



THE STATUS OF NEW ZEALAND'S FOOD

**Report on the NZFSA-ESR Science Contract
2004-2005**

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Report on the NZFSA-ESR Science Contract 2004-2005

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CONTENTS

PREFACE	i
1 INTRODUCTION	1
2 MICROBIOLOGICAL RISK PROFILING	2
2.1 Risk Profiles Review	3
2.2 Risk Ranking Policy Document.....	4
3 MICROBIOLOGICAL FOOD SAFETY	6
3.1 Development and Implementation of a National Typing Database: Food Specific Inputs	6
3.2 Microbiology of Uncooked Retail Meat Products: <i>Salmonella</i> and STEC	7
3.3 Prevalence and Numbers of <i>Campylobacter</i> and <i>Salmonella</i> on Chickens Prior to Scalding	9
3.4 Domestic Food Practices	9
3.5 Temperature Control at Retail Level	11
3.6 Microbiological Survey of Imported and Domestic pork: <i>Salmonella</i> , STEC and Generic <i>E.coli</i>	11
3.7 Effect of Low Temperature on <i>Campylobacter</i> in Poultry	12
3.8 Further Development of a Risk Model for <i>Campylobacter</i> in Poultry in New Zealand.....	13
3.9 <i>Salmonella</i> – Egg Survey.....	15
3.10 Further Development of a Risk Model for <i>Salmonella</i> in Poultry in New Zealand.....	15
3.11 Comparison of quantitative technologies for STEC and <i>E.coli</i> O157 in food ...	16
3.12 <i>Yersinia</i> in meat: Analytical Development and Survey.....	17
3.13 Exposure Assessment of <i>Listeria monocytogenes</i> via Unpackaged Ready-to- eat Meats	18
3.14 Analytical Development: Norovirus Detection	18
3.15 Pasteurisation Risk Model	19
4 GENERIC	21
4.1 Assessment of Food-borne Disease Outbreaks/Human Health Surveillance Interface	21
5 CHEMICAL FOOD SAFETY	25
5.1 2003/2004 New Zealand Total Diet Survey (NZTDS).....	26
5.2 Food Residue Surveillance Programme.....	27
5.3 WHO Global Environment Monitoring System/ Food.....	28
5.4 Genetically Modified Food Analysis and Capability Development.....	29
5.5 Fortification Overage of the Food Supply	30
5.6 Kelp as a Food Ingredient.....	31
5.7 Sulphite, Sorbate and Benzoate Dietary Exposure and Risk Assessment - Children	31
5.8 Food Allergen – Capability Extension.....	32
5.9 Acrylamide.....	33
6 CURRENT AWARENESS AND RISK COMMUNICATION	34

6.1	<i>B. cereus</i> in Cooked Rice Fact Sheet.....	34
6.2	Current Awareness – Genetically Modified Foods and Cloning.....	35
6.3	Servicing Consumer Information Requests	37
6.4	Risk Communication	38
7	EMERGENCY RESPONSE.....	39
8	NZFSA/HPO TECHNICAL SUPPORT.....	40
8.1	Data Transmission	40
8.2	Food Complaints.....	41
8.3	Food Consultation/Courier	41
8.4	Export Wine Certification.....	43
APPENDIX 1	NEW ZEALAND FOOD SAFETY AUTHORITY – ESR SCIENCE CONTRACT 2004/2005. SERVICE DESCRIPTIONS, WORK AREAS AND AGREED OUTPUTS	44

LIST OF TABLES

Table 1: Prevalence of <i>Salmonella</i> and STEC in New Zealand retail meats.....	8
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LIST OF FIGURES

Figure 1: Mean overall temperature; Christchurch, Auckland and Rural refrigerators	10
Figure 2: <i>B. cereus</i> in cooked rice fact sheet.....	34

PREFACE

Occasionally foods will contain components that increase our risk of diseases, ranging from acute, transitory stomach upsets to chronic or fatal conditions. The role of the NZFSA-ESR science contract is to provide scientific information to allow the NZFSA to manage the risks that are inevitably associated with the food supply that New Zealanders consume.

The last year has seen a consolidation of the risk ranking and profiling activities initiated during previous years. Risk profiling activities during the year included completion of a quartet of risk profiles related to *Salmonella* in poultry and eggs and progressing of all but one outstanding risk profiles to review stage. The development and implementation of a risk ranking methodology, to inform NZFSA risk prioritisation, was further advanced through the year, with a stakeholder meeting helping to define the key risk criteria and an expert consultation used to elicit opinion on data inputs to risk criteria.

During the 2004/2005 year a major survey of bacterial pathogens in uncooked retail meats was concluded. The survey covered *Campylobacter*, *Salmonella* and shiga toxin-producing *Escherichia coli* (STEC), a relative of common gut bacteria with the ability to produce a toxin capable of causing a range of serious outcomes, including kidney damage. The *Campylobacter* component of the project concluded in the previous year. The combined outputs from this study provide an invaluable picture of baseline levels of these pathogens in New Zealand meats.

Risk modelling activities begun in 2003/2004 (*Campylobacter* and *Salmonella* in the poultry food chain) continued during 2004/2005. One issue that was highlighted was the pathogen prevalence and concentrations on birds arriving at the processing facilities. Techniques have been validated to determine the level of *Campylobacter* and *Salmonella* on whole chickens and a survey is now underway to assess contamination of whole birds.

A multi-year project to examine factors in the home that may impact on food safety was begun in 2004/2005. In the initial year the project examined the temperature characteristics of domestic refrigerators and surveyed over 300 people concerning the purchasing, transport, storage, thawing, cooking, and kitchen hygiene practices of New Zealanders in relation to meat and poultry.

Work has progressed well on the flagship dietary chemical exposure study – the New Zealand Total Diet Survey. Testing of the 121 different foods included in the survey for pesticide residues, metal contaminants and some nutrients was completed and the data generated were used to estimate New Zealanders' dietary exposure to these chemicals. The 'whole of diet' approach taken by the Total Diet Survey was complemented by a series of narrowly targeted residue surveys, including analysis of chloramphenicol and nitrofurans residues in imported prawns, antimicrobial residues in pork, and agricultural compound residues in oranges, pears, strawberries, lettuce, potatoes, taro and peanuts.

Some foods sold in New Zealand are permitted to contain fortified levels of certain key nutrients. During 2004/2005 work was initiated to look at the levels and stability of fortified nutrients in foods, to allow more accurate modelling of the impact of fortification on human nutrition. Activity in 2004/2005 focussed on folate and iron.

ESR carries out a number of ongoing functions in support of the NZFSA and Public Health Units. These functions include the investigation of consumer food complaints, provision of current awareness information and consultancy, and testing of export wine samples. With the growth of the New Zealand wine industry, 2004/2005 saw the analysis of record numbers of wine samples, with 4356 samples being analysed compared to 3061 in 2003/2004.

Our work continues during the 2005/2006 year and will see a continuation of a number of major projects described in the current report, including risk modelling activities, domestic food handling investigations, the food residues surveillance programme and investigation of fortification overages. A range of new projects will also be carried out, covering such diverse topics as pet chews as a possible vehicle for *Salmonella*, inactivation of foodborne viruses by low temperatures and assessment of salt levels in New Zealand foods. Work will also continue on risk profiling, to assist the NZFSA in identifying priority issues for further action.

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September 2005

1 INTRODUCTION

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

The Programme is divided into seven Science Service Descriptions:

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

The 2004/2005 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 seven Science Service Descriptions during the year July 2004 to June 2005.

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 activity of ESR so that it also is based on risk assessment.

A key issue facing risk managers is how to rank and prioritise food safety issues, for the allocation of resources. Ranking food safety issues is a strictly scientific process, to be based on defined criteria, and some of the activity in this Science Service seeks to develop a science-based ranking process. Prioritisation is a further risk management process that will incorporate broader considerations that reach beyond the scientific ambit of this Science Service.

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 address risk management of specific issues of importance to public health and standard setting.

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, 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 and several of these are being addressed in the other ESR Science Services. In this way, a systematic risk profiling process has underpinned the significant expansion of microbiological risk assessment in the 2004/2005 contract.

The components of this Science Service during 2004/2005 were:

- Risk Profiles Review
- Risk Ranking

2.1 Risk Profiles Review

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 four Risk Profiles were completed during 2004/2005, with drafts of seven more Profiles and other documents delivered to the NZFSA and stakeholder groups for comment. The additional completed Risk Profiles were:

Lake RJ, Hudson JA, Cressey PJ, Wong TL, Gilbert S. (2004) Risk profile: Salmonella (non-typhoidal) in poultry (whole and pieces). ESR Client Report FW0425. Christchurch: ESR (this is an update of an earlier risk profile).

Wong TL, Gilbert S. (2004) Effect on Salmonella in poultry meats of removal of antibiotics from poultry feed in New Zealand. ESR Client Report FW0430. Christchurch: ESR.

Lake RJ, Hudson JA, Cressey PJ, Gilbert S. (2004) Risk profile: Salmonella (non-typhoidal) in and on eggs. ESR Client Report FW0420. Christchurch: ESR

Wong TL, Lake RJ. (2004) Salmonella spp. in chicken nuggets. ESR Client Report FW0427. Christchurch: ESR.

Seven further Risk Profiles are currently undergoing external peer review prior to being finalised:

Lake RJ, Hudson JA, Cressey PJ, Gilbert S. (2004) Risk profile: Listeria monocytogenes in soft cheeses. ESR Client Report FW0382. Christchurch: ESR

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: Listeria monocytogenes in ready-to-eat salads. ESR Client Report FW0446. Christchurch: ESR

Lake RJ, Hudson JA, Cressey PJ, Gilbert S. (2004) Risk profile: Shiga toxin-producing Escherichia coli in leafy vegetables. ESR Client Report FW0456. 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).

Risk Profiles at the draft stage concern:

Shiga toxin-producing *Escherichia coli* in raw milk

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 Policy Document

This project was intended to develop a scientifically-based process for ranking food safety risks that has broad application, is user friendly, and has wide acceptance by stakeholders.

A risk ranking process usually includes the following steps:

1. Define and categorise the risk to be ranked;
2. Identify the risk attributes (criteria) that should be considered;
3. Describe the risks in terms of the attributes in risk summary sheets;
4. Select participants and perform the risk ranking; and,
5. Describe the issues identified and the resulting rankings.

In the current exercise, the categorisation of risks is covered by the food/hazard combinations used for Risk Profiles.

At a consultation meeting held in July 2004 it was decided that the criteria for ranking would be:

- Public health (incidence of illness apportioned to the food of interest);
- Severity (morbidity, mortality);
- Uncertainty about the risk (quality of data);

Due to uncertainty in describing the food/hazard combinations in terms of these criteria (particularly apportionment), the July 2004 meeting also decided to make Step 3, in the process above, the subject of an expert consultation. This was held in May 2005, and discussed:

- Apportionment of total disease incidence due to transmission in foods in general;
- Apportionment of total disease incidence due to transmission in the specific foods considered in Risk Profiles;
- Severity; and,
- Associated issues, such as the definition of “foodborne”.

The results of this consultation were consolidated into a report, together with quantitative data from surveillance and other sources.

The final step in the risk ranking process is to combine the apportionment and severity estimates. A suggested final ranking was presented.

A final risk ranking process for the NZFSA was suggested as an amended version of the above:

1. Define and categorise the food/hazard combinations whose risks are to be ranked;
2. Assemble available scientific data related to the attributes incidence and severity.
3. Describe the risks in terms of the attributes on the basis of an expert consultation;
4. Combine scientific data and expert consultation to produce the risk ranking; and,
5. Describe the issues identified and the resulting rankings.

Cressey PJ, Lake RJ. (2004) Ranking food safety risks. A prototype methodology (Revised October 2004). ESR Client Report FW0492. Christchurch: ESR.

Cressey PJ, Lake RJ. (2005) Ranking food safety risks. Development of NZFSA policy 2004-2005. ESR Client Report FW0563. 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, 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 risk management options 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 2004/2005 year were:

- Development and Implementation of a National Typing Database: Food Specific Inputs
- Microbiology of Uncooked Retail Meat Products: *Salmonella* and STEC
- Prevalence and Numbers of *Campylobacter* and *Salmonella* on Chickens Prior to Scalding
- Domestic Food Practices
- Temperature Control at Retail Level
- Microbiological Survey of Imported and Domestic Pork: *Salmonella*, STEC and Generic *E.coli*
- Effect of Low Temperature on *Campylobacter* in Poultry
- Further Development of a Risk Model for *Campylobacter* in Poultry in New Zealand
- *Salmonella* – Egg Survey
- Further Development of a Risk Model for *Salmonella* in Poultry in New Zealand
- Comparison of quantitative technologies for STEC and *E.coli* O157 in food
- *Yersinia* in meat: Analytical Development and Survey
- Exposure Assessment of *Listeria monocytogenes* via Unpackaged Ready-to-eat Meats
- Analytical Development: Norovirus Detection
- Pasteurisation Risk Model

3.1 Development and Implementation of a National Typing Database: Food Specific Inputs

Under the auspices of the Enteric Zoonotic Disease Research Steering Committee and with the financial and technical support of NZFSA, ESR is establishing a microbial typing database and network for zoonotic microorganisms, with an initial focus on *Campylobacter*, *Salmonella*, shiga toxin-producing *Escherichia coli* (STEC) and *Listeria*. The project involves standardising Pulsed-Field Gel Electrophoresis (PFGE) subtyping methods

performed in New Zealand (ESR, other CRIs, and Universities) so that it is compatible with, although not limited to, international PulseNet methodology. The database itself will be based on Bionumerics software.

Key benefits include:

- Ensuring comparability between New Zealand laboratories and overseas databases through standard PFGE methods, standardised nomenclature, standard isolates and the electronic comparison of PFGE typing.
- Providing an archive of all PFGE typing that occurs in New Zealand, hence facilitating the extension of epidemiological surveys and outbreak investigations, and more effectively detecting linkages between human case isolates and food/environmental isolates.

The National Typing Database will be an important tool facilitating the identification of factors that, if controlled, should reduce the burden of human gastroenteritis in New Zealand.

The National Typing Database initiative is lead by the ESR Water Quality Group, with ESR's Food Safety Group providing specific assistance including:

- Analysis of a selection of historical isolates to confirm sub-typing in new nomenclature;
- Performing additional analyses, with an additional enzyme, on some isolates to investigate further sub-typing;
- Investigating methods of overcoming PFGE untypability of some isolates; and
- Preparing summary data of the *Campylobacter* database, as an example of how the databases can be used.

Overall, the project has:

- Established PulseNet Aotearoa New Zealand, initially focusing on *Campylobacter*, *Salmonella*, Shiga-toxin producing *E. coli* (STEC) and *Listeria*;
- Implemented the standardised PulseNet USA PFGE methodology for each organism at ESR, and completed initial certification with PulseNet USA;
- Conducted a PFGE and BioNumerics training course in Palmerston North in November 2004 with 29 participants;
- Established a server database for each organism at ESR, which is compatible with the PulseNet USA customised BioNumerics databases. The databases have been set up based on a SQL-platform, and in a way that minimises the effort required to implement future PulseNet USA updates and enhancements.

Cornelius A. (2005) Development and implementation of a national typing database: Food specific inputs. ESR Client Report FW0557. Christchurch: ESR.

3.2 Microbiology of Uncooked Retail Meat Products: *Salmonella* and STEC

A national survey of *Salmonella*, shiga toxin-producing *Escherichia coli* and generic *E. coli* in five types of uncooked retail meats in New Zealand was undertaken from August 2003 to May 2005 to establish baseline proportionality data. Results are summarised in Table 1.

Table 1: Prevalence of *Salmonella* and STEC in New Zealand retail meats

Meat type	Number of samples	Number positive (percent)	Serotypes (number of samples)*#
<i>Salmonella</i>			
Beef	232	1 (0.4%)	<i>S. Infantis</i>
Unweaned veal	183	1 (0.5%)	<i>S. Typhimurium</i> DT 1
Chicken	232	7 (3.0%)	<i>S. Typhimurium</i> DT 1 <i>Salmonella</i> sp 6,7:k:- <i>S. Enteritidis</i> PT9a <i>Salmonella</i> sp. 4,5,12:-:- <i>Salmonella</i> 4,12:-:- (2) <i>S. Typhimurium</i> DT160
Lamb/mutton	230	3 (1.3%)	<i>Salmonella</i> sp. 4:-:2 <i>S. Brandenburg</i> (2)
Pork	231	0 (0.0%)	
STEC			
Beef	233	5 (5.2%)	
Unweaned veal	183	4 (2.2%)	<i>E. coli</i> O157:H7 <i>E. coli</i> O26:H11 (2)
Lamb/mutton	231	34 (14.7%)	<i>E. coli</i> O157:H7 (3)
Pork	231	15 (6.5%)	<i>E. coli</i> O157:H7

* Number of samples containing the serotype is one, unless specified

For STEC, only serotypes carrying shiga toxin, intimin and haemolysin genes are listed here

Low prevalences of *Salmonella* in 1108 samples of retail meats were observed for all meat types. The three *Salmonella* sp. 4,5,12:-:- or *Salmonella* 4,12:-:- isolates from chicken were very similar phenotypically and serologically to the attenuated *Salmonella* vaccine strain used in MeganVac for poultry. One lamb sample enumerated a count of 4.2 MPN/g of *S. Brandenburg* while the other positive samples were all <1.0 MPN/g.

Prevalences of STEC in 878 samples of retail meats were in the range 2.2% (unweaned veal) to 14.7% (lamb/mutton). Chicken was not tested for STEC. There were 65 isolates of STEC of which five *E. coli* O157:H7 (one from unweaned veal, three from lamb/mutton and one from pork) and two *E. coli* O26:H11 (from unweaned veal) isolates possessing *stx* 1 and/or *stx* 2 genes in conjunction with the intimin *eaeA* and enterohaemolysin *hlyA* genes were detected by PCR. These two serotypes are recognised internationally as pathogenic enterohaemorrhagic *E. coli* serotypes. All other STEC isolates including another pathogenically recognised serotype, O113:H21 from beef, did not carry the *eaeA* gene.

Generic *E. coli* counts in 50.8% of meat samples were <5 cfu/g and a further 34.2% were below 100 cfu/g. Less than 13% were above 100 cfu/g and only 2.5% were above 1000 cfu/g. Out of 877 samples of meat, only 0.8% exceeded 5000 cfu/g, the figure regarded as the “M” value for making decisions on acceptance of raw meat preparations by NZFSA (refer to MAF internet website, www.nzfsa.govt.nz).

The results provide baseline information for *Salmonella* and STEC in retail uncooked meats that will facilitate future exposure assessment in light of other information such as consumption data and subsequently quantitative risk assessment.

3.3 Prevalence and Numbers of *Campylobacter* and *Salmonella* on Chickens Prior to Scalding

The risk modelling activity that is currently underway (see sections 3.8 and 3.10) has identified a significant data gap related to the prevalence and numbers of *Campylobacter* and *Salmonella* on freshly slaughtered chickens prior to the first stage of processing. Most processing steps can be modelled as changes in numbers of organisms on carcasses, but the initial distribution of numbers of organisms is required so that the model can produce a distribution of numbers after processing. Without these data, we have to use information from overseas that could differ from the New Zealand situation.

The sampling plan included 200 feathered broilers to be sampled following ex-sanguination, but prior to scalding, from four poultry processing plants in New Zealand, two in the North Island and two in the South Island. All three major poultry companies were represented in this plan. Five chickens were sampled from each premises per month and, at the end of the schedule, 40 flocks of chickens will be represented in this survey.

Interim results from 16 flocks of chickens showed presence of *Campylobacter* on the outside (feathers and skin) of all birds in all flocks. *Campylobacter* was not isolated from caecal swabs of chickens from two flocks (presence of pathogen in caeca indicates that the bird is infected). This meant that 2/16 flocks (12.5%) showed contamination of *Campylobacter* on the outside feathers and skin acquired elsewhere, possibly from transport cages and faecal material in the holding pen at the start of the processing line. Counts on these two flocks were between 6 and 300 MPN per bird. *Campylobacter* counts on the other 14 positive flocks ranged from 10^3 to 10^8 cfu/bird with more than 50% of birds with counts in the range of 10^6 to 10^7 cfu/bird. Most were identified as *C. jejuni* while one of the low count flocks showed presence of *C. coli* only.

Salmonella was found on five flocks. The majority of the *Salmonella* counts were below 300 MPN/bird with the highest count being 600 MPN/bird from one chicken. The serotypes isolated were *S. Tennessee* (4/16), *S. Infantis* (1/16), *S. Typhimurium* DT101 (10/16) and DT12a (1/16). All *Salmonella* isolations were from the South Island.

The project will continue during the 2005/2006 year.

3.4 Domestic Food Practices

A significant proportion of foodborne illness is thought to be caused by unsafe food handling practices in the home. Data on the food handling practices of New Zealanders are limited. This project was initiated to provide more, and better targeted, information on domestic handling of meat and poultry in New Zealand. The information is needed to support risk assessment by the NZFSA, particularly the development of quantitative risk models to assess potential interventions.

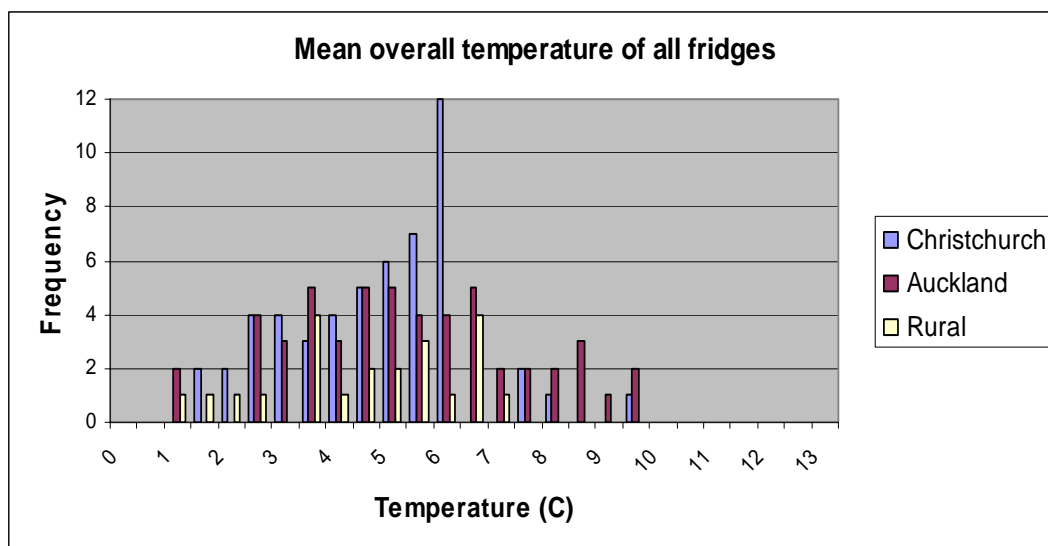
The project is to be carried out over two years; July 2004 – June 2006. During the 2004/2005 year, the project developed and administered two surveys and collected refrigerator internal temperature data using data loggers.

The refrigerator survey and temperature data collection were drawn from 105 respondents in Auckland and Christchurch (personal contacts of ESR staff in both cities). Contact with rural respondents was made via a Federated Farmers newsletter. There were 22 rural participants from across New Zealand.

The meat and poultry handling surveys were administered by post to 1000 New Zealanders chosen at random from the electoral roll. The response rate of useable completed surveys was approximately 33%.

Refrigerator survey results indicated that 84/127 (66%) were operating in the recommended range, with a mean temperature below 6°C (a tolerance of 1°C was applied to the preferred temperature of below 5°C as the accuracy of the data loggers was stated to be $\pm 1^\circ\text{C}$). However, one third (43/127; 34%), had a mean temperature of above 6°C. The overall distribution of refrigerator temperatures is shown in Figure 1.

Figure 1: Mean overall temperature; Christchurch, Auckland and Rural refrigerators



The meat and poultry handling survey provided information on the purchasing, transport, storage, thawing, cooking, and kitchen hygiene practices of New Zealanders.

The results of the refrigerator and meat and poultry handling surveys suggest that a high proportion of New Zealanders are at least aware of good practices in domestic kitchens in terms of food safety. Estimates of the prevalence of potentially unsafe practices are probably conservative, as an Australian report indicates that observational studies show a higher rate of unsafe practices than that found by survey methodology.

These results will be useful for a number of purposes; principally quantitative risk assessment models. Other uses will include food safety promotion efforts to domestic consumers, via the Foodsafe Partnership.

Gilbert S, Lake R, Whyte R, Bayne G. (2005) Domestic food practices in New Zealand. Refrigerator survey and meat handling survey. ESR Client Report FW0542. Christchurch: ESR.

3.5 Temperature Control at Retail Level

A number of quantitative risk assessments for major foodborne microbiological hazards, currently under development, require a better understanding of the temperature control of meat during retail processing and storage in order to determine the potential for bacterial pathogens to increase at different stages in the retail chain.

This project focused on two parts of the retail chain; transport from the slaughter facility to the retail outlet and storage and processing at the retail level. Temperature readings were gathered using a combination of data loggers and infrared thermometers. Results from the transport temperature study were examined in relation to the New Zealand Industry Standard for transport and storage (IS9).

On the majority of occasions meat was transported in such a manner that the preservation temperature (7°C) of products was maintained throughout transport, thereby controlling growth of pathogenic bacteria, even in warmer summer conditions.

Results from the survey of meats on retail display also indicated that temperatures are being well controlled, with only 1% of readings exceeding 13°C, the maximum storage temperature allowed by the Food Hygiene Regulations. Where both window display cases and non-window display were used to store meat, it was found that in most cases the temperatures were higher in window displays.

Whyte R. (2005) Temperature control of meat at retail level. ESR Client Report FW0558. Christchurch: ESR.

3.6 Microbiological Survey of Imported and Domestic pork: *Salmonella*, STEC and Generic *E.coli*

A qualitative pathogen (*Salmonella* and *E. coli* O157:H7) and quantitative generic *E. coli* survey in uncooked New Zealand-produced and imported pig meat was undertaken. The aim was to use the study as a pilot survey to guide pending development of a domestic pork National Microbiological Database, as well as providing data to assess likelihood of introduction of novel pathogen serotypes.

A total of 100 New Zealand-produced pig carcasses and 110 imported pig meat samples were obtained from two pork-processing premises in New Zealand, one in the South Island and the other in the North Island. Carcasses were swabbed with a sponge using a 100 cm² template. Imported pig meat was sampled by excision or swabbing.

Salmonella prevalence in Australian pig meat was 6.2% (4/65) while overall prevalence for imported pork was 3.6%. The serotype isolated was *Salmonella* London. *Salmonella* was not isolated from 19 Canadian and 26 USA pig meat samples or from New Zealand-produced pig carcasses.

Escherichia coli O157:H7 prevalence in Australian pig meat was 3.1% (2/65), with an overall prevalence of 1.8% for all pig meat imported into New Zealand. One *E. coli* O157:H7 isolate carried only the shiga-like toxin 2 (*stx2*) gene while the other carried both *stx1* and *stx2* genes. Other virulence factors, intimin (*eaeA*) and the enterohaemolysin (*hlyA*)

genes, were also detected by PCR. Both isolates can be regarded as virulent strains, pathogenic to humans. The prevalence of *E. coli* O157:H7 in New Zealand produced pig carcasses was 1%.

Low generic *E. coli* counts indicate that the hygiene quality of New Zealand-produced and imported pig meat is good. Only one New Zealand-produced pig carcass swab and two excised imported pig meat samples exceeded 100 cfu/cm². However, when a generic *E. coli* count of 100 cfu/cm² or gram was arbitrarily used as a criterion to separate good and poor hygiene quality, this survey found no correlation between hygiene quality and the presence of *Salmonella* or *E. coli* O157:H7 in pig meat.

In conclusion, *Salmonella* London was isolated from uncooked Australian pig meat and *E. coli* O157:H7 from imported pig meat and New Zealand-produced pig carcasses at a very low prevalence. Importation of uncooked pig meat is a potential route for the introduction of new clones of such pathogens into New Zealand. However, effective control of prerequisite programmes in Food Safety Plans operating in pork processing premises should limit the potential for spread to the consumer as well as occupational exposure to these pathogens.

Wong TL. (2005) *Microbiological survey of imported and New Zealand pork: Salmonella, generic Escherichia coli and E. coli O157:H7. ESR Client Report FW0565. Christchurch: ESR.*

3.7 Effect of Low Temperature on *Campylobacter* in Poultry

The main objective of this work was to identify a potential means to reduce the burden of campylobacteriosis in the New Zealand population by reducing the numbers of *Campylobacter* on fresh poultry meat. An assessment was made of the effectiveness of freezing or chilling in the reduction of *Campylobacter* numbers achieved under standard industry practice, and under potential new chilling regimes. While adequate cooking of food is the most important means of control, control during processing is recognised as important for the reduction of exposure to the hazard by the consuming population.

The information from this project will feed into a risk model for *Campylobacter* in poultry meat and assist the assessment of risk management options undertaken using the risk model.

Work was carried out in three parts:

- A literature review was undertaken to define “freezing” under New Zealand law and in scientific terms, to determine what potential chilling and freezing regimes were legal in New Zealand;
- A survey was conducted to measure the effect of current “crust freezing” techniques used by industry on surface numbers of *Campylobacter*; and
- Laboratory experiments were carried out to determine the effect of freezing temperatures on the reduction of *Campylobacter* numbers.

Current industry practice uses a temperature reduction from 0 to –2°C over 110 minutes, followed by holding for 150 minutes. Product is then allowed to warm to 2°C over the following 24 hours. This practice, termed “crust freezing” was developed to extend shelf life rather than for the purpose of reducing numbers of *Campylobacter*. Results of the survey

showed that the crust freezing process does not result in a statistically significant reduction in *Campylobacter* numbers.

Laboratory experiments, in which a range of isolates of *C. jejuni* were chilled in sterile chicken drip to five final holding temperatures ranging from -2 to -10°C , showed no change in numbers after chilling and there was no evidence of cellular injury. In a further set of experiments a cocktail of three *C. jejuni* isolates was inoculated onto the skin of chicken portions, and chilled to -2 or -10°C under two different cooling profiles. The final count on chicken portions chilled to -2°C did not differ from the pre-cooling count. When chilled to -10°C an approximate $1 \log_{10}$ difference in counts could be measured, with the most likely reason being the time for which the samples were frozen (around 19 hours compared to 4 hours at -2°C).

While the potential for freezing to be used as a means of reducing *Campylobacter* numbers has been shown in this work, the required freezing rates and temperatures are likely to lie in a range that; i) currently would not be legally permissible, and ii) would require a significant investment from industry in order to move away from its current practices.

Whyte RJ, Hudson JA, Turner NJ. (2005) *Effect of low temperature on Campylobacter on poultry meat. ESR Client Report FW0593. Christchurch: ESR.*

3.8 Further Development of a Risk Model for *Campylobacter* in Poultry in New Zealand

This project continues the development of a quantitative risk model to investigate *Campylobacter* spp. contamination in the processing and consumption stages of the New Zealand poultry food chain.

Model outputs are intended to describe the exposure of New Zealanders to *Campylobacter* from poultry, in terms of probability that an exposure (e.g. a poultry meal) will be contaminated, and if so, the numbers of bacteria involved. The purpose of the model is to assess the effect of changes in the poultry food chain on that exposure. This is intended to support the development of risk management measures by the NZFSA.

The model describes each step in the chain as distributions of the likelihood of contamination with *Campylobacter* and the numbers of bacteria present. Within a risk assessment, the model output (exposure) can be applied to dose response information to provide a risk characterisation that predicts the numbers of infected (or ill) people. However, there is considerable uncertainty in this prediction for a number of reasons. This step has been included in the current model, but with appropriate caveats.

The model itself consists of two computer files written using the @RISK software:

- Flock sequence model; and,
- Processing model.

The model examines the effect on the prevalence and numbers of bacteria through the primary processing steps for poultry, including cross contamination at the defeathering stage. It then considers cross contamination and freezing effects during further (secondary) processing). The carcasses are then directed into one of two channels: domestic, and

foodservice. The foodservice channel is then further split into three: fast food/deep fried outlets, restaurants, and “other”.

In each of these channels, the likelihood and numbers of bacteria in four potential exposures are considered: during food purchase, during food preparation, cross-contamination to a secondary food, and undercooking.

Model outputs indicate a modest decrease in the prevalence of contamination (by approximately 20%) during primary processing. However, the numbers of bacteria on a carcass reduce markedly, from a mean of $\log_{10}\text{cfu}/\text{carcass} = 6$ at entry, to $\log_{10}\text{cfu}/\text{carcass} = 2$ after the chiller.

The number of positive exposures is heavily weighted to the domestic channel (approximately 90%) over the foodservice channel. The probability of infection is greatest for food handling, followed by cross-contamination and food purchase. Undercooking represents only a small contribution to the overall probability of infection.

The model outputs appear reasonable, given the available data from New Zealand for contamination prevalence, and incidence of illness. The current model appears to underestimate the prevalence of contamination in the fresh poultry supply, suggesting that it is conservative in this area. One possible reason for this underestimate is that estimates of cross-contamination during further processing are too low. The potential for cross-contamination during handling in supermarkets has not been explicitly included.

The outputs suggest that poultry is a significant source of exposure and human infection, and exposure via the domestic channel is more important than via the foodservice channel. This would be expected as the majority of poultry is consumed via the domestic channel.

Sensitivity analyses indicate that the most important factor for reducing infections from *Campylobacter* in poultry is to reduce the numbers of bacteria on birds entering processing. Analyses also suggest that gains from changes in domestic practices are minor; the most important factors are “on farm” and during processing.

The model is flexible, and can be readily altered to accommodate different conditions; the effects of logistic slaughter and freezing have been investigated in this report. The former appears to produce only modest reductions in numbers of infections, while the effect of freezing the entire supply does reduce infection considerably, as would be expected. The feasibility of the freezing option is another matter.

This model is still in development, but is already useful for evaluating risk management options. At present survey results on domestic food handling in New Zealand are being analysed, and a survey to determine the numbers of *Campylobacter* on birds entering processing is also in progress. These studies will produce additional data, which will refine the model. In addition, an extensive peer review process is now necessary to consolidate the model as a risk management tool.

Lake RJ, Hudson JA, Cressey PJ, Bayne G. (2004) Quantitative risk model: Campylobacter spp. in the poultry food chain. ESR Client Report FW0520. Christchurch: ESR.

3.9 *Salmonella* – Egg Survey

The scope of this project was expanded after discussions with the New Zealand Egg Producers Federation. It was agreed that the project would consider free-range and barn-produced eggs, in addition to testing of eggs from caged birds. Sampling will be split 50:30:20 between caged, free-range and barn-laid eggs respectively. The changes to the project mean that this work will be largely carried out in the 2005/2006 year.

3.10 Further Development of a Risk Model for *Salmonella* in Poultry in New Zealand

A quantitative risk model is a computer-based mathematical description of a process, to be used as a tool for evaluating the effect of changes in that process. This report describes the further progress in the development of a quantitative risk model to evaluate the prevalence and counts of *Salmonella* spp. in the New Zealand poultry food chain. The report covers work during 2004/2005, which has expanded on that undertaken in 2003/2004.

The prevalence of *Salmonella* in the New Zealand poultry food supply dropped markedly during the 1990s, as a result of risk management efforts by member companies of the Poultry Industry Association of New Zealand (PIANZ). The prevalence of contamination in whole bird rinses from the end of the processing chain (data collected for the National Microbiological Database) was 2.0% in 2003, while interim results from a 2003/2004 survey of raw chicken mince available for retail sale showed a contamination prevalence of 1.4%. By comparison with the prevalence of contamination of retail poultry products overseas, (e.g. 41-53% in Australia), this indicates good control of *Salmonella* contamination in broiler production and processing.

Consequently the purpose of the *Salmonella* model is not to support the development of new risk management measures, but (as described in the project specification) to:

- Elucidate the influences on *Salmonella* prevalences and bacterial counts in poultry in New Zealand, in order to support the maintenance of, and to improve, existing control measures;
- To evaluate poultry and livestock rations as a hazard pathway; and,
- To identify data gaps and direct future research requirements.

While the prevalence of contamination of poultry by *Salmonella* is generally low, there is the potential for occasional “spikes”, caused by the contamination of birds on farms. One such event occurred in the first half of 2003 when an increased isolation of *Salmonella* Typhimurium DT1 and DT12a was detected from chickens processed in Canterbury. This was caused by *Salmonella* contamination of feed.

During 2003/2004 the principal activities under this project were:

- Review of existing models from overseas for *Salmonella* in the poultry food chain;
- Collation of New Zealand information, on *Salmonella* in poultry, the poultry food chain, and poultry feed production;
- Collation of information from the scientific literature, including information on the effect of poultry processing on *Salmonella*, as well as the effects of feed production and on-farm activities on the prevalence and counts of *Salmonella* in poultry;

- Liaison with the poultry industry, via meeting attendance and correspondence.
- Development of overall strategy for the *Salmonella* in poultry model, taking account of the New Zealand situation.

During 2004/2005 the following activities were undertaken:

- Construction of an overview of the structure of the New Zealand poultry industry, in terms of companies, production and distribution, with review by PIANZ;
- Communication with a UK modelling group working on the same issue. This group was lead by Tom Orton of the Silsoe Research Institute (although they have now been closed down). The modelling approaches taken by this group have been published and the UK group has generously supplied reports and software from their models.
- Preliminary adaptation of the UK group's models for New Zealand.
- Investigation of feed production practices in New Zealand, with a visit to two North Island feedmills.
- Updated review of scientific literature on the effects of primary poultry processing for the effect of *Salmonella* prevalence and counts in broilers.
- Consideration of growth models for *Salmonella* to be included in the model.
- Liaison with the poultry industry, including a visit to a meeting of the PIANZ Technical Committee in November 2004.

In the 2003-2004 report, appendices were included which summarised existing models for *Salmonella* in poultry, and the scientific literature with respect to effects on *Salmonella* during feed production, on-farm, and primary processing. These have not been included in this report, although the latter file has been updated during the 2004-2005 year.

Lake RJ, Hudson JA, Cressey PJ, Bayne G, Turner N. (2004) Quantitative risk model: Salmonella spp. in the poultry food chain. ESR Client Report FW0546. Christchurch: ESR.

3.11 Comparison of quantitative technologies for STEC and *E.coli* O157 in food

An Association of Analytical Chemists (AOAC) Official Method for the enumeration of *Escherichia coli* O157 from food is available, but there is currently no standard method available for enumeration of other shiga toxin-producing *E. coli* (STEC).

The hydrophobic grid membrane filtration (HGMF) based Official Method would require a small investment in testing apparatus, has a relatively short turnaround time for results, is relatively inexpensive, would require only basic microbiology skills, and may be able to be adapted to enumerate STEC by careful choice of media. However, the detection limit (10 MPN/g) may not be adequate to detect the low numbers of bacteria expected in most foods.

The most probable number (MPN) technique is the most sensitive method for enumeration, has very good specificity for *E. coli* O157, requires no capital outlay and only basic microbiology skills. Disadvantages of this technique are the increased cost associated with testing multiple tubes, lack of specificity for STEC and the longer turnaround time. Careful choice of enrichment and plating media and screening of tubes using serological or molecular methods could allow this sensitive technique to be adapted for enumeration of STEC and *E. coli* O157 from food.

Other culture techniques, including colony counting methods, membrane filtration and impedance, either lack sensitivity or are seldom reported in the literature.

Stained-cell counting methods are very specific for *E. coli* O157 but their dependence on specific antibodies makes them less useful for the detection of less well-characterised STEC serotypes. These techniques, although very rapid and providing an indication of viability, require capital investment and are less sensitive than HGMF and MPN methods.

Polymerase chain reaction (PCR) methods, particularly real-time PCR, have the potential to be very sensitive, rapid enumeration methods for STEC and *E. coli* O157 in food. Currently, however, the techniques are unable to ensure counted cells are viable, require significant capital outlay, advanced technical skills and have detection limits too high to be useful for detection of low numbers of these pathogens in food.

Cornelius A. (2005) Comparison of quantitative technologies for STEC and E. coli O157 in food. ESR Client Report FW0487. Christchurch: ESR.

3.12 *Yersinia* in meat: Analytical Development and Survey

This project aimed to develop a method to allow the detection of virulence plasmid-bearing *Y. enterocolitica* present in enrichment cultures and to be able to isolate colonies of that organism. It is a continuation of work carried out in 2004/2005.

Methodology included, enrichment of meat surface swabs using Ossmer broth followed by KOH treatment and plating to CIN agar. This allowed the isolation of a number of *Y. enterocolitica* serotypes inoculated at numbers in the range of 10-20 cfu/cm². PCR analysis enabled detection of the organism in the enrichment broth, so presenting an opportunity to use this method to screen positive samples prior to conventional culture.

The isolation of *Y. enterocolitica* to date has been difficult and prevented survey work from commencing, but the method developed overcomes this problem. The use of the PCR to screen out negative enrichments will allow isolation attempts by conventional means to be made for pathogenic *Y. enterocolitica* in a targeted manner. Development of this method gives the opportunity to initiate prevalence surveys of New Zealand foods, and to work towards quantitative methods to provide data for risk assessments.

Hudson JA, Cornelius AJ, Turner N, Bigwood T, Monson S. (2005) Detection and isolation of Yersinia enterocolitica from raw pork. Prepared for submission to the Journal of Applied Microbiology.

3.13 Exposure Assessment of *Listeria monocytogenes* via Unpackaged Ready-to-eat Meats

This project was designed to produce data on the prevalence and numbers of *L. monocytogenes* in unpackaged ready-to-eat meats, to enable this transmission route to be evaluated in terms of relative exposure of the consumer population.

A total of 120 unpackaged ham samples, purchased from retail outlets in Auckland, Wellington and Christchurch, were examined for the presence and number of *L. monocytogenes* after storage in a laboratory refrigerator for one week at 4°C (to simulate domestic storage conditions). Of the samples tested five (4.6%) contained *L. monocytogenes*, and of these three were at numbers beneath the level of enumeration (50 cfu/g), while two contained 50 cfu/g. In addition four samples contained *Listeria* spp., three being *L. innocua* (two <50 cfu/g and one 230 cfu/g), one of which also contained *L. monocytogenes*, and one *L. welshimeri* at <50 cfu/g.

In other experiments attempts were made to identify contaminated batches of ham and to incubated them at 4°C over 22 days to assess the rate of growth of natural contaminants in this food. No batch of ham containing *L. monocytogenes* was identified, but to date, one containing *L. welshimeri* and another *L. innocua* have been incubated and enumerated as described. The number of *L. welshimeri* was shown to increase from 250 cfu/g at day two to 3,700 cfu/g at day 22.

Listeria monocytogenes was isolated infrequently from the ham samples tested, and when present was at low numbers. Growth of naturally occurring *Listeria* spp. in ham at refrigeration temperatures was slow, and moderate levels were reached only after incubation periods which would be most unlikely to occur in foods deemed fit to be consumed. Ham sold unpackaged from delicatessens seems likely to contribute only in a minor way to the burden of foodborne listeriosis in New Zealand.

Cornelius AJ, Hudson JA. (2005) Exposure assessment to Listeria monocytogenes via unpackaged ready-to-eat meats. Prepared for submission to the Journal of Applied Microbiology.

3.14 Analytical Development: Norovirus Detection

This project was initiated during the 2003/2004 year. During year two of the project, evaluation of norovirus recovery methods from oysters and development of a generic norovirus real-time RT-PCR assay have continued.

Further evaluation of three virus recovery methods (alkaline elution, acid adsorption and protease digestion) was carried out using oysters seeded with different concentrations of norovirus in controlled experiments. These experiments were carried out to determine which method to select as the recommended method for regulatory use in New Zealand. The results of trials showed that the protease digestion method was superior for recovery of norovirus from oysters when seeded with both low and high concentrations of norovirus. This method was then used in a series of experiments to examine various parameters and determine the optimum conditions required for virus recovery. The theoretical limit of detection and the limit of quantitation for this method were also estimated from real-time RT-PCR

experimental data generated in this study using shellfish seeded with both noroviruses and norovirus Armored RNA.

For seeding experiments, sensitive real-time norovirus assays specific for the norovirus inoculum strains were used to determine virus recovery. Development of generic norovirus real-time assays that detect the full range of New Zealand Genogroup I and Genogroup II norovirus strains has been more problematic. A number of norovirus real-time assays have now been reported in the literature. Four of these have been tested in this project. The Japanese GI real-time assay and a combination GII assay using French primers and Japanese probes have performed best for detection of New Zealand norovirus strains and so have been selected for use in the detection of norovirus in shellfish.

During the year the ESR Food and Environmental Virology Laboratory participated in three European Community Reference Laboratory (ECRL) Ring Trials for the detection of norovirus and hepatitis A virus. ESR's results for both the norovirus and hepatitis A virus trials were in accordance with expected results and within acceptable limits.

Greening GE, Hewitt J. (2005) Improved methods for recovery and detection of Norovirus from shellfish and foods. ESR Client Report FW0597. Porirua: ESR.

3.15 Pasteurisation Risk Model

The NZFSA is in the process of establishing the level of consumer protection provided by pasteurisation as part of a risk assessment for dairy products in New Zealand. The risk assessment will provide a tool for the comparative evaluation of alternative dairy processing options.

The project will develop a model that describes the level of protection through the dairy food chain. The model has a series of modules, with ESR primarily undertaking the development of the domestic handling module. Domestic handling is described as the part of the dairy food chain from consumer purchase to consumption. The module is intended to include practices that may result in the cross-contamination of products in the home, and practices that may allow the survival and growth of the identified pathogens in the product.

As model development will principally occur in 2005/2006, computer modelling has been postponed, in order to make sure that ESR activity is complementary to that undertaken by NZFSA and Fonterra. Instead, this project has concentrated on assembling relevant information from New Zealand and overseas.

The major activities during 2004/2005 have been:

- Obtaining and reviewing the Food Handling Practices Model, developed by the US Food and Drug Administration, for its value to the current project;
- Review of scientific literature information on spoilage of dairy products (spoilage may prevent consumption of foods in which pathogen numbers have reached high levels);
- Evaluation of National Nutrition Survey and Child Nutrition Survey data on consumption of dairy products; and,

- Attendance at an initial meeting of the scientists convened to plan the experiments concerning the efficacy of pasteurisation.

Useful information concerning refrigerated storage as part of domestic food handling, and food consumption by susceptible groups will derive from other ESR projects to be undertaken in 2005/2006.

Hudson JA, Cressey PJ, Lake RJ, Bayne G. (2005) Pasteurisation risk model. Development of domestic consumption module 2004-2005. ESR Client Report FW0560. Christchurch: ESR.

4 GENERIC

The single project carried out under this Science Service during 2004/2005 was:

- Assessment of Food-borne Disease Outbreaks/Human Health Surveillance Interface

4.1 Assessment of Food-borne Disease Outbreaks/Human Health Surveillance Interface

This report was commissioned by the New Zealand Food Safety Authority (NZFSA) to evaluate current foodborne disease surveillance in New Zealand as part of a programme to improve the quality of epidemiological information that is gained from foodborne disease surveillance, investigation and reporting.

The evaluation used the framework from “Updated Guidelines for Evaluating Public Health Surveillance Systems” published by the Centres for Disease Control (CDC, USA) 2001.

Human foodborne disease surveillance in New Zealand is primarily a subset of the enteric disease components of the communicable disease and outbreak surveillance system. The key sources of communicable disease surveillance data in New Zealand evaluated in this report are: national notifiable disease and outbreak surveillance system (EpiSurv), laboratory-based surveillance, FoodNet, and the ESR Enteric Reference Laboratory.

Analysis of EpiSurv data was supplemented by information derived from interviews with a sample of Public Health Unit staff, and comments by ESR staff involved in preparing risk assessment and other reports for the NZFSA from a national perspective.

The usefulness of the surveillance system in relation to enteric disease is rated high.

Enteric disease is detected in a timely manner permitting effective management (e.g. of potential contacts in the workplace) and incidence and trends are captured and analysed, at both the local PHU and national levels.

There are some qualifications to this rating:

- There are a number of barriers to people with enteric disease presenting to the health system and being captured by the surveillance system. These contribute to under-reporting of enteric disease. These factors include:
 - Mild symptoms of self-limiting disease;
 - Lack of awareness by the public regarding who to contact;
 - Socioeconomic barriers to seeking treatment;
 - Cases with gastrointestinal symptoms for which GPs do not request a specimen;
 - Laboratory confirmed cases for which GPs do not pass on information to PHUs; and
 - Self reported cases (to PHUs) that do not provide a specimen, and outbreaks that occur within a household (i.e. likely to be caused by person to person transmission) are less likely to be reported.

- Enteric disease outbreaks and dispersed events occurring across regions appear less likely to be recognised.
- There is an inherent bias in reporting, as cases where a pathogen has been identified are much more likely to be notified.

In terms of the surveillance of foodborne disease however, the usefulness of the surveillance system is rated low to medium. Foodborne disease is difficult to identify amongst the overall reporting of enteric disease (from all transmission routes). The system also provides little information regarding the magnitude of foodborne disease, detection of trends, and the assessment of the effect of risk management measures.

The main reasons are as follows:

- Not all potentially foodborne diseases are notifiable (although outbreaks of disease caused by non-notifiable pathogens may be identified);
- No risk factor information at all is collected or reported for a high proportion of potentially foodborne enteric disease cases;
- Food vehicles are rarely identified definitively, either for outbreak or sporadic cases; and,
- The reported information in defined fields can be at variance with that given in comments or free text fields.

In terms of providing information for risk assessment the surveillance system is also rated low to medium. Of considerable value is the national coverage, allowing comprehensive overviews of enteric disease incidence to be assembled for New Zealand. However, while foodborne transmission is often suspected, it is rarely confirmed by epidemiological or laboratory studies. There is limited information available to assign proportionality of foodborne transmission amongst other potential routes. Surveillance information must be reviewed carefully (often “line by line” and considering text comments) to assess the reliability of any conclusions drawn.

Comments regarding foodborne disease surveillance system attributes (as listed for review by CDC) are as follows:

System Attribute	Comment
Simplicity	The notifiable diseases surveillance system appears to be functioning well at the national and local level, suggesting that the complexity is not a barrier to PHU participation (except perhaps for outbreak reporting). FoodNet appears to be more complex, and the relationship with EpiSurv incomplete, thus inhibiting use of this database for surveillance purposes.

System Attribute	Comment
Flexibility	The notifiable diseases surveillance system appears to be highly flexible with opportunities for generic or unexplained illnesses (“gastroenteritis”) reporting alongside the more well-defined specific illnesses. The management of data on a national basis within a single organisation (ESR) readily allows modifications to be made in response to national or local needs. At a national level, EpiSurv data are readily collated and analysed for review for risk assessment. The fact that several PHUs have developed “in house” programmes to extract and analyse data at a local level suggests that analytical potential needs to be improved. One aspect of flexibility needs to be improved: EpiSurv reporting forms are primarily designed for data entry and database needs; tools for information collection and write-up at the PHU level need to be developed.
Data quality	Data quality is uneven. For enteric disease surveillance the data quality is high, with demographic and pathogen data reported for a high proportion of cases, and laboratory confirmation obtained for the vast majority. Timeliness for data entry is good, although delays between onset of symptoms and reporting are too long (however, this is outside the control of the surveillance system). Data quality for surveillance of foodborne disease is rated poor for the reasons given in Section 6.1 i.e. risk factor information is incomplete, food vehicles are rarely identified definitively, and the reported information may be internally contradictory.
Acceptability	The willingness of PHUs and laboratories to participate in the surveillance system appears to be very high. The failure to collect risk factor data for certain types of illness, or the lack of investigation, is a resourcing issue. There appear to be some barriers to participation by GPs, related to resources available to transmit information, or privacy issues.
Sensitivity	The sensitivity of the communicable disease surveillance system in terms of the proportion of cases of serious disease detected is generally high. Most, if not all cases of serious potentially foodborne illness will be captured by one of several reporting channels (GPs, laboratories, hospitals, PHUs). For potentially foodborne enteric infections where it is acknowledged there are many cases in the community which do not come to the attention of the health system, New Zealand reported rates of illness are similar (or higher) than other developed countries. It seems reasonable to conclude that the system will be sensitive to changes in rates. Considering sensitivity in terms of the ability to detect potentially foodborne outbreaks and unusual pathogens, this is also high, with PHUs regularly (daily or weekly) examining local notification data, and typing information from the Enteric Reference Laboratory augmenting notification data. An exception is dispersed events occurring across boundaries where a more intensive national overview appears to be desirable.
Predictive value positive	The predictive value positive of the communicable disease surveillance system is high, with almost all cases confirmed by laboratory identification of a pathogen.

System Attribute	Comment
Representativeness	<p>The representativeness of the communicable disease surveillance system in terms of foodborne disease is poor. This derives from a number of factors:</p> <ol style="list-style-type: none"> 1. Underreporting: not all cases of illness will come to the attention of the health and surveillance systems. This is due to a variety of reasons as described above. 2. Not all potentially foodborne diseases are notifiable. 3. Risk factor information is collected and reported for only a proportion of potentially foodborne illness cases. 4. A transmission route of any kind is reported as “suspected” for only a small proportion of enteric illness cases, and rarely reported as “definite”. 5. There is a variety of approaches to the follow-up and investigation of potentially foodborne illness; 6. Not all information related to investigations is captured by the national surveillance system, with write-ups at a PHU level not always being forwarded to EpiSurv; and, 7. Investigations that are carried out principally involve food premises, with illness associated with other settings rarely examined. 8. The opportunity to confirm or exclude a source of infection for notified cases through analysis of samples provided to the PHLs is not fully utilised, through incomplete connection between laboratory results, FoodNet, and EpiSurv. 9. Isolates submitted to the Enteric Reference Laboratory are a subset of those from human cases; most submitted isolates are matched to cases in EpiSurv to supplement other data, but for campylobacteriosis and yersiniosis few isolates are received.
Timeliness	<p>The timeliness of reporting of potentially foodborne illness from a national perspective is rated good, with an Auckland study finding that the average reporting delay was 2 days, and most cases notified within one week. However, at a PHU level this is too slow, with daily updates being required for public health management. A similar comment applies to reporting channels from EpiSurv; monthly and annual summaries being acceptable for risk assessment purposes, but too slow for local issue management.</p>
Stability	<p>This system attribute is rated high, in terms of potentially foodborne disease. The surveillance system has been stable for several years (at least since the early 1990s), enabling the comparison of disease rates across time.</p>

The communicable disease surveillance system has the potential to provide high quality foodborne disease surveillance, but incompleteness of data gathering/entry, as well as inconsistency in follow-up and investigative practices means that the available information from a national perspective is incomplete and of limited utility.

Lake RJ, Whyte R, Kliem C. (2005) Evaluation of foodborne disease outbreaks/human health surveillance interface. ESR Client Report FW0522. Christchurch: ESR.

5 CHEMICAL FOOD SAFETY

International food chemical safety issues such as dioxins in Belgian foods, illness from Coca-Cola in Europe, Genetically Modified Foods (GMFs), chloropropanols in soy-based foods and acrylamide have seen food safety become a very high priority concern.

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 it may identify potential issues that may subsequently lead to targeted follow up compliance monitoring, possible food recalls, review of food regulations, encouragement to industry to adopt safer food manufacturing processes, and/or appropriate advice to consumers, amongst other risk management/communication options.

An on-going commitment to risk-based chemical surveillance 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 food chemical surveillance ultimately aims to improve food safety in New Zealand.

Projects included in this Science Service in 2004/2005 were:

- 2003/2004 New Zealand Total Diet Survey
- Food Residues Surveillance Programme
- WHO Global Environment Monitoring System/ Food
- Genetically Modified Food Analysis and Capability Development
- Fortification Overages of the Food Supply
- Kelp as a Food Ingredient
- Sulphite, Sorbate and Benzoate Dietary Exposure and Risk Assessment – Children
- Food Allergen – Capability Extension
- Acrylamide

5.1 2003/2004 New Zealand Total Diet Survey (NZTDS)

The NZTDS is a large and complex study, and this current survey is the sixth in the last thirty years. All previous surveys were undertaken by the New Zealand Ministry of Health (MoH). The recently established NZFSA is responsible for the sixth NZTDS.

The primary focus of the NZTDS is to assess dietary exposure to chemical residues, contaminant elements and selected nutrients, from 121 representative foods, across the average diet of different age-sex groups within the New Zealand population. Sampling of foods occurred during 2003 and 2004. Sampling covers one whole year and is broken up into quarterly activities.

A distinguishing characteristic of Total Diet Studies (TDSs), including the NZTDS, is that foods are analysed on an 'as consumed' basis (i.e. banana, peeled; meat, cooked). The NZTDS thus provides an assessment of any potential risk to the consumer at the point of consumption of the food, contrasting with commodity-based surveillance or monitoring, which analyses foods as they are available for sale or 'as produced' (i.e. bananas, whole with skin; meat, raw).

The two main approaches to the aggregation of food samples in Total Diet Studies are the individual foods approach, in which all foods are kept separate for analysis, and the food composite approach, in which foods are blended to form food group composites, such as 'Grain foods'. The individual representative foods approach was used in the 2003/04 NZTDS. This allows greater flexibility with regard to assessing the dietary exposures of different age-sex groups within the population and tracing back issues to key foods.

The NZTDS contributes to New Zealand's international commitments and obligations, such as the World Health Organization Global Environmental Monitoring System Food programme (WHO GEMS/Food), the Codex Alimentarius Commission, the FAO/WHO Joint Expert Committee on Food Additives (JECFA), and the FAO/WHO Joint Meeting on Pesticide Residues (JMPR). The NZTDS also provides valuable information that can contribute to the review of Maximum Permissible Concentration (MPCs) in food with Food Standards Australia New Zealand (FSANZ) and the setting of food standards by the NZFSA.

The NZTDS is of international standing, and is recommended by WHO as a template for developing countries initiating their first TDSs.

This was the third year of the 2003/04 NZTDS and it involved finalising the third quarterly analytical results report, completing the fourth and final quarter of analyses and preparing an associated report for release on the NZFSA website. The complete set of analytical data for the 2003/04 NZTDS was consolidated, and discussions held with NZFSA so that the format for the final interpretative NZTDS reports could be agreed. The first draft of the reports were completed by 30 June 2005. NZFSA have applied a strict project management approach and key deliverables for 2003/04 that reflect this are:

Vannoort RW. (2004) 2003/04 New Zealand Total Diet Survey Analytical results – Q3. 8 July 2004. ESR Client Report FW0447.

Vannoort RW. (2004) 2003/04 New Zealand Total Diet Survey Analytical results – Q4. 16 November 2004. ESR Client Report FW0493.

Vannoort RW, Thomson BM. (2005). 2003/04 New Zealand Total Diet Survey. Agricultural Compounds, Selected Contaminants and Nutrients. ESR Client Report FW0549.

The draft report has been completed but is subject to client and international review, before finalisation and public release, intended for October 2005.

Vannoort RW, Thomson BM. (2005). Auxiliary Data - 2003/04 New Zealand Total Diet Survey. Agricultural Compounds, Selected Contaminants and Nutrients. ESR Client Report FW0561.

The report is now available on the NZFSA website.

All these reports have been or will be published on the New Zealand Food Safety Authority website (<http://www.nzfsa.govt.nz>).

5.2 Food Residue Surveillance Programme

The 2004/05 Food Residue Surveillance Programme (FRSP) is part of an on-going agricultural compound food surveillance programme. The NZFSA identified a need for data to verify the effectiveness of current controls on the use of agricultural compounds and resulting residues, but had limited information in this area.

Primary plant and animal products were selected on the basis of likely residues, lack of NZFSA information about actual residues, food consumption and other intelligence. In this second year of the programme, nine foods were sampled, seven of which were plant-based, and two animal-based. These were:

- oranges;
- pears;
- strawberries;
- lettuce;
- potatoes;
- taro;
- peanuts;
- prawns; and
- pork (imported only)

The plant-based foods were sampled from retail outlets. They were sampled at each of three locations (Auckland, Palmerston North, and Christchurch) at two different times of year.

All plant-based food samples were analysed, as received, by a multi-residue agricultural compound screen covering approximately 200 compounds, including organochlorine and organophosphorus pesticides, fungicides, herbicides and plant growth regulators.

The prawns were sampled from a range of different consignments at the port of importation (Auckland) and subsequently analysed for chloramphenicol and metabolites of nitrofurans.

The imported pork was sampled from different meat processors at different times of the year and analysed for sulphonamides and other antibiotics.

Spreadsheets detailing the results of the FRSP have been provided to the NZFSA. Discussions have been held about the format of the full report, which it is intended will be completed later in 2005.

5.3 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.

Participating organisations in approximately 70 countries have submitted information under the GEMS/Food programme since 1978, on estimated daily intakes and levels in foods for a list of priority food contaminants. New Zealand became involved in the GEMS/Food programme in 1978 when the, then, Food and Nutrition Branch, New Zealand Department of Health was appointed a designated Collaborating Centre for Food Contaminant Monitoring. New Zealand, through the efforts of staff at ESR and the New Zealand Food Safety Authority are now a leader in initiatives related to the GEMS/Food programme.

During the 2004/2005 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 preservatives (sulphite, sorbate and benzoate) in New Zealand foods and estimated dietary exposure of the general population to these compounds;
- Concentrations of bisphenol A (BPA), a component of can lacquer, in canned food in New Zealand and estimated dietary exposure of the general population to these compounds;
- Concentration data on pesticides and selected contaminant metals and nutrients from the 2003/2004 New Zealand Total Diet Survey;
- Concentrations of pesticides in selected commodities from the 2003/2004 Food Residue Surveillance Programme;
- Concentrations of the herbicide, glyphosate, in New Zealand grown wheat and potatoes;

- Concentration data from import monitoring of aflatoxins in nuts, metals (cadmium, copper and selenium) in crustaceans, chloropropanols in soy sauce and arsenic in seaweed;
- Concentrations of mercury in New Zealand fish; and
- Concentrations of phthalates in infant formulae.

During 2004/2005 ESR 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 2004/2005 year and a proposed work plan for the 2005/2006 have been drafted for submission to the WHO Regional Office for the Western Pacific in Manila.

5.4 Genetically Modified Food Analysis and Capability Development

Stakeholder concern over the presence of genetically modified material in foods continues to be an issue within both New Zealand and the International Community. 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.

This Science Service is needed to:

- Provide analyses to assist the NZFSA in monitoring compliance with the FSANZ labeling standard for Genetically Modified Food, and
- Enable the ongoing development of optimised methodologies and capability for the detection of genetically modified material within complex food matrices.

During 2004/2005, the contracted project was designed to:

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

A total of twenty samples were analysed during the contract period. Five of these samples gave a positive result for GM content. Two of these five had levels of GM ingredient(s) that exceeded the current labeling threshold of 1% GM per ingredient component. The remaining three positive samples had levels of GM ingredient(s) that were below the current labeling threshold of 1% GM per ingredient component.

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

Capability maintenance and development was address in three areas.

- ESR continued to perform at a satisfactory level in international proficiency programmes for the detection of GM ingredients in food.
- Methodologies were validated to overcome contamination of food samples by color compounds.
- Work was continued in the research project “Cooking Genes”, leading to the development of assays to determine the effect of cooking on DNA stability and of TaqMan assays to detect GM components in cooked potato tissue.

Podivinsky E. (2004) Genetically modified food analysis and capability development. ESR Client Report FW0590. Christchurch: ESR.

5.5 Fortification Overage of the Food Supply

The aim of the project was to assess the levels of iron and folate in fortified foods and to compare levels to those claimed on product labels.

Approximately 260 samples from nine different food and supplement groups were analysed for added iron or folate. Samples were purchased in September or November 2004 from Christchurch retail outlets, with the exception of the breads, which were purchased in March 2005 from Auckland, Wellington and Christchurch according to the manufacturing locations of the selected breads.

The stability of the folate fortificant was assessed by measuring concentrations in selected foods over a six-month period of storage.

Iron content was determined using a high-pressure microwave nitric/hydrochloric acid digestion and analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES). Inter-sample variability (same product, different batches) for iron generally exhibited a coefficient of variation (CV) of $\pm 20\%$. Total folate was extracted by a tri-enzyme technique and assayed by a microbiological method using *Lactobacillus casei* as the test organism. Inter-sample variability for folate was generally $\pm 30\%$ CV.

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.

Iron concentration in fortified foods met or exceeded the label claim for iron. Of selected products, 57% (21/37) had iron overages ranging from 16-166%. High consumption of the product with the maximum iron overage would result in an iron intake of 35% of the Upper Intake Limit for adults.

Folate concentration was 15-33% below the label claim in 24% of the products tested (9/38) and exceeded the label claim for folate in 34% (13/38) of products with overages of 41-296%. High consumption of the product with the maximum folate overage would result in a folate intake at the Upper Intake Limit for adults.

There was no measurable degradation of folate in fortified products after storage for a six-month period.

Thomson BM. (2005) Fortification overages of the food supply: Folate and iron. ESR Client Report FW0536. Christchurch: ESR.

5.6 Kelp as a Food Ingredient

Seaweed can be a concentrated form of iodine and whilst iodine is an essential element, small quantities of consumed seaweed can lead to an iodine intake well in excess of recommended upper intake levels.

Foods containing seaweed or seaweed-derived ingredients were identified from the Manufactured Foods Database, industry and scientific consultation, and food outlet browsing and were analysed for iodine content. A total of 104 food samples were purchased from retail outlets in Christchurch, New Zealand throughout November 2004.

Iodine was detected above the limit of detection in 94% of the samples. Mean iodine concentrations were below 1 mg/kg except for kelp pepper, seaweed and sushi wrap.

The concentration of iodine in the seaweed samples was highly variable, ranging from 19 to 2800 mg/kg.

A number of seaweed-derived products are used as food additives (agar, alginates, carrageenan), but there is no evidence that the use of seaweed-derived additives is a source of iodine in foods.

An estimate of iodine intake per serving of food was calculated from serving size information provided on the food packaging. Single servings of kelp pepper, seaweed and sushi wrap might lead to the Recommended Daily Intake (RDI) for iodine being exceeded. Indeed, the Upper Intake Limit (UIL) for iodine may be exceeded with the consumption of kelp pepper or some seaweeds.

Thomson BM. (2005) Iodine in seaweed containing foods. ESR Client Report FW0516. Christchurch: ESR.

5.7 Sulphite, Sorbate and Benzoate Dietary Exposure and Risk Assessment - Children

This project aimed to extend work carried out on exposure and risk assessment of New Zealand adults to the food preservatives sulphite, sorbate and benzoate (see 2003-2004 Annual Report) to assess risks to children due to exposure to preservatives. Data on food consumption patterns of children (5-15 years) have been collected as part of the 2002 National Children's Nutrition Survey (2002CNS). However, there were some delays in the release of the 2002CNS data and this project will now be completed in the 2005-2006 year.

5.8 Food Allergen – Capability Extension

The allergen capability project aims to develop testing capability to support the application of Australia New Zealand Food Standard 1.2.3, requiring mandatory declaration of certain allergenic materials in foods.

Activity under this project during 2004/2005 included:

- Review of methods for the analysis of sulphite, to ensure that available methods are able to enforce Standard 1.2.3;
- Review of available methods and research towards methods for allergens for which no ELISA method is available (fish and fish products); and
- Laboratory validation of Enzyme-linked Immunosorbent Assays (ELISA) for the major of allergens for which declaration is mandatory.

Review of sulphite methods confirmed that the classical Monier-Williams method, with minor modification, is able to detect sulphite down to the Standard limit of 10 mg/kg. Experiments confirmed that the Monier-Williams method was suitably sensitive, but further work is required to establish the accuracy of the method at these very low levels.

The diversity of fish species to which allergic reactions can occur may be a barrier to the establishment of immunoassays for fish material in processed foods. However, little has been published on this topic and the reasons for the lack of immunoassays are not clear. Gene-based assays utilising the polymerase chain reaction appear to offer more promise and the marketing of an allergen testing service for fish by Eurofins and Genetic-ID suggests that this is achievable, although it is uncertain what target sequences are being used.

PCR methods based on the 5S ribosomal RNA gene (5S rDNA) have been used to distinguish between different fish species. The 12S rRNA target appears more promising for general detection of fish in processed foods, as a single PCR product is produced across a range of fish species.

Validation studies have been carried out on immunoassay testkits for peanut, soy, egg, milk (casein and β -lactoglobulin), gluten, almond, hazelnut and crustacea. With the exception of the kit for crustacea, all kits are satisfactory for qualitative testing and have met requirements to be included under ESR's IANZ terms of accreditation. Most kits will be suitable for quantitative testing and IANZ accreditation will be pursued in the 2005/2006 year.

The target protein for the crustacean kit was demonstrated to vary considerably in concentration between different crustacean species and, consequently, a meaningful limit of detection, in terms of crustacean as a food component, could not be defined.

Cressey PJ, Jones S. (2005) Food allergen capability development. Summary of investigations 2004-2005. ESR Client Report FW0569. Christchurch: ESR.

5.9 Acrylamide

The objective of this project in the 2004/2005 year was to identify foods most likely to contribute significant amounts of acrylamide to typical New Zealand diets. The simulated diets from the 2003/04 Total Diet Survey were used as the basis for selecting New Zealand foods for further testing. Where no New Zealand data existed, the proposal at this first assessment was to use overseas data for equivalent foods.

The initial assessment identified a number of foods that are significant components of the New Zealand diet that could potentially contain acrylamide, but for which the overseas data were non-existent or ambiguous as to likely acrylamide content. These were foods such as beer, which is prepared from dried and roasted malt, or tea, where the available information was for Japanese tea rather than black tea.

Other foods identified included roast kumara, a food containing sugars that is at least in part heated during cooking to significantly over 100°C.

During the course of the project, it was discovered that the selected analytical method, under some conditions, could convert acrylamide precursors in samples to acrylamide at the injection step, resulting in over-estimates of the sample acrylamide content. The injector is normally run at quite a high temperature as this gives flash evaporation of the solvent and volatile sample components thus giving a sharp peak for samples after separation. Running the injector at a lower temperature (below 100°C) was still sufficiently high to flash evaporate acrylamide, while eliminating the possibility of acrylamide formation during the injection step. As a result of this problem, the samples from the earlier analytical report with a significant content of acrylamide were also retested.

Estimation of dietary acrylamide intake using the new analytical data and simulated diets showed that potato crisps and potato chips contribute approximately 40% of the acrylamide in these diets. Total estimated dietary intakes of acrylamide are between 0.9 to 2.4 µg/kg body weight/day and these intakes are very similar to estimated intakes at the national level for other countries, that ranged from 0.3 to 2.0 µg/kg body weight/day for the average member of the general population.

It should be noted that in the New Zealand diets, adults had acrylamide intakes of approximately 1 µg/kg body weight/day, but intakes were higher for younger children reflecting both the relatively larger amount of food per unit body weight consumed by this age group and their dietary preferences.

Love JL, Grounds P. (2005) Acrylamide in New Zealand food. ESR Client Report FW0545. Christchurch: ESR.

6 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 2004/2005 were:



- *B. cereus* in Cooked Rice Fact Sheet
- Current Awareness: GMFs and Cloning
- Servicing Consumer Information Requests
- Risk Communication


6.1 *B. cereus* in Cooked Rice Fact Sheet

Figure 2 shows the food safety fact sheet prepared under this project for distribution to potentially risk businesses, such as takeaway outlets and restaurants.

Figure 2: *B. cereus* in cooked rice fact sheet

Food Safety Fact Sheet

	Safe cooling of cooked rice	
Information for food service		September 2004

<p>What is the issue?</p> 	<p>Very few people realise that cooked rice can be responsible for their foodborne illness. Rice forms the basis of many ethnic foods and foods containing rice are frequently implicated in food poisoning episodes. It is common for food producers to prepare large quantities of rice a day ahead of use and leave it to cool slowly at room temperature, before heating and serving the next day. Such practices lend themselves to time/temperature abuse due to the slow rate of cooling. Temperature abuse allows pathogenic bacteria to grow, some of which produce toxins</p>
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What can go wrong?

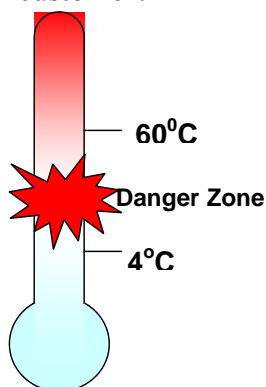
Uncooked rice frequently contains bacteria called *Bacillus cereus*. These bacteria can form protective spores that survive the cooking process. If cooled slowly, these spores can germinate, grow and produce an emetic (vomit inducing) toxin. Reheating rice before serving will not inactivate the emetic toxin or kill all the bacterial cells, so the rice may not be safe.

If you consume cooked rice that is contaminated with *Bacillus cereus* toxin you are likely to experience symptoms of nausea and vomiting within 1 to 6 hours, occasionally followed by diarrhoea within 10-12 hours. The illness is short lived with recovery within 12-24 hours.

How can I tell if product is contaminated?

There is no way of telling that cooked rice is contaminated. Cooked rice that contains toxin produced by *Bacillus cereus* will not look, taste or smell off.

What can I do to protect the customer?



To ensure that cooked rice is safe for eating, appropriate controls are needed to reduce the risk of illness.

- If rice is to be cooked in advance, do not cook too much at one time as large amounts take too long to cool.
- Either, keep cooked rice hot (>60°C) or cool rice as quickly as possible. Rice will cool more quickly if removed from hot container and divided in clean shallow containers (<10cm deep). Alternatively, cool in a colander under cold running water.
- Cover cooked rice and store in a refrigerator (<4°C)
- Use a stock rotation system to ensure that the oldest rice is used first (“first in, first out” rule).

The factsheet can be found on the NZFSA website at:

<http://www.nzfsa.govt.nz/processed-food-retail-sale/fact-sheets/cooked-rice/index.htm>

6.2 Current Awareness – Genetically Modified Foods and Cloning

This report is one of a series intended to provide the NZFSA with an independent source of current scientific information on issues related to genetically modified foods and foods from cloned animals. During the last year:

- The global planting area of GM crops continues to increase.
- There is an increasing commitment to and involvement in biotechnology research from developing countries.
- Implementation of EU regulations to approve GMOs continues to be problematic. There is a continuation of the situation where EU ministers are unable to reach a consensus to accept or reject approvals. In this situation the approvals have to pass back to the EU Commission who then makes a decision. The lack of decision-making by the EU

Council of Ministers is having the effect of undermining the EU approval process for GMOs. However, the EU Commission has confirmed its full confidence in the approval process and will continue to comply with its legislative obligations and proceed with approval of pending authorisations.

- Several global regulatory authorities met during the reporting period, with meeting agendas including aspects of GMO regulation. These included Codex Alimentarius, the members of the Aarhus Convention and the members of the Cartagena Protocol on Biosafety.
- GM crops continue to be approved in a number of countries around the world, both for use in food and feed and for planting. During the reporting period these included: insect-resistant corn lines in the EU, the Philippines, Portugal and Japan as well as herbicide-tolerant oil seed rape in the EU.
- Researchers continue to develop improved detection methodologies for GM crops. These are largely targeted at large-scale detection and the use of micro-array chip technologies is popular. It is likely that a portion of commercial testing systems will adopt these methods in the future. A notable development is a model system using micro-arrays to detect unknown GMOs. It will be of interest to see if the model developed is sustainable in a laboratory testing situation.
- There was a major world-wide contamination issue during the reporting period, when Syngenta released details of the contamination of Bt11 corn with the unapproved corn line Bt10. Implications from this were long-term contamination of US crops and export seed and products of Bt11 since 2001. The USDA fined the company for the contamination. Safety issues were raised as a result of the announcement, but Syngenta maintained the unapproved Bt10 line posed no risk to human or animal health or to the environment. The EU put in place a series of emergency measures to prevent ongoing contamination of corn imports by EU Member States with Bt10, and required that a testing protocol for Bt10 be made available to them and be validated by the EU Community Reference Laboratory.
- There were a number of reports from researchers looking at new methods to generate GM crops. These included methods to increase sustainability of Bt toxin cassettes, use of alternative bacterial transformation agents to *Agrobacterium sp.*, and the successful demonstration of the use of gene replacement technology to manipulate a plant.

During the reporting period there has been little in the literature on the safety or legislation of food from cloned animals. Most work on cloning of animals still remains in the laboratory at a research level. However, the US FDA released its decision on whether meat and milk from cloned animals and their offspring are safe for human consumption, and maintained that these products are as safe as their conventional counterparts.

Two summary reports were produced during the 2004/2005 year:

Podivinsky E. (2005) Current awareness of issue related to genetically modified food and food from cloned animals. July - December 2004. ESR Client Report FW0518. Christchurch: ESR.

Podivinsky E. (2005) Current awareness of issue related to genetically modified food and food from cloned animals. January - June 2005. ESR Client Report FW05101. Christchurch: ESR.

6.3 Servicing Consumer Information Requests

In the absence of any suitable consumer information requests during the 2004/2005 year, effort in this area was redirected into an assessment of risks associated with jelly mini-cups, which have been responsible for more than 15 choking deaths worldwide. The assessment was structured in the format of a Risk Profile.

The purpose of a Risk Profile is to provide contextual and background information relevant to a food/hazard combination so that risk managers can make decisions and, if necessary, take further action. Risk Profiles include elements of a qualitative risk assessment, as well as providing information relevant to risk management. Risk profiling may result in a range of activities e.g. immediate risk management action, a decision to conduct a quantitative risk assessment, or a programme to gather more data, ranking of a particular food safety issue.

Jelly mini-cups are a jelly confectionery having a firm consistency. They are contained in a semi-rigid dome or bell-shaped container (mini-cup). In some cases they contain a hard piece of fruit embedded within the jelly. The jelly mini-cups can be ingested by sucking the jelly out of the mini-cup or by applying pressure to the bottom of the mini-cup to projection the jelly into the mouth.

It has been reported that 15 choking fatalities associated with consumption of jelly mini-cups has occurred worldwide. This number includes eight deaths in Japan, five deaths in the USA and one each in the United Kingdom and Australia.

Initial regulatory action focused on the use of konjac flour and the fact that it is not a permitted food additive in many countries. This was the basis used for banning konjac-containing jelly mini-cups in New Zealand, Australia, the USA and, initially, UK/EU. Jelly mini-cups, irrespective of gelling agent, are now effectively banned in the European Union. Jelly mini-cups containing konjac are banned in the USA and Australia. Enforcement activity has been brought against non-konjac-containing jelly mini-cups in the USA following hazard assessment that stressed that the hazard was associated with “the physical characteristics of the gel candies”.

There appears to be good agreement between EU and US experts that the major choking hazard is due to the physical characteristics of the jelly mini-cups, rather than the choice of gelling agent. Although the choice of gelling agent will impact on the consistency of the resultant gel, the EU expert panel did not consider that the use of gelling agents other than konjac would significantly reduce the level of risk.

Testing carried out at ESR on konjac- and carrageenan-containing jelly mini-cups demonstrated no qualitative difference in two risk measures; physical dimensions and solubility.

Cressey PJ. (2005) Risk profile: Jelly mini-cups as a choking hazard. ESR Client Report FW0567. Christchurch: ESR.

6.4 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:

- The number of cases of foetal death or still births associated with foodborne illness
- The risks to infants of *Enterobacter sakazakii* in powdered infant formula
- Consumer focussed information on agricultural chemicals and their use relevant to food safety
- A data sheet on *Arcobacter* sp. for use by food businesses and consultants when developing HACCP-based programmes
- A literature review to assess whether visual inspection of food, instead of use of a temperature probe, is an option for food businesses to determine whether safe cooking limits have been achieved

Verbal presentations included:

- Pesticide residues in conventionally-grown and organic New Zealand produce
- Glyphosate in potatoes
- Nitrite and nitrate exposure

Further material related to these presentations can be found at:

<http://www.nzfsa.govt.nz/consumers/food-safety-topics/chemicals-in-food/residues-in-food/consumer-research/index.htm>

Fact sheets were written to highlight the hazards involved in preparing large volumes of starchy foods such as cooked rice and reconstituted mashed potatoes. These fact sheets are available on the NZFSA website using the following links:

<http://www.nzfsa.govt.nz/processed-food-retail-sale/fact-sheets/cooked-rice/index.htm>

<http://www.nzfsa.govt.nz/consumers/food-safety-topics/foodborne-illnesses/potatoflakes/index.htm>

7 EMERGENCY RESPONSE

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.

Investigations carried out under the Emergency Response Science Service were:

- Follow-up investigation of high lead levels in a baby food, detected as part of the 2003/2004 New Zealand Total Diet Survey;
- Follow-up investigation of high iodine levels in a soy milk, detected as part of the 2003/2004 New Zealand Total Diet Survey;
- Analysis of spice and oil samples for the presence of the prohibited food colourings, Sudan 1-4.

8 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.

This Science Service also includes a programme of analysis of export wine, as required by the Wine Act.

The Science Service covers the following areas of science support:

- Data Transmission
- Food Complaints
- Food Consultation/Courier
- Export Wine Certification
- Annual report

8.1 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.

8.2 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 2004/2005 year 148 food complaints were submitted to ESR laboratories for investigation. The largest proportion of these was from the Auckland area (28%), followed by Canterbury (22%). The patterns of foods associated with complaints and the types of complaints made are consistent with previous years. In 2004/2005 the types of foods most commonly associated with food complaints were takeaway foods, bread and bakery products, meat and poultry products, and seafood. Canned products and beverages were more prominent amongst food complaints than during the 2003/2004 year.

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 2004/2005, 63% of all food complaints were related to foreign objects. This represents a significant increase from the 2003/2004 year when 47% of all food complaints submitted to ESR related to foreign objects, but is similar to 2002/2003 and previous years. The types of foreign objects most commonly identified were insects (including eggs, pupae and caterpillars), glass and plastic fragments and 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 follow-up sampling targeted at product previously recalled due to contamination or imported foods identified by clearance testing as warranting further investigation. Complaints relating to the presence of allergens (incorrect labeling/composition) also appear to be increasing.

Wilson MW, Whyte RJ, Cornelius AJ. (2005) Food complaints and foodborne illness: six-month summary report July to December 2004. ESR Client Report FW0547. Auckland: ESR

Wilson MW, Whyte RJ, Cornelius AJ. (2005) Food complaints and foodborne illness: six-month summary report January to June 2005. ESR Client Report FW0596. Auckland: ESR

8.3 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.

During the 2004/2005 year, requests for information or advice have ranged from the safety of Teflon-coated cookware, the safety of Manchurian mushroom tea, to a number of queries about food additives including BZP, para red dye, alum, amophos and annatto, to name a few.

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. Enquiries ranged from smoked fish and dried vegetable production through to more specialised foods such as flax seed oil, prosciutto, kanga kopiro and dukkah.

The following analytical projects were carried out within this work programme:

1. Testing of hijiki seaweed for inorganic arsenic. Seven samples of hijiki seaweed had levels of inorganic arsenic in the range 60-90 mg/kg, while three samples of other types of seaweed had insignificant levels (0.1 mg/kg or less). These results are similar to those found overseas.
2. Four samples of imported maize products were tested for lead following the discovery of high levels of lead in baby food during the New Zealand Total Diet Survey.

Two training workshops for HPOs were held during the year, one in Auckland and one in Christchurch. Topics presented included:

- Ethylene oxide in New Zealand herbs and spices.
- Comparative studies of pathogens on NZ meat: presentation of data on levels of *Campylobacter*, *Salmonella* and STEC in poultry, pork, sheep meat, beef and bobby veal purchased from retail stores in New Zealand.
- Calculating the shelf life of foods.
- Understanding “uncertainty” in relation to laboratory reporting.
- Nitrite poisoning associated with meatball consumption.
- Sampling, sub sampling and sample transport.
- Total Diet Survey – interesting findings.
- Issues in labelling and testing for allergens.
- Domestic fridge survey.
- Group discussion – Surveillance of outbreaks.
- Smoking of foods – does it have a preservative effect? Critical limits in smoked fish processing
- Infectious intestinal diseases – how does NZ compare?
- How ESR projects fit with NZFSA risk process.

HPOs gave presentations on the following topics: a berry farm outbreak; the Foodsafe Partnership; food safety for hangi and umu; discovery of prohibited plant in imported food; labelling project; prosecution following the finding of a cigarette in Chinese food, and Sudan food colours in chilli powder.

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

Whyte R. (2004) Food consultation. Quarterly progress report July to September 2004. ESR Client Report FW04107. Christchurch: ESR.

Whyte R. (2004) Food consultation. Quarterly progress report October to December 2004. ESR Client Report FW04110. Christchurch: ESR.

Whyte R. (2005) Food consultation. Quarterly progress report January to March 2005. ESR Client Report FW0544. Christchurch: ESR.

Whyte R. (2005) Food consultation. Quarterly progress report April to June 2005. ESR Client Report FW0591. Christchurch: ESR.

8.4 Export Wine Certification

Under the Wine Act 2004, the NZFSA is empowered to make regulatory controls to assure the quality of wine exported from New Zealand. These controls are under review but at present involve chemical analysis to demonstrate compliance with the Food Standards Code, and sensory analysis to demonstrate freedom from obvious fault (oxidised, tainted by extraneous flavours, or malodorous). ESR has carried out the required chemical analysis since the original introduction of export wine monitoring (under the Wine Makers Act 1981), and a panel of judges nominated by New Zealand Winegrowers carries out the sensory assessment. In addition to the analyses required for New Zealand regulatory compliance, some other analyses are carried out to satisfy the requirements of importing countries, notably the European Union (EU).

The incidence of non-compliance with the Code in New Zealand export wines is very low. In the July 2004-June 2005 year 4356 samples were received (an increase of 31% from the previous year) and 14 samples (0.3%) did not comply. The non-compliance related to inaccurate labelling of alcohol content (13 samples) and excess sulphur dioxide (1 sample).

A more substantial problem is encountered with the accuracy of labelling of alcohol content for the EU, where a very tight tolerance ($\pm 0.5\%$ compared with $\pm 1.5\%$ for NZ) is required. A further 257 samples did not meet this tolerance. It is notable that industry standards of alcohol labelling accuracy appear to have fallen from the previous year, when there were 3 New Zealand non-compliances and 155 EU non-compliances. Strict EU requirements for levels of volatile acidity and added citric acid were not met by a further four samples.

Some changes have been observed in the composition of New Zealand export wines over the last 15 years. Median alcohol levels have risen from 11.8% in 1990 to about 13% (whites) and 13.5% (reds), presumably as a result of improved ripeness of grapes at harvest. Recently there seems to be a trend in red wines away from completely dry to containing a small amount of residual sugar. This latter category has increased from 6% to about 20% of the red wines over the last five years.

Brief progress reports on sample numbers were provided to NZFSA on a monthly basis.

**APPENDIX 1 NEW ZEALAND FOOD SAFETY AUTHORITY – ESR SCIENCE
CONTRACT 2004/2005. SERVICE DESCRIPTIONS, WORK AREAS
AND AGREED OUTPUTS**

MICROBIOLOGICAL RISK PROFILING

Risk Profiles Review

- *Completion of review and amendment to risk profiles, and posting on the NZFSA website*

Risk Ranking

- *Attendance and presentation at stakeholder group meetings*
- *Attendance at final consultative meeting*
- *Delivery of final risk ranking document*

MICROBIOLOGICAL FOOD SAFETY

Development and implementation of a National Typing Database: food specific inputs

- *Summary report of ESR Food Safety Group involvement with development of the National Typing Database*

Microbiology of uncooked retail meat products: *Salmonella* and STEC

- *Delivery of completed report as draft scientific paper plus data appendices (August 2004)*

Prevalence and numbers of *Campylobacter* and *Salmonella* on chickens prior to scalding

- *Provision of final report to NZFSA in journal paper format*

Domestic food practices

- *Preparation of material for use by Foodsafe Partnership*
- *Provision of first year report/scientific paper(s) to NZFSA*

Temperature control at retail level

- *Provision of final report/scientific paper to NZFSA*

Microbiological survey of imported and domestic pork: *Salmonella*, STEC and generic *E. coli*

- *Draft scientific paper for submission to Journal of Food Protection to NZFSA*

Effect of low temperature on *Campylobacter* in poultry

- *Draft scientific paper for submission to Journal of Food Protection to NZFSA*

Further development of a risk model for *Campylobacter* in poultry in New Zealand

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

Salmonella – egg survey

- *Draft scientific paper for submission to Journal of Food Protection to NZFSA*

Further development of a risk model for *Salmonella* in poultry in New Zealand

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

Comparison of quantitative technologies for STEC and *E. coli* in food

- *Comprehensive report on quantitative technologies for STEC and E. coli O157 to NZFSA*

Yersinia in meat: Analytical development and survey

- *Draft scientific paper produced for NZFSA approval*

Exposure assessment of *Listeria monocytogenes* via unpackaged ready-to-eat meats

- *Report in journal paper format to NZFSA*

Analytical development – Norovirus Detection

- *Submit final year 2 report to NZFSA*

Pasteurisation risk model

- *Report on data collation and model development*

GENERIC

- *Final report provided to NZFSA*

CHEMICAL FOOD SAFETY

2003-04 New Zealand Total Diet Study (NZTDS)

- *Finalised Q4 raw data reports submitted to NZFSA for website*
- *Pesticides and Elements 1st draft final reports to NZFSA*

Food residues surveillance programme

- *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 2004 calendar year*
- *Complete annual report and proposed work plans for submission to WHO*

Genetically Modified Food Analysis and Capability Development

- *Final written overview of analyses of samples submitted to NZFSA*
- *Final written overview provided of research results, with particular reference to capability maintenance/development for detection of GM components in food*

Fortification overages of the food supply

- *Final report to NZFSA*

Kelp as a food ingredient

- *Final report to NZFSA*

Sulphite, sorbate and benzoate dietary exposure and risk assessment -Children

- *Final report to NZFSA*

Food allergen – capability extension

- *Develop allergen testing capability and gain IANZ accreditation*
- *Brief summary report to NZFSA*

Acrylamide

- *Report on test results found to NZFSA*

CURRENT AWARENESS AND EMERGING ISSUES

B. cereus in cooked rice fact sheet

- *Provision of final fact sheet to NZFSA*

Current Awareness: GMFs and cloning

- *Two six-monthly summary reports*

Servicing consumer information requests

- *Copies of all short reports produced*
- *Summary of reports produced, as a component of the quarterly reporting*

Risk Communication

- *Copies of all short reports produced*
- *Summary of reports produced, as a component of the quarterly reporting*

EMERGENCY RESPONSE

- *Report of the work within the Service Description presented at quarterly meetings*

NZFSA/HPO TECHNICAL SUPPORT

Data transmission

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

Food complaints

- *Quarterly budget reports to NZFSA*
- *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*
- *One training workshop for HPOs at both the Christchurch and Auckland sites of ESR*

Export wine certification

- *Annual report on the previous year's work (ie 2003-4)*
- *Monthly sample number data is to be sent to the NZFSA project leader so that use of project funding can be monitored*

Annual report

- *Submission of final report*