to the measured value after making an allowance for the measurement uncertainty associated with this value.

Mean vitamin C concentrations were 21-84% below the average label claim in 20% of the products tested (5/25) and exceeded the label claim in 52% (13/25) of products with overages of 19-529%. The mean concentration of twenty eight percent (7/25) of the products analysed for vitamin C met the average label claim. A single serving of the fruit based canned baby food with the highest overage of 529% would result in an intake of 227 mg of vitamin C contributing between seven to eight times the adequate intake of vitamin C for a 7-12 month infant and 23% of the prudent upper limit for vitamin C.

Mean zinc concentrations were 14-56% below the average label claim in 20% of the products tested (4/20) and exceeded the label claim in 30% (6/20) of products with overages of 18-83%. The mean concentrations of 45% (9/20) of the products analysed for zinc met the average label claim. High consumption of the product with the maximum zinc overage would result in an intake of up to 26% of the Upper Level of intake (UL).

The mean concentrations of 20 % (9/45) of the foods sampled were less than claimed, based on the criteria applied in this assessment. Consumers of these products are ingesting less of the added nutrients than they would believe, based on average label claims.

The mean concentrations of 42% (19/45) of the foods sampled were higher than claimed. None of the selected foods fortified with vitamin C or zinc appear to present a realistic hazard of a consumer exceeding the UL of any of these nutrients.

All analytical measurements have associated uncertainty arising from sampling, the analytical method and the manufacturing technique. For standard setting, consideration may be given to defining a range around the label claim that takes measurement uncertainty into account.

Selenium in infant formulae

Approximately 100 samples of 20 different infant formulae were analysed for selenium content. Samples were purchased between November 2006 and March 2007 from Auckland, Christchurch or Wellington retail outlets. Infant formulae, prepared as for consumption, were analysed for selenium content by atomic absorption following an acid digestion and conversion of the selenium to selenium hydrides. The variability of selenium content between batches, as measured by CV, ranged from 0-63% for different batches of the same product.

Mean selenium concentrations met the label claim in 60% of the infant formulae tested (12/20) and exceeded the label claim in 35% (7/20) of products with overages of 7-49%. One product made no claim for selenium content. Each of the infant formulae with a selenium label claim complied with the maximum and minimum permissible amounts of selenium.

Consumption of the recommended three to four feeds per day, of the two follow-on formulae with the highest overages, would result in an intake of 128% of the Adequate Intake (AI) and 32% of the UL for a seven to twelve month infant, the target consumer for these products. None of the selected infant formulae gave any indication of a possibility of exceeding the UL of selenium.

Thomson B. (2007) Fortification overages of the food supply. Vitamin C, Zinc and Selenium. ESR Client Report FW0745. Christchurch: ESR.

4.6 Improving Mercury Exposure Assessments

This project is planned to run over two project years (2006-2007 and 2007-2008) and no specific outputs were designated for the first year.

4.7 Iodine Retention in Processed Foods

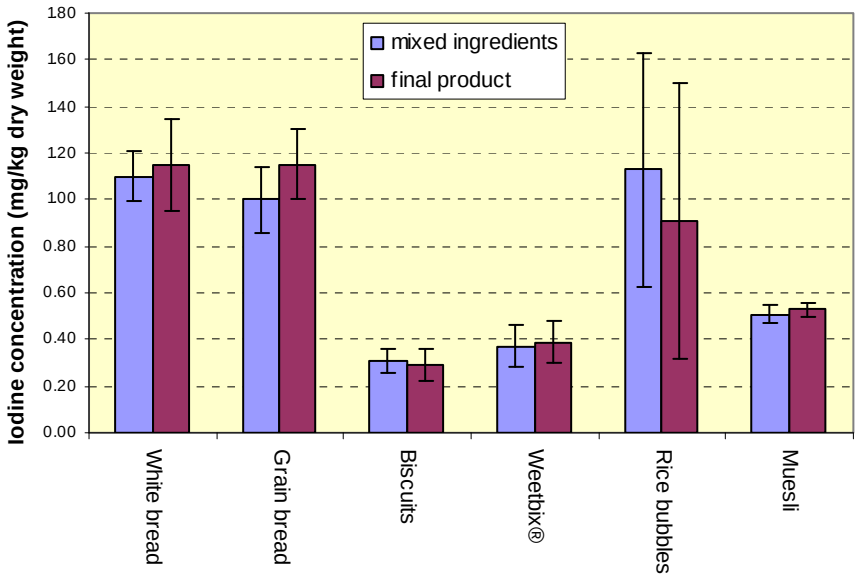
The dietary exposure of iodine in New Zealand has decreased over the past 25 years and is low for most New Zealanders, ranging from 40 - 57% of the recommended daily intake across eight population subgroups in the 2003/04 Total Diet Survey. The current project was undertaken as part of the New Zealand government's initiatives to address the public health issue of low iodine intake through the development of a food standard relating to the mandatory addition of iodine to selected foods.

White bread, grain bread and sweet biscuits were prepared by Coupland's Bakeries using non-iodised and iodised salt respectively. Triplicate runs were prepared at the bakery in Hornby, Christchurch, for each selected food between September 2006 and February 2007. Multiple runs of Weetbix®, rice bubbles and toasted muesli were manufactured by Sanitarium, Auckland between September 2006 and May 2007. Triplicate samples were taken at various steps during processing of each food and analysed for moisture and iodine content.

Iodine concentration was determined by inductively coupled plasma-mass spectrometry following an alkaline digestion. Quality assurance of the analytical results included analysis of spiked samples, certified reference materials and duplicates.

Iodine, from iodised salt, was 100% retained in each of the selected foods from the time of mixing to the final product. There was no measurable loss of iodine during the processing of either breads, biscuits or cereals when non-iodised salt was replaced by iodised salt. Results are shown graphically in Figure 3.

Figure 3: **Retention of iodine from iodised salt as an ingredient in breads, biscuits and cereals (mean ± 1SD)**



Thomson B. (2007) Iodine retention in processed foods. ESR Client Report FW0739. Christchurch: ESR.

4.8 Scoping Risk from Natural Toxins in New Zealand Crop Plants

Crop plants contain many hundreds of chemicals, some of which have beneficial nutritional consequences for humans if consumed, while others may result in adverse health consequences for humans. Some plant chemicals may be both beneficial and harmful, depending on the dose consumed and the context of the consumption event. Chemicals naturally present in plants or produced by the plant in response to environmental factors that can elicit adverse health effects in humans or animals are often referred to as natural plant toxins.

This report is a qualitative assessment of the risks associated with natural toxins in crop plants available in New Zealand, based on currently available data. It was agreed that the summaries for each toxin would answer a series of questions within the framework of a qualitative risk assessment, relating to the evidence for the human toxicity of the toxins and the evidence for exposure to the toxin by the New Zealand population.

While the assessment highlighted considerable uncertainties and data gaps the following general conclusions were reached:

- There are little or no human data supporting the toxicity of caffeic acid, glucosinolates, saponins and quercetin. There is some evidence to suggest beneficial effects from these compounds at dietary levels of exposure, while adverse effects may occur at levels of exposure well above normal dietary levels.
- There are no human data to support the toxicity of proteinase and amylase inhibitors. Forms of foods causing problems in animals (raw soy meal) are not relevant to human

diets and enzymes will often be inactivated by normal food processing. These compounds are also being investigated for potentially beneficial therapeutic purposes.

- Potato glycoalkaloids and cucurbitacins may cause adverse health effects in humans under certain environmental circumstances. These circumstances are understood for potatoes (physical injury, plant stress, exposure to light), but not for cucurbits. The extreme bitterness of cucurbitacin-containing foods is usually considered to be a barrier to widespread or prolonged incidents of intoxication.
- Plant products containing cyanogenic glycosides are capable of causing serious cases of cyanide poisoning. However, the main cyanogens-containing foods (e.g. cassava) are not normal components of the New Zealand diet, although they may be increasing in importance.
- Xenoestrogens have been implicated in a range of cancers and non-cancer conditions relating to development of the reproductive organs. However, correlative epidemiological studies have generally focused on synthetic xenoestrogens, rather than phytoestrogens. Some phytoestrogens have also been promoted as having positive health effects. Evidence is currently insufficient to establish the human toxicity of phytoestrogens.

Based on these conclusions, potato glycoalkaloids and cyanogenic glycosides appear to be the toxins associated with cultivated plants consumed in New Zealand with the greatest potential to cause adverse health effects.

Cressey P, Thomson B. (2007) Scoping risk from natural toxins in New Zealand crop plants. ESR Client Report FW07009. Christchurch: ESR.

4.9 Stochastic Risk Models for Chemical Food Safety Issues

This report describes the development of a quantitative risk model to assess risks associated with contamination of processed foods by selected allergenic source materials (milk, egg, soy, peanut).

The output of the model is intended to describe the exposure of New Zealanders to allergenic material, based on defined contamination scenarios, and to estimate the probability of adverse allergic events resulting from the contamination.

The model considers:

- The probability of the food being consumed;
- The amount of food consumed in a typical serving;
- The age of the consumer and the probability that they are allergic; and
- The probability that the ingested dose exceeds the lowest provoking dose level.

The model itself consists of a computer file written using the @RISK software.

The model was designed to be flexible and allow modelling of a range of possible scenarios. Sample outputs are presented to assess:

- The relative risks of a fixed amount of allergen being distributed in different manners within a processed food; and

- The level of residual risk associated with action levels for allergen contamination developed as part of an allergen risk assessment project, under the auspices of the Australian Food and Grocery Council.

Cressey P. (2007) Stochastic risk model: Allergens in processed foods. ESR Client Report FW0732. Christchurch: ESR.

5 CURRENT AWARENESS AND RISK COMMUNICATION

A significant requirement of a public health agency is to respond when necessary to new information and developments. ESR provides NZFSA with a service that monitors local and overseas food safety developments in the areas of chemical safety, microbiological safety, and safety of genetically modified foods. Background information is gathered and reviewed if required. This allows NZFSA to have early and informed information on food safety issues arising elsewhere which may subsequently impact on New Zealand.

To support this information gathering exercise ESR has established a wide network of contacts with overseas experts. This network allows ESR and NZFSA to have access to the most authoritative advice and specialist analytical services related to topical issues.

ESR also assists NZFSA in risk communication activities when needed, typically with preparation or review of documents for the public, or in public presentations.

Projects included in this Science Service in 2005-2006 were:

- GMFs and Cloning: Current Awareness
- Risk Communication

5.1 GMFs and Cloning: Current Awareness

This report is one of a series intended to provide NZFSA with information on current and emerging food safety issues related to GM Foods, and foods derived from cloned animals, which contributes to effective food policy, regulatory and risk management activities.

This report covers selected developments in the period July to December 2006, and includes:

- Use of Cre-*lox* systems for generating marker-free GM crops.
- Use of -omics technologies in the assessment of food safety of GM crops.
- Methodologies to assess the allergenic potential of food from GM crops.
- Adventitious contamination of US rice exports with unapproved line LLRICE601 and the response of the global market.
- Release of documents by the USFDA assessing the food consumption risk of cloned animals and their progeny.
- Chloroplast transformation
- Cisgenic gene transfer systems
- Intragenic vector gene transfer systems
- Are GM and conventionally bred cereals really different?
- Genetically modified feed does not affect meat.

Podivinsky E. (2007) Current awareness of issues related to genetically modified food and food from cloned animals. July – December 2006. ESR Client Report FW07007. Christchurch: ESR.

Podivinsky E. (2007) Current awareness of issues related to genetically modified food and food from cloned animals .January – June 2006. ESR Client Report FW0771. Christchurch: ESR.

5.2 Risk Communication

The Risk Communication work area has been developed to allow ESR scientists with expertise in food safety to work with NZFSA to communicate food safety information to the consumer as part of a process of increasing consumer awareness and allowing consumers to better understand food risks.

This work has involved both the production of written material and presentation of verbal communications to consumers or consumer groups to clarify food safety issues.

Topics for which written material was provided included:

- Safe handling of retail meat packages.
- Food safety and slow cooking or crock pot cooking.
- Food safety issues for frozen foods.
- Modified atmosphere foods, storage life (eg, of pasta, meat) and colour as an indicator of freshness.
- The safety of fruit and vegetable juices.
- Pathogen risks associated with supermarket bulk bins eg, dried fruit and seeds.
- Pathogens in pet foods (dried and fresh) and tips on handling them safely in consumers kitchens.
- Safety of cling film in microwave cooking.
- Safety of Teflon cookware for food contact.

6 EMERGENCY RESPONSE AND EMERGING ISSUES

This service description ensures that ESR capability across the spectrum of food safety science is available to deal with emergency responses to food safety incidents. In order to maintain capability, supplementary research projects, agreed with NZFSA, are undertaken when not engaged in emergency response investigations.

Two project related to the performance of domestic freezers were carried out under the emergency response project in 2006-2007.

6.1 Quantifying the Potential for Domestic Freezers to Reduce *Campylobacter* Levels in Fresh Poultry

Campylobacteriosis is the most frequently reported gastrointestinal illness in New Zealand, with greater than 50% of cases being attributed to consumption of chicken (Eberhart-Phillips *et al.*, 1997). A recent commentary by Baker and colleagues (2006) on the rates of *Campylobacter* infection in New Zealand has suggested that all fresh poultry should be temporarily withdrawn from the food supply and replaced with frozen or processed alternatives. While scientific evidence supports some decline in *Campylobacter* numbers following freezing, this approach is not in itself a 100% effective intervention and does not take into account issues regarding thawing and potential undercooking. It also flies in the face of consumer preference for fresh poultry in New Zealand where 71% of consumers purchase 50% or more of their poultry fresh (Gilbert *et al*., 2005; Gilbert *et al*., 2007). However, given that 66.3% of consumers also freeze over half of this fresh poultry in the home (Gilbert *et al*., 2005; Gilbert *et al*., 2007), an investigation of domestic freezing conditions has merit.

This project was therefore initiated to provide baseline information on: (i) domestic freezer types commonly in use in New Zealand; (ii) typical domestic freezer temperatures; and (iii) freezing and thawing temperature profiles for chicken samples, with a view to generating information to support a more quantitative assessment of the effects of freezing.

An email survey using ESR staff was conducted to analyse the prevalence of freezer types in New Zealand. Fridge-freezers were most commonly reported (70.3%), of which bottom-loading freezer compartments were more prevalent than top-loading freezers by a factor of 2 to 1. A questionnaire and chicken samples fitted with data loggers were then distributed to 41 participants in a Christchurch-based survey of domestic freezers.

Using temperature profile data from the data loggers, it was found that surveyed freezers operated at a mean temperature of -16.56°C. Sample location and freezer loading both had an impact on freezer temperature, with the top section of freezers 2 to 2.5°C warmer than the middle or bottom sections, and three quarters to fully loaded freezers operating at temperatures 1 to 2°C warmer than less loaded freezers. Other factors including freezer type, age, defrost mechanism and dial/setting adjustment did not affect mean freezer temperatures.

Freezing temperature data for chicken portions were also analysed. Freezer type, sample location and freezer loading were all found to significantly influence the rate of freezing of samples over a defined temperature range (from 0 to -5°C). These parameters should

therefore be considerations in the development of future experimental work to determine the quantitative decline in numbers of campylobacters during domestic freezing.

Thawing of chicken portions at different temperatures was also considered. Chicken samples thawed at room temperature took on average 686 minutes to reach ambient temperatures. This suggests that the period such food spends at ambient temperature under typical domestic thawing conditions is limited, and therefore so is the potential for bacterial growth. Thawing at refrigeration temperatures took considerably longer, from 18 hrs to nearly 3 days. While this is not a concern from a pathogen growth perspective it is an inconvenience that likely drives the more common practice of room temperature thawing.

This information will be valuable in supporting risk management initiatives by the New Zealand Food Safety Authority to control *Campylobacter* through the food chain, and contribute valuable data to ongoing pathogen risk model developments in this area. Data will also be used to develop practical experiments to quantify the effect of domestic freezing on *Campylobacter* levels on poultry.

McIntyre L, Bayne G, Gilbert S, Lake R. (2007) Domestic food practices in New Zealand. Freezer Survey. ESR Client Report FW0735. Christchurch: ESR.

6.2 Quantifying the Potential for Domestic Freezers to Reduce *Campylobacter* Levels in Fresh Poultry – Part 2

This project was initiated to quantify the reduction of two *Campylobacter jejuni* isolates, ST u48 and ST 474, following simulated domestic freezing and frozen storage for up to 10 weeks.

Declines in *C. jejuni* populations, ranging from 0.08 to 4.49 $\log_{10}$ cfu per portion, were not significantly different for the two isolates, but larger reductions in mean *C. jejuni* counts were observed in samples stored for more than 4 weeks (2.6 $\log_{10}$ cfu) as opposed to short term storage (0.9 $\log_{10}$ cfu). Thawing at 4°C was found to reduce counts for isolate ST 474 significantly more than thawing at 20°C ($p=0.0033$). This finding both supports the NZFSA's advice to consumers to thaw frozen poultry at refrigeration temperature rather than at room temperature, and suggests that such advice to consumers to thaw domestically frozen poultry may have significant public health benefit.

This information will be valuable in supporting risk management initiatives by the New Zealand Food Safety Authority to control *Campylobacter* through the food chain, and contribute valuable data to ongoing pathogen risk model developments in this area.

McIntyre L, Gilbert S. (2007) Domestic food practices in New Zealand. Quantifying the reduction of Campylobacter jejuni *on skin-on chicken breasts frozen and stored for up to 10 weeks in a domestic freezer. ESR Client Report FW0776. Christchurch: ESR.*

7 NZFSA/HPO TECHNICAL SUPPORT

ESR has for many years provided the NZFSA, the Ministry of Health, and District Health Boards with analytical results, scientific advice and consultation relating to the chemical and microbiological quality of food. It is important that regulatory staff have the best quality analytical results and that they have access to current scientific background information if they are to take the most appropriate actions. It is also important that requests for analytical work and advice are scientifically assessed in terms of the identified issue and that requested work is focused on supporting a regulatory solution to this issue. It is also important that ESR has appropriate support structures and access to other relevant information on food safety in New Zealand if it is to be able to provide scientific advice relevant to New Zealand.

The Science Service covers the following areas of science support:

- Data Transmission
- Food Complaints
- Food Consultation/Courier
- Annual report

7.1 Data Transmission

Each day, ESR transfers an electronic version of completed results generated by ESR's Food Chemistry and Public Health Laboratories into the NZFSA FoodNet database. The NZFSA then replicates selected results into versions of FoodNet held by District Health Boards and the Ministry of Health.

Transmitted data includes results from the testing of foods within the NZFSA Science Contract, results from the testing of samples related to suspected food poisoning incidents and clinical samples within the Ministry of Health contract, and the testing of imported foods submitted to ESR as part of the requirements for the importation of high risk foods.

It is important that transmitted results are reliable and the project involves a quality assurance component to ensure results within the FoodNet system accurately reflect the original data held by ESR and involves checking a selection of data held in FoodNet against the original version. Quality assurance also involves ensuring that ESR staff approve completed results so that they are transmitted to FoodNet in a timely manner and that identified missing information is followed up to ensure analytical results can be cross referenced to other information on the same events and samples held in other food and health related databases.

7.2 Food Complaints

When consumers feel that the food they have purchased is unacceptable in some way these foods may be submitted to Health Protection staff at District Health Boards for investigation. This investigation will, in some instances, include laboratory analysis by ESR. The most common reasons consumers complain about foods are:

- The presence of an unexpected and unwanted item in the food (Foreign objects)
- The presence of an unexpected and unwanted taste or odour in the food (Taint)
- The belief that the food has ‘gone off’ (Spoilage). This belief may be based on the taste, odour or appearance of the food

- The belief that the food may contain a contaminant, such as pesticide residues or pathogenic bacteria (Contamination)
- The belief that a food contains additives which it shouldn't (Adulteration)

During the 2006-2007 year 158 food complaints were submitted to ESR laboratories for investigation, similar to the number submitted during 2005-2006 (167). The largest proportion of these was from the Auckland area (27%), followed by Canterbury (23%). The patterns of foods associated with complaints and the types of complaints made are consistent with previous years. In 2006-2007 the types of foods most commonly associated with food complaints were bread and bakery products, takeaway foods, dairy products and canned foods.

As in other years, the most common reason for making a food complaint was the presence of a foreign object in a food item. During 2006-2007, 66% of all food complaints were related to foreign objects. This is similar to the pattern for 2005-2006 when 59% of all food complaints submitted to ESR related to foreign objects. The types of foreign objects most commonly identified were insects (including eggs, pupae and caterpillars), glass, plastic fragments, metallic fragments or items. About 30% of foreign object complaints were unsubstantiated with many foreign objects submitted as food complaints appearing to be normal components of food.

The majority of samples submitted for microbiological examination this year have been related to incidents where the food was believed to be spoiled. Complaints relating to the presence of allergens (incorrect labeling/composition) continue to increase.

Wilson MW, Whyte RJ. (2007) Food complaints and foodborne illness: six-month summary report July to December 2006. ESR Client Report FW0715. Auckland: ESR

Wilson MW, Whyte RJ. (2007) Food complaints and foodborne illness: six-month summary report January to June 2007. ESR Client Report FW0780. Auckland: ESR

7.3 Food Consultation/Courier

The Food Consultation work area provides a mechanism by which staff of Public Health Units and NZFSA can seek advice from ESR consultants with scientific skills and expertise in the area of food safety. These enquiries may be answered by an email or telephone response or may receive more extensive written replies.

The majority of requests continue to be for scientific support in the area of Food Safety Programme evaluation, which involves HPOs reviewing food production processes and determining whether all potential hazards have been identified, and appropriate controls implemented to prevent hazards from occurring.

No analytical projects were carried out within this work programme during 2006-2007.

Two training workshops for HPOs were held during the year, one in Auckland and one in Christchurch. Workshops included technical presentations and presentations on key food safety projects. The course was divided into microbiology, chemistry and foreign body sessions and included a selection of technical presentations by ESR staff. The microbiology

sessions concentrated on the bacterium *Campylobacter* as requested by the NZFSA. The sessions in this regard followed a logical flow through from poultry farm to the consumer's plate. The sessions included;

Microbiology
- *Campylobacter* overview (Sue Gilbert),
- *Campylobacter* on the farm (Dr. Rob Lake),
- *Campylobacter* on broiler chickens prior to scalding (Dr. Teck lok Wong),
- Quantitative Risk Assessment Models for *Campylobacter* in NZ (Peter Cressey),
- Domestic freezer survey (Dr. Lynn McIntyre),
- *Campylobacter* transfer from chicken to hands (Dr Teck lok Wong),
- Acute Gastro-Intestinal Study (AGI) (Dr Rob Lake),
- Interactive session on sources of *Campylobacter* (Dr Brent Gilpin)

Chemistry
- Histamine in Fish (Dr Jim Mitchell),
- Ciguatera Fish Poisoning (Peter Cressey),
- When apples go bad –patulin (Maurice Wilson).

Foreign body analysis
- Investigation of foreign objects, taints etc (Jill Schumacher – Auckland, Darren Saunders – Christchurch).

Presentations were also presented by FAOs (NZFSA standing in for the Auckland session). These were;

- Histamine in Cheese – a case study (Katherine Russell)
- 57,000 green bottles – case study regarding patulin (Sally Johnston – NSFSA Auckland; Tui Shadbolt FAO, Christchurch)

A questionnaire was administered following the two day sessions and attendees were asked to rate their responses to each question from 1 to 6 with "1" representing "less favourable" and "6" representing "most favourable". They were given the chance to remain anonymous. The total number of responses was 34.

Analysis of feedback

Some of the comments are pertinent to the venue, therefore the analysis is split between Auckland and Christchurch. A summary of the mean ratings for each question (out of a score of 6) are shown in Table 3 with the details from each venue following in order. Alongside each of the question ratings, the respondents were invited to add any comments. These are collated below for each question.

Table 3: Summary of attendee feedback on HPO training days

	Auckland	Christchurch	Total
Question 1 Rate ESR talks	4.6	5.4	4.9
Question 2 ESR informative?	4.9	5.5	5.1
Question 3 Rate NZFSA talks	4.1	4.8	4.3
Question 4 NZFSA informative?	4.2	4.3	4.4

Consultation provided as part of this service was summarised in four quarterly reports:

Gilbert S. (2006) Food consultation. Quarterly progress report July to September 2006. ESR Client Report FW0670. Christchurch: ESR.

Gilbert S (2007) Food consultation. Quarterly progress report October to December 2006. ESR Client Report FW06116. Christchurch: ESR.

Gilbert S. (2007) Food consultation. Quarterly progress report January to March 2007. ESR Client Report FW0726. Christchurch: ESR.

Gilbert S. (2007) Food consultation. Quarterly progress report April to June 2007. ESR Client Report FW0752. Christchurch: ESR.

APPENDIX 1 NEW ZEALAND FOOD SAFETY AUTHORITY – ESR SCIENCE CONTRACT 2006-2007. SERVICE DESCRIPTIONS, WORK AREAS AND AGREED OUTPUTS

MICROBIOLOGICAL RISK PROFILING

Risk Profiling

- *Report on redesigned risk profile scope*
- *Completed Risk Profiles:*
    - *Cryptosporidium* in seafood
    - Ciguatera in seafood
    - *Staphylococcus aureus* and *S. aureus* enterotoxin (STE) in red meat.
    - Toxoplasma and Red Meat Risk Profile (update).
    - Discussion document on pathogens in vegetables and fruits

Risk Ranking: DALYs - Development of a single metric

- *Report summarising options and selection of single metric approach*
- *Final report describing estimates of values of disease burden derived using the selected metric approach for food-hazard combinations chosen in consultation with NZFSA*

MICROBIOLOGICAL FOOD SAFETY

Incorporation of risk models for *Campylobacter* in poultry and red meat into the comparative exposure model

- *Report describing integrated model*

On-farm risk factors for *Campylobacter* contamination of poultry

- *Literature review on likely Campylobacter risk factors under NZ conditions*
- *Final report identifying on-farm risk factors that contribute to Campylobacter status of the NZ flock*

Secondary Processing of Poultry

- *Final poultry risk model report*

Potential re-growth of *Salmonella* from contaminated pet chews

- *Finalise scientific paper on the survey of pet chews with NZFSA and submit to journal*
- *Final scientific paper forwarded to NZFSA for approval to submit to journal*

Review of notified salmonellosis outbreak data as a source of information for attribution

- *Interim report on amount and scope of information collated forwarded to NZFSA*
- *Final report forwarded to NZFSA*

Domestic Food Handling

- *Complete a summary of information on experiments on temperatures of food in cars during transport home and forward to NZFSA and the Foodsafe Partnership*
- *Final report forwarded to NZFSA*

Bakery products - Microbiological quality

- *Interim report for winter/spring 2006 sampling*
- *Interim report for summer 2006-07 sampling*
- *Final report consisting of overall sample information, result analysis and discussion of seasonal differences between results to be forwarded to Project Leader NZFSA*

Growth of *L. monocytogenes* in refrigerated foods under non-static temperature conditions

- *Paper submitted to journal*
- *Survey completed, and results forwarded to NZFSA*

L. Mono in RTE salads - Exposure assessment to *Listeria monocytogenes* via Deli Ready-to-eat salads (with dressings)

- *Paper submission to journal*
- *Survey completed, and results forwarded to NZFSA*

Murine Norovirus (MNV-1) – a suitable surrogate for human norovirus?

- *Literature review and interim 6-month report to NZFSA*
- *Scientific paper submitted to journal*

Norovirus Detection in Shellfish

- *Final report submitted to NZFSA*

Pasteurisation Risk Model

- *Final report and final model forwarded to NZFSA*

Vibrio parahaemolyticus and *Vibrio vulnificus* in North Island Commercially Harvested Oysters (*Crassostrea gigas)*

- *Final report, incorporating revisions from NZFSA*

VNC - Resuscitation of putative viable but non culturable foodborne bacteria of significance to New Zealand

- *Brief report on resuscitation of pathogens by other methods forwarded to NZFSA*

- *Brief report on attempts to resuscitate putative VNC pathogens on meat forwarded to NZFSA*
- *Report in scientific paper format to the submitted to NZFSA*

Yersinia in meat: Analytical Development and Survey

- *Paper submission to journal*
- *Survey completed and results forwarded to NZFSA*

PulseNet Aotearoa (New Zealand) - Implementation and optimisation

- *Provide a brief report on work undertaken and contents of the PulseNet Aotearoa (New Zealand) databases*

CHEMICAL FOOD SAFETY

NZTDS (New Zealand Total Diet Study)

- *Organisation of week 1, and preparation and presentation of keynote presentations at 4th international WHO TDS workshop, Beijing*
- *Final report to NZFSA*

FRSP 06/07 (Food residues surveillance programme)

- *Procedures manual for 06/07 FRSP survey sent to NZFSA*
- *Finalised report to NZFSA (S1)*
- *Reporting of S2 results to NZFSA and chapter written for draft annual report*

WHO GEMS/Food

- *Audit New Zealand data held by WHO GEMS/Food for completeness and accuracy*
- *Extract, format and submit to WHO relevant New Zealand food contaminant and residue data for 2005 calendar year*
- *Complete annual report and proposed work plans for submission to WHO*

Genetically Modified Food Analysis and Capability Development

- *Analyses of samples received by or sourced by ESR for testing*
- *Six monthly progress report on results of sample analyses submitted to NZFSA*
- *Final written overview of the years work*

Fortification overages of the food supply

- *Final report to NZFSA*

Improving Mercury Exposure Assessments

- *Two year project with main project deliverables in the 2007-2008 year*

Iodine Retention in Processed Foods

- *Final report to NZFSA*

Scoping Risk from Natural Toxins in New Zealand Crop Plants

- *Final scoping document to NZFSA*

Stochastic Risk Models for Chemical Food Safety Issues

- *Further developed model supplied to NZFSA with summary of available data*
- *Project report supplied to NZFSA*

CURRENT AWARENESS AND EMERGING ISSUES

GMFs and Cloning – Current Awareness

- *Two six-monthly summary reports, providing background, detailed analysis, critique and the significance of five studies/topics*

Risk Communication

- *Short summaries of all 06/07 projects, highlighting potential Risk Communication issues*
- *Copies of all short reports produced*

EMERGENCY RESPONSE

Emergency response and emerging issues

- *Report of the work within the Service Description presented at NZFSA/ESR meetings*

NZFSA/HPO TECHNICAL SUPPORT

Data transmission

- *Daily delivery of accurate data from ESR to FoodNet*

Food complaints

- *Quarterly budget reports to NZFSA*
- *Documented criteria and guidelines for submission and acceptance of samples for analysis against the Food Complaints budget, developed by NZFSA with input and assistance from ESR*
- *Six monthly reports summarising sample numbers, food types, laboratory results and, where available, other information relating to CCP failures and follow up action*

Food consultation/courier

- *Quarterly reports on advice given and other activity to the NZFSA.*
- *Quarterly utilisation summary*
- *Documented criteria and guidelines for submission and acceptance of requests for information against the Food Consultation/Courier budget, developed by NZFSA with input and assistance from ESR*
- *One training workshop for HPOs at both the Christchurch and Auckland sites of ESR*
- *Evaluation report on HPO training workshops*

Annual report

- *Submission of final report*