THE STATUS OF NEW ZEALAND'S FOOD

Report on the NZFSA-ESR Science Contract 2003-2004

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Report on the NZFSA-ESR Science Contract 2003-2004

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PREFACE

The foods we eat may contain a wide array of chemicals and microbes. Many of these are normal components of the food with positive health benefits, such as proteins, vitamins and nutrient elements, while others are merely 'innocent bystanders' that do not contribute positively or negatively to our food-related 'riskscape'. Occasionally foods will contain components that increase our risk of diseases range 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 Zealander's consume.

The NZFSA has now been in existence for two complete contract years and the science programme purchased from ESR and the projects within the programme can be seen to represent a range of activities on the progression from food safety issue identification to risk management option selection.

When faced with a wider array of risks and a limited amount of resources, risk management activities should ideally be directed towards the areas where the biggest gains can be made. To inform the NZFSA's prioritisation activities ESR have been developing methodologies for ranking foodborne risks, using criteria related to the incidence and the severity of the resultant diseases. This methodology is initially being applied to microbiological risks, however, a discussion document was also prepared during the 2003/2004 year to discuss approaches for the ranking of chemical risks of food.

The last year has seen a consolidation of the risk profiling activities initiated during the previous three years. Activities during the year included completion of three quite diverse risk profiles (*Bacillus* spp. in rice, *Vibrio parahaemolyticus* in seafood, and *Yersinia enterocolitica* in pork), updating of risk information on *Salmonella* in poultry products (poultry meat and eggs) and completion (to review stage) of a cluster of profiles relating to *Listeria monocytogenes* in ready-to-eat foods (soft cheese, low moisture cheese, and ready-to-eat salads).

New Zealand's reported rates of campylobacteriosis are the highest in the developed world; however, no obvious reason for this phenomenon has been identified. During 2003/2004 a major review of available information on *Campylobacter* and campylobacteriosis in New Zealand was conducted to try to determine the relative importance of the various routes by which we can be exposed to *Campylobacter*. The study concluded that New Zealand does not appear to be obviously different to other countries where control of exposure to *Campylobacter* from poultry has lead to improvements in reported rates of campylobacteriosis.

During the 2003/2004 year a major survey of bacterial pathogens in uncooked retail meats was initiated. 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 survey will conclude in the 2004/2005 year and will provide information on the relative importance of different meat types as potential transmission routes for these key pathogens.

The scientific support provided to NZFSA by ESR entered a new phase during the year with the initiation of work on two risk models; *Campylobacter* and *Salmonella* in the poultry food chain. Risk models include mathematical representations of the increases and decreases in bacterial populations that may occur due to steps that the food goes through between the time it is produced on the farm and the time it enters a consumer's mouth. For example, chickens pass through a hot-water bath prior to the removal of the feathers – this will cause some bacteria to die, while others are washed off to possibly contaminate other carcasses. Once completed, the risk models will allow key food control steps in the progression from farm to fork to be identified and will allow the effect of possible interventions to be assessed.

A number of studies were carried out during the year to estimate dietary exposure to a range of chemical additives and contaminants of food. Exposure assessment involves combination of measured levels of the chemical in foods with information on the amounts of the foods consumed by the population. Estimates of dietary exposure can then be compared to internationally accepted 'acceptable' or 'tolerable' dietary exposures to determine the likely level of risk.

Work has progressed well on the flagship dietary 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 is nearing completion with dietary exposure estimation due to be carried out in the 2004/2005 year. Several more targeted projects have assessed the dietary exposure of New Zealanders to food additives (the preservatives sulphur dioxide, benzoic acid, sorbic acid, nitrite and nitrate) and packaging materials (the estrogen mimic, bisphenol A, which is a component of the lining of many cans). New Zealander's exposures to these chemicals appear to be low by international standards.

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, 2003/2004 saw the analysis of record numbers of wine samples, with 3061 samples being analysed compared to 2617 in 2002/2003.

Our work continues during the 2004/2005 year and will see a number of major projects nearing completion, including the survey of bacterial pathogens in uncooked retail meat, the risk models on *Campylobacter* and *Salmonella* in the poultry food chain, and the current round of the New Zealand Total Diet Survey. A range of new projects will also be carried out, covering such diverse topics as an investigation of food temperature control within retail premises, such as butchers and supermarkets, examination of foods fortified with folate and iron to determine what level of fortification remains at various points during the food's shelf-life, development of testing capabilities for a wide range of food allergens, and analysis of whole chickens to determine the degree of contamination of birds entering processing. Work will also continue on risk profiling and risk ranking, to assist the NZFSA in identifying priority issues for further action.

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1 INTRODUCTION

The primary purpose of the Food Safety Programme 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
- Chemical Risk Profiling
- Microbiological Food Safety
- Chemical Food Safety
- Current Awareness and Risk Communication
- Emergency Response
- NZFSA/HPO Technical Support

The 2003/2004 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 quantitiative risk assessments are central to this approach.

The current report summarises activities carried out under the seven Science Service Descriptions during the year July 2003 to June 2004.

2 MICROBIOLOGICAL RISK PROFILING

The New Zealand Food Safety Authority utilises a "regulatory model" that adopts a risk-based approach to food control. 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 too 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 these work areas 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 2003/2004 contract.

The components of this Science Service during 2003/2004 were:

- Risk Profiles for 2003/2004
- *Campylobacter* Pathways Discussion Document
- Pasteurisation of Dairy Products Discussion Document
- Risk Ranking Policy Document

2.1 Risk Profiles for 2003/2004

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 three Risk Profiles were completed during 2003/2004, 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. (2002) Risk profile: Bacillus *spp. in rice. ESR Client Report FW0319. Christchurch: ESR.*

Lake RJ, Hudson JA, Cressey PJ. (2002) Risk profile: Vibrio parahaemolyticus *in seafood. ESR Client Report FW0348. Christchurch: ESR.*

Lake RJ, Hudson JA, Cressey PJ. (2002) Risk profile: Yersinia enterocolitica *in pork. ESR Client Report FW0328. Christchurch: ESR.*

Interim work has been completed on a further Risk Profile and it has been decided that this profile requires refocusing, with greater veterinary input during 2004-2005:

Lake RJ, Hudson JA, Cressey PJ. (2002) Risk profile: Mycobacterium bovis *in red meat. ESR Client Report FW0320. Christchurch: ESR.*

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

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*

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*

Risk Profiles at the draft stage concern:

Campylobacter jejuni/coli in mammalian and poultry offals
Campylobacter jejuni/coli in red meat
Shiga toxin-producing *Escherichia coli* in raw milk
Shiga toxin-producing *Escherichia coli* in boutique cheeses

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 *Campylobacter* Pathways Discussion Document

As an important public health problem in New Zealand, and campylobacteriosis has been the subject of numerous research projects in this country over the last ten years. This project brought together the results of that research, in order to synthesise a picture of the potential transmission routes, the evidence to support their existence, and their relative importance. The current report is based on the most up-to-date scientific literature available.

Information on sources and potential transmission routes of *Campylobacter* was supplemented with data on relevant exposures, such as food consumption data.

The report also presents an overview of the international situation regarding campylobacteriosis and transmission routes. This was derived from the scientific literature and government reports. It was not intended to be an exhaustive review of the extensive literature on *Campylobacter*; instead the focus was on surveillance and epidemiological studies, as well as case-control investigations, which provide the most information on sources of human infection.

The key questions for the New Zealand Food Safety Authority are:

- Is foodborne transmission of campylobacteriosis significant enough to warrant new risk management interventions?
- If so, which foods represent the greatest risk?

The second question is easier to answer. Based on results from case control studies and surveys of the prevalence and level of contamination, poultry products are the most common risk factor and the product most likely to be contaminated. The prevalence of contamination in other foods is lower, with the highest levels being in offals, pork and bobby veal.

The transmission of *Campylobacter* in New Zealand is likely to be complex, with a number of risk factors operating at once. It is possible that no single factor is sufficiently important to significantly affect the rate of illness.

However, it is the report author's belief that effective management of the risk from *Campylobacter* in poultry will cause a significant reduction in the incidence of campylobacteriosis in New Zealand, for the following reasons:

- The proportion of campylobacteriosis cases in rural areas (8-12%) is similar to the rural population (approximately 14%), and notification rates in rural and urban total populations are similar;
- The majority of cases occur in urban regions, and case-control studies of predominantly urban populations have identified poultry associated risk factors as important (representing over 50% of the population attributable risk in one study);
- Even if there are differing transmission route patterns for urban and rural populations, the majority of the risk management activity should focus on the urban pattern;
- A temporary removal of poultry from the market in Belgium was followed by a 40% drop in campylobacteriosis notifications;
- Successful risk management of the incidence of campylobacteriosis in Iceland by focusing on poultry, alongside consumer education measures.

Of the remaining risk factors for campylobacteriosis, overseas travel and animal contact (for the rural population), appear to be the most important.

Potable water, pets, and environmental water, are likely to be more minor parts of the overall transmission route picture.

This study does not provide an answer for the key question of why the rate of reported campylobacteriosis in New Zealand is high compared to overseas countries. However, the available data from a variety of studies does indicate that poultry, as a source of *Campylobacter* and leading directly or indirectly to infection, is the risk factor whose management is the most likely to lead to a significant drop in illness.

The available New Zealand data were drawn from generally small scale and/or limited studies, and results should be treated with caution. Nevertheless, the main tools of epidemiological and microbiological investigation have been applied to the problem of campylobacteriosis in New Zealand It seems reasonable, based on New Zealand and overseas experience, to attempt intervention(s) that will contribute to reducing food-borne risks. Decisions as to which interventions are likely to be the most effective will require careful consideration, as well as consultation with stakeholders.

Lake RJ.(2004) Transmission routes for campylobacteriosis in New Zealand. ESR Client Report FW0424. Christchurch: ESR.

2.3 Pasteurisation of Dairy Products Discussion Document

A number of pathogenic micro-organisms can occur in raw milk from contamination by faeces or by being shed directly into milk as a result of mastitis in the cow. Before pasteurisation became mainstream the consumption of raw milk was associated with a wide range of microbial diseases. The aim of pasteurisation is to control pathogens and spoilage organisms, without affecting the nutritional and organoleptic characteristics of the milk. This study collated information from New Zealand and overseas on the:

- Prevalence of pathogens in raw milk;
- Efficacy of pasteurisation in controlling these pathogens.

The primary purpose of the project was to evaluate whether review of the scientific literature would provide a benchmark against which the efficacy of alternative milk treatment systems can be assessed.

The thermal inactivation that pasteurisation inflicts on microbial pathogens is not always known with any high degree of certainty. The published scientific data may be old or incomplete, and/or the experimental methods may not be truly representative of what occurs in commercial pasteurisation systems. Recently, claims have been made that *Mycobacterium avium* subsp. *paratuberculosis* can survive pasteurisation and there is some evidence for the detection of the organism in pasteurised milk. However, work in New Zealand using a pilot plant system with turbulent flow indicates that the organism would rarely survive.

Milk that has been properly pasteurised and handled correctly is not the cause of significant disease from any of the "traditional" foodborne bacteria, although the identification of emerging pathogens may challenge this view. Based on several reviews of outbreaks reported overseas, the consumption of raw milk products results in a similar number of outbreaks to their pasteurised counterparts while the amount of raw milk products consumed is significantly less (of the order of 1% of pasteurised dairy products).

Alternative milk treatment processes include thermisation and aging. Thermisation produces a lesser inactivation of microbial pathogens when compared to pasteurisation, and aging may or may not result in a further inactivation. Equivalence with pasteurisation needs to be judged on a case-by-case basis.

Hudson JA, Wong TL, Lake RJ. (2003) Pasteurisation of dairy products: time, temperatures and evidence for control of pathogens. ESR Client Report FW0374. Christchurch: ESR.

2.4 Risk Ranking Policy Document

This project was intended to develop a prototype risk ranking methodology (including risk categories and criteria) suitable for food safety issues appropriate to the NZFSA. The report prepared in 2003-2004 (and summarised here) was intended to be the subject of consultations to refine the risk ranking process during 2004-2005.

A risk ranking process includes the following steps:

- Define and categorise the risk to be ranked;
- Identify the risk attributes (criteria) that should be considered;
- Describe the risks in terms of the attributes in risk summary sheets;

- Select participants and perform the risk ranking; and,
- Describe the issues identified and the resulting rankings.

The categorisation of risks is covered by the food/hazard combinations used for Risk Profiles.

The proposed criteria for ranking include:

- Criteria associated with public health (incidence of illness);
- Criteria associated with severity (morbidity, mortality);
- Criteria associated with exposure (food consumption, hazard prevalence);
- Criteria associated with uncertainty about the risk (quality of data);
- Criteria associated with topicality (emerging hazards, changes in existing hazards).

A suggested risk ranking process involves the convening of a group of interested parties from consumer groups, the food industry, technical experts and relevant government agencies. This group would meet to discuss and agree the risk ranking process and initial rankings.

Risk summary sheets are included in Appendix 1 to the project report, and this material is used to create two prototype risk rankings. The material in the Appendices is taken from completed Risk Profiles.

Cressey PJ, Lake RJ. (2004) Ranking food safety risks. A prototype methodology. ESR Client Report FW0389. Christchurch: ESR.

3 CHEMICAL RISK PROFILING

The New Zealand Food Safety Authority utilises a "regulatory model" that adopts a risk-based approach to food control. This means, in general, that effort and resources are applied to issues that constitute the greatest risk. Food safety issues may relate to (micro)biological, chemical or physical hazards and, ideally, a consistent framework should be applied to the consideration of the different categories of hazard.

Microbiological risk profiles provide evidence for the existence (or otherwise) of well-characterised adverse health effects from a hazard, the evidence linking transmission of the hazard with a particular food (from investigation of incidents of illness as well as exposure assessments), and options for risk management, if required. The evidence for adverse health effects is principally derived from public health surveillance data, supported by exposure assessment.

For chemical risks, the adverse health effects are not usually as well characterised, and evidence for the existence of those adverse health effects derives from toxicology and exposure assessments and, in some cases, epidemiology, rather than surveillance. Nevertheless chemical risk profiles can still function as a useful risk analysis tool for risk managers by answering questions about the need for (or existing level of) management of particular chemical risks. Chemical risk profiles need to assess the strength of the link between exposure and adverse health effects in determining the need for risk management, but would generally rely on international assessments, where these are available, and provide an overview, rather than conducting in depth reviews of the toxicological and epidemiological literature.

The only component of this Science Service during 2003/2004 was:

- Chemical Risk Ranking Methodologies

3.1 Chemical Risk Ranking Methodologies

Risk ranking is driven by the premise that if the relative risks of a range of problems can be established, then risk reduction efforts can be directed at the worst problems first. NZFSA has adopted a structured approach to food safety risk management that includes, where possible and practical, "ranking of the food safety issue for risk management". Prototype methodologies are in place for the ranking of microbiological food safety issues. The current report examined issues and possible solutions for extending the prototype approach to a consideration of chemical food safety issues.

Ranking of microbiological food safety issues utilises criteria related to public health (incidence of disease), severity (mortality, morbidity) and exposure (food consumption, contamination prevalence). For chemical contaminants and residues direct determination of the incidence of disease caused and the severity of outcomes is not possible. The current report reviews approaches adopted by organisations such as WHO, OECD and SETAC to the categorisation or ranking of chemical issues related to public health.

This investigation concluded that a food chemical risk ranking exercise would need to consider:

- The weight of evidence for a causative relationship between exposure to the chemical and an adverse human health effect
- A measure of the dose-response relationship for the chemical or its carcinogenic potency
- A ranking scale for comparing diverse adverse health outcomes (severity).

Suggested options are presented in each of these areas.

Exposure assessment for chemicals in foods is discussed. A number of techniques ranging from the simple to the sophisticated are available and estimation of dietary exposure to chemicals is generally less problematic than for microbiological contaminants.

Cressey P. (2004) Chemical risk ranking methodologies. ESR Client Report FW0413. Christchurch: ESR.

4 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 2003/2004 year were:

- Development and Implementation of a National Typing Database: Food Specific Inputs
- Microbiology of Uncooked Retail Meat Products: *Campylobacter*
- Undercooked Chicken Livers as a Vehicle for Campylobacteriosis
- Development of a Preliminary Draft Risk Model for *Campylobacter* in Poultry in New Zealand
- Expanded Risk Profile of *Salmonella* in Chicken Nuggets
- Development of a Preliminary Draft Risk Model for *Salmonella* in Poultry in New Zealand
- Vertical Chain Estimation of Prevalence of *Salmonella* in Raw Poultry from End of Primary/Secondary Processing to Retail Outlets
- Microbiology of Uncooked Retail Meat Products: *Salmonella*
- Microbiology of Uncooked Retail Meat Products: STEC
- Survey of Ready-to-eat Dairy Products for Quantitative Levels of *Listeria monocytogenes*
- Analytical Development: Norovirus Detection

4.1 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 providing 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:

- Attendance at a BioNumerics database training course in Wellington (December 2003), run by Applied Maths, the producers of the BioNumerics programme.
- Running a series of comparison gels to assist with PulseNet certification with CDC, Atlanta.
- Assistance in running the pilot system at ESR between Christchurch Science Centre (CSC) and Kenepuru Science Centre (KSC) by running KSC reference STEC isolates at CSC.

Overall, the projects entitled "Development and Implementation of a National Typing Database" (both Food Specific Inputs and Training and International Certification Modules) have made the following progress on the objectives:

- Certification requirements have been completed for *Salmonella, Listeria monocytogenes* and STEC, although official certification has yet to be received from CDC Atlanta. Certification is currently not available for *Campylobacter jejuni*. Certification for this bacterial species will be carried out once it is available.
- The pilot system has been run between the KSC and CSC sites at ESR.

Cornelius A. (2004) Development and implementation of a national typing database: Food specific inputs. ESR Client Report FW 0455. Christchurch: ESR.

4.2 Microbiology of Uncooked Retail Meat Products: *Campylobacter*

The strategic goal of NZFSA to reduce the incidence of foodborne illness in New Zealand requires a robust understanding of the proportionality of exposure to various pathogens from different food groups, in this case meat from different animal species. While the National Microbiological Database (NMD) programmes provide processor data on a range of pathogens in meat, they do not include *Campylobacter*. The "*Campylobacter* in Poultry Meat" Steering Group identified the need to survey retail meat products for the presence of *Campylobacter* in order to answer the questions of proportionality of exposure and to identify the most appropriate species for which to implement risk management options.

This project was designed to carry out a statistically robust survey that was national in scope and covered four seasons, from August 2003 to June 2004. Quantitative data were obtained for the presence of *Campylobacter* in uncooked beef, bobby veal, chicken, lamb/mutton and

pork. The meat product was minced, diced or shredded to take into account the extra handling at retail outlets. Meat products were purchased in five main centres, Auckland, Hamilton, Wellington, Christchurch and Dunedin. Initial investigations indicated that meat processed by most local abattoirs, meat works and primary poultry processing plants were represented in sales by retail outlets in these five cities.

Meat samples were first enriched and tested for presence/absence of thermophilic *Campylobacter* by multiplex PCR. Positive samples were further analysed by MPN/PCR for enumeration, Penner serotyped and genotyped by Pulsed-Field Gel Electrophoresis (PFGE; see section 4.1).

The prevalence of *Campylobacter* in different meat species after 12 months of sampling are shown in Table 1. The majority of the *Campylobacter* isolates were *C. jejuni*.

Table 1: Prevalence of *Campylobacter* in uncooked retail meat

Meat species	Samples analysed	Samples positive for *Campylobacter* (%)
Chicken	230	205 (89.1%)
Pork	230	21 (9.1%)
Bobby veal	90*	9 (10.0%)
Lamb/mutton	231	16 (6.9%)
Beef	230	8 (3.5%)

* Due to the scarcity of fresh bobby veal on the New Zealand retail market, these samples included some frozen samples

Enumeration of *Campylobacter* showed that, except for one bobby veal with a count of >10.9 MPN/g, one pork with 0.3 MPN/g, and two lamb samples with 0.3 MPN/g, all other beef, bobby veal, pork and lamb/mutton samples were <0.3 MPN/g. *Campylobacter* counts in chicken meat showed that out of 205 samples positive for *Campylobacter*, 83 samples had counts of <0.3 MPN/g, 104 were in the range between 0.3 to 10.9 MPN/g, 12 samples with 23.7 MPN/g, 1 sample with 28.8 MPN/g, 3 samples with 45.9 MPN/g and 1 sample with 110 MPN/g.

Out of 247 isolates from meat that were typed by HS serotyping and genotyped by pulsed field gel electrophoresis techniques, 30 combinations were found to be indistinguishable from sero-genotypes from the ESR PulseNet database that had previously caused campylobacteriosis in humans. Of these 30 sero-genotypes, 28 belonged to isolates from chicken, 6 from pork, 5 from beef, 6 from lamb/mutton and 1 from bobby veal.

Even more significantly, of the total number of isolates that were typed and found to be indistinguishable from previous human *C. jejuni* isolates, 83 isolates (33.6%) were from chicken meat, 8 isolates (3.2%) from pork, 6 isolates (2.4%) from beef, 6 isolates (2.4%) from lamb/mutton and 1 isolate (0.4%) from bobby veal.

Wong TL. (2004) Campylobacter *in uncooked retail meat products, 2003-2004.ESR Client Report FW0478. Christchurch: ESR.*

4.3 Undercooked Chicken Livers as a Vehicle for Campylobacteriosis

Chicken livers are unlike whole pieces of red meat such as steaks or chops. With these foods, microbial contamination is restricted to the external surfaces and as long as these surfaces are seared, the internal tissue can be eaten "rare" with safety. Laboratory studies have shown that chicken livers can be contaminated with *Campylobacter* on both the inside tissues and the outer surfaces and therefore sufficient heating must be applied to penetrate to the inner tissues.

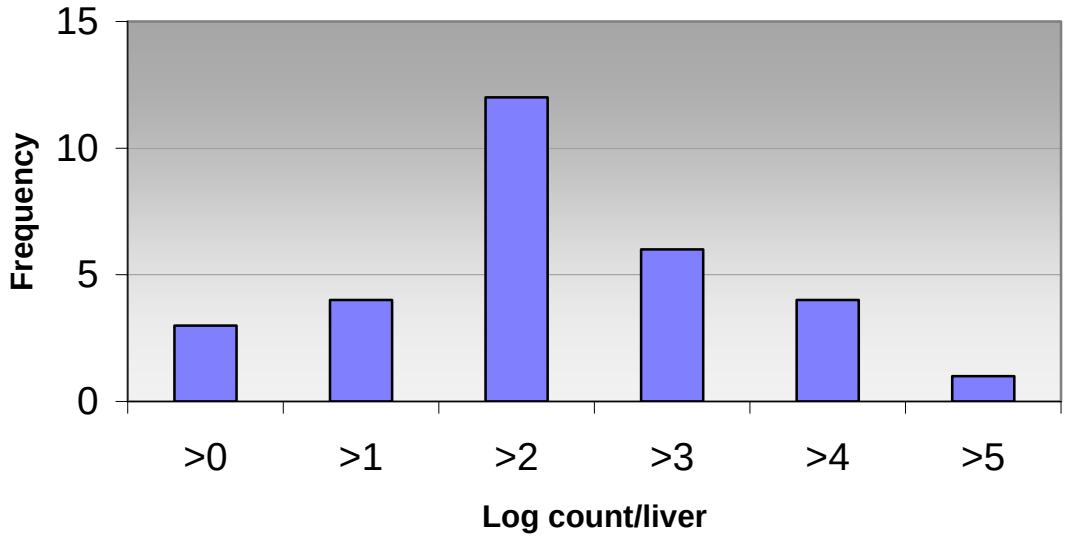
Chicken liver pâté has been associated periodically with outbreaks of campylobacteriosis in New Zealand. Investigations by Christchurch Health Protection Officers indicate that chefs are trained to cook livers until they are "pink in the middle", and there is no indication that this mild heat treatment is an adequate cooking regime.

Experimental work was carried out in association with the chef training school at Christchurch Polytechnic Institute of Technology (CPIT). Three sets of experiments were carried out to determine:

- *Campylobacter* contamination levels of chicken liver
- The effectiveness of pâté cooking methods for the inactivation of *Campylobacter*, and
- The effect of heat and time on the inactivation of *Campylobacter*.

All chicken livers purchased from retail premises were found to be externally contaminated with *Campylobacter*, with counts of greater than 100 MPN/liver on over half of the samples. Figure 1 shows the numbers of *Campylobacter* per chicken liver expressed as a log count.

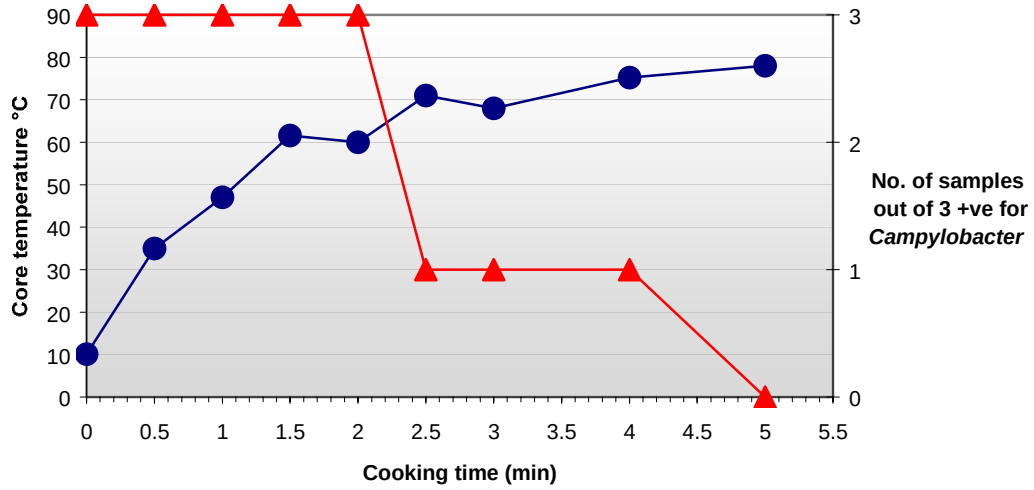
Figure 1: Distribution of *Campylobacter* counts in retail chicken livers



Campylobacter were also isolated from the internal tissues of the majority of livers (90%). No *Campylobacter* were detected in cooked pâté samples prepared under each of three regimes (livers sautéed rare, liver sautéed to an internal temperature greater than 74°C, and raw ingredients baked in a bain marie).

To test the effect of temperature and time on *Campylobacter* survival, batches of three livers were sautéed for various lengths of time, with the core temperature taken immediately upon removal from the pan. Figure 2 shows the inactivation of *Campylobacter* as affected by temperature and time. Core temperatures of livers did not increase significantly after two and a half minutes of cooking, however *Campylobacter* was not inactivated until 5 minutes cooking time.

Figure 2: The effect of temperature and time on the survival of *Campylobacter* in chicken livers



The results of this study were used to produce a Food Safety Factsheet that has been posted on the NZFSA website (http://www.nzfsa.govt.nz/consumers/food-safety/safe-cooking-of-chicken-livers/index.htm**).**

Whyte RJ, Hudson JA. (2004) Undercooked chicken livers as a vehicle for campylobacteriosis. ESR Client Report FW0411. Christchurch: ESR.

4.4 Development of a Preliminary Draft Risk Model for *Campylobacter* in Poultry in New Zealand

This project involved the initial stage of development of a quantitative risk model i.e. evaluating the level of *Campylobacter* spp. in the New Zealand poultry food chain. The report covers work during 2003-2004, during which time a "preliminary draft" model has been developed. Further refinement of the model will take place during 2004-2005.

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

The model describes each step in the chain as distributions of the likelihood of contamination with *Campylobacter* and the level of that contamination. Distributions are used because the data at each step has both uncertainty and variability.

- Uncertainty: This arises because we have imperfect knowledge of the effect of each step in the process;
- Variability: This arises because these will be inherent biological variability in the process being described.

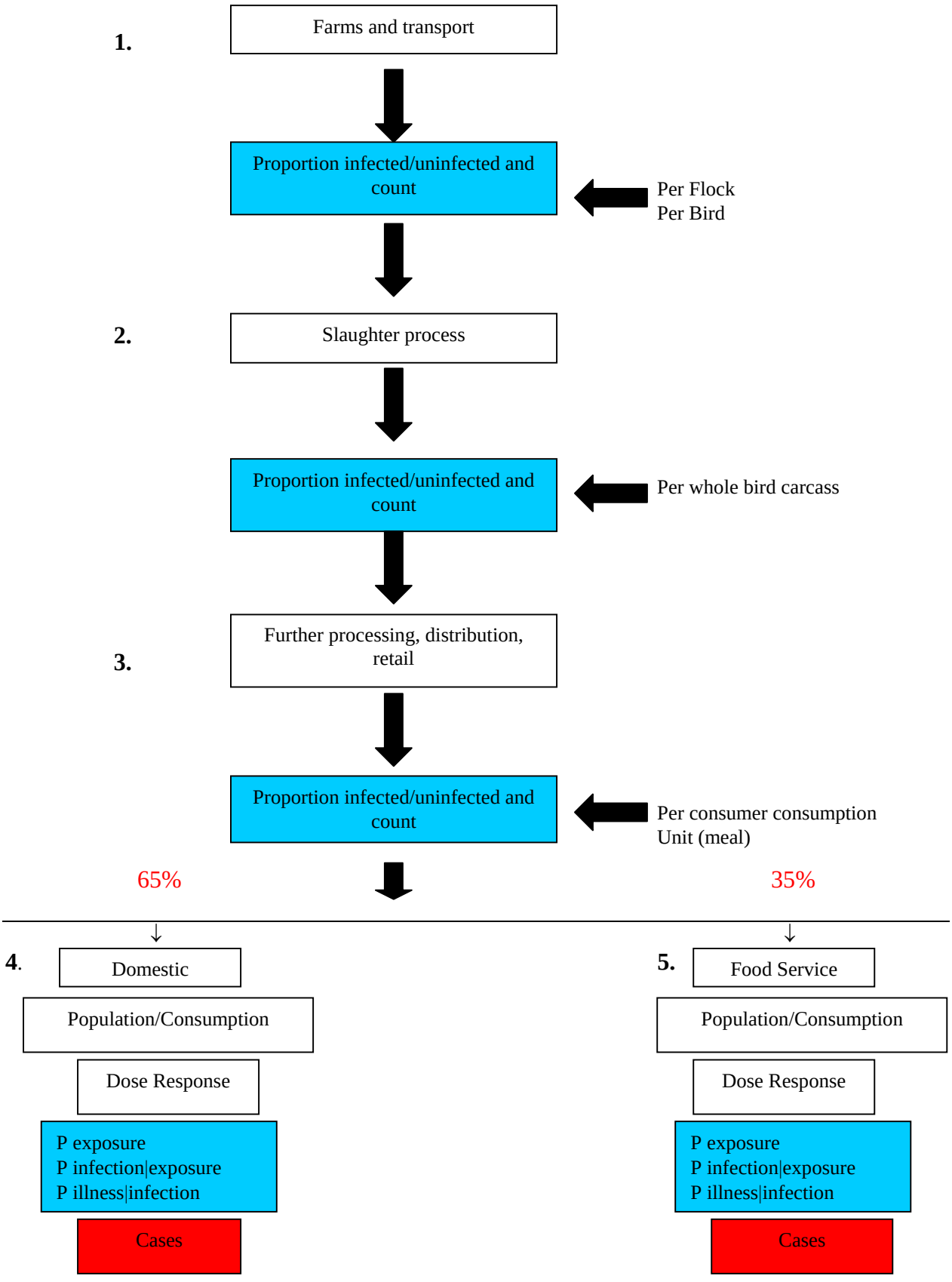
The components of the chain to be modeled are shown diagrammatically in Figure 3.

Within a risk assessment, the model output (exposure) can be applied to dose response information to provide a full 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 not been included in the current version of the model, which focuses on determining exposure. This step will be included during development in 2004-2005.

The development of the New Zealand model has been guided by models developed overseas, particularly the Danish Quantitative Risk Assessment. The approach taken in the New Zealand model is similar to the Danish one, although the input data has been updated to include more recent, as well as local, information, and a different approach to modelling certain steps has been taken.

It is important to recognise that this summary, and the current status of the model represents a snapshot of current development, as part of a longer term process.

Figure 3: ***Campylobacter*** **risk model components with makeup of the New Zealand poultry industry**



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

- Review of existing models from overseas for *Campylobacter* in the poultry food chain;
- Collation of New Zealand information, on *Campylobacter* in poultry, the poultry food chain itself, as well as exposure related information, such as food consumption data, cooking behaviour, and companion foods (principally from the 1997 National Nutrition Survey);
- Collation of information from the scientific literature, particularly material published after that used by the existing risk models (i.e. material published since 2001);
- Liaison with the poultry industry. This was largely conducted via the Poultry Industry Association of New Zealand (PIANZ). ESR representatives attended two meetings of the Technical Committee of PIANZ (August 2003 and February 2004), to update the industry on progress on this and other poultry related projects, as well as soliciting additional data. PIANZ also facilitated a visit by several ESR staff to the Tegel poultry processing plant at Hornby, Christchurch in March 2004.
- Development of computer files as the model. These files were primarily developed using @RISK software (Version 4.5, Palisade, 2002), as well as Analytica (Version 2.0, Lumina Decision Systems, 1999).

Lake RJ, Hudson JA. (2004) Quantitative risk model: Campylobacter *spp. in the poultry food chain. ESR Client Report FW0433. Christchurch: ESR.*

4.5 Expanded Risk Profile of *Salmonella* in Chicken Nuggets

In early 2003 the "*Salmonella* in Poultry Meat" Steering Group convened by the New Zealand Food Safety Authority (NZFSA) identified a potential risk to children through inadvertent consumption of uncooked chicken nuggets. In addition, the Steering Group was unsure whether the meat inside the nugget has been subjected to adequate heat treatment to render it safe from *Salmonella* contamination. There is a possibility that this type of product may be perceived by consumers as fully cooked and therefore handled in an unsafe manner in domestic environments. Partially cooked chicken nuggets have been implicated internationally in foodborne outbreaks of salmonellosis.

As with any poultry product in New Zealand, there is a low (but non-zero) risk of *Salmonella* contamination in chicken nuggets. This conclusion can be drawn from testing data from the National Microbiological Database (NMD) and ESR, backed up by in-house testing data from one manufacturer.

An outbreak of salmonellosis in Australia has been linked to consumption of undercooked chicken nuggets. This was attributed to consumer confusion about the cooking status of the product, as both fully and partially cooked chicken nuggets are on the Australian market. It is also worth noting that the level of *Salmonella* in Australian poultry products appears to be higher than the current New Zealand level (see Section 4.6). A survey by Australian Capital Territory Health in 1999-2000 found *Salmonella* present in 41% (109/266) of retail poultry products (see Food Survey Reports 1999-2000 under Publications at http://www.health.act.gov.au).

In New Zealand the risk of *Salmonella* infection from chicken nuggets cooked according to the manufacturers instructions is extremely low. The manufacturing processes in the three plants visited are well controlled and the end products are snap frozen for ease of weighing, packaging and storage. The lack of drip from thawed nuggets will minimise cross-contamination in the kitchen surfaces and in handling food during preparation for cooking.

To our knowledge fully cooked nuggets are not available on the New Zealand market, and so there is less potential for consumer confusion between raw and fully cooked products.

The risk to consumers arises from the potential for misunderstanding of the need for effective cooking of the product. This may arise from a perception that the product is already cooked and so may be consumed either directly, or with reheating (as in a microwave) rather than proper cooking. Label pictures showing a product that appears to be already cooked may reinforce this perception. The outbreak in Australia indicated the potential for greater risk to children.

In the absence of cases of salmonellosis conclusively linked to chicken nuggets in New Zealand, as well as the low level of *Salmonella* in New Zealand poultry, options to ensure negligible risks to consumers include:

- For all manufacturers to label their product as not cooked.
- For all manufacturers to cook their product fully (there appears to be the potential for confusion if only some manufacturers produce a fully cooked product).

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

4.6 Development of a Preliminary Draft Risk Model for *Salmonella* in Poultry in New Zealand

This work area complemented that described in section 4.4 of this report on modeling *Campylobacter* in the poultry food chain, by addressing *Salmonella* in the poultry food chain. This summary covers work during 2003-2004, during which time work towards a "preliminary draft" model has been undertaken. Further development of the model will take place during 2004-2005.

The output of the model is intended to describe the exposure of New Zealanders to *Salmonella* from poultry, principally in terms of probability that an exposure (e.g. a poultry meal) will be contaminated, and the bacterial count associated with that contamination. The poultry food chain principally concerns broilers; a proportion of egg laying hens at the end of their life are processed for food, and this will be considered as to the overall importance in the food supply.

This model has been developed in parallel with another that describes the prevalence and counts of bacteria of *Campylobacter* spp. in the poultry food chain. The purpose of that model is to assess the effect of changes in the poultry food chain on that exposure in order to support the development of new risk management measures by the New Zealand Food Safety Authority.

This model for *Salmonella* has a slightly different purpose, and this has shaped the initial work conducted to develop the model. In addition the resources allocated to developing the *Salmonella* model were more modest, and so progress has largely involved developing the high-level structure of the model, collation of data on the industry, and literature review.

The prevalence of *Salmonella* in the New Zealand poultry food supply dropped markedly during the 1990s, according to data reviewed in the "*Salmonella* in poultry" Risk Profile (revised in 2004). 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:

- Elucidate the influences on *Salmonella* prevalences and bacterial counts in poultry in New Zealand, in order to support the maintenance of, and, if necessary, 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.

Within a risk assessment, the model output (exposure) can be applied to dose response information to provide a full 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 not been included in the current version of the model, which focuses on determining exposure. This step will be included during development in 2004-2005.

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.

Lake RJ, Hudson JA, Cressey PJ. (2004) Quantitative risk model: Salmonella *spp. in the poultry food chain. ESR Client Report FW0441. Christchurch: ESR.*

4.7 Vertical Chain Estimation of Prevalence of *Salmonella* in Raw Poultry from End of Primary/Secondary Processing to Retail Outlets

Salmonellosis is the second most frequently reported bacterial gastrointestinal illness in New Zealand and, because of the common perception of salmonellosis as "foodborne" in origin, in particular through poultry meat, it ranks high for NZFSA risk management action. The strategic requirement of NZFSA to reduce the incidence of foodborne illness in New Zealand requires the provision of robust data. Presently an incongruity in *Salmonella* prevalence data exists between National Microbiological Database (NMD) data collected immediately after immersion chilling (~2% in 2003) and much higher rates (up to 34%) indicated from a previous specific retail study prior to 2000.

The "*Salmonella* in Poultry Meat" Steering Group recognised that these data are not matched by product, by geographic location or by season. In effect the data sets are not comparable. The aim of this project was to provide congruent data at both ends of the supply chain (at primary processing and retail outlets). This involved monitoring *Salmonella* from chicken portion samples at processing and then vertically tracing these to chicken portions offered for sale at retail. The Steering Group believes that this study will help to identify the most appropriate location in the supply chain to implement any risk management options that are necessary.

This project assessed the *Salmonella* status of 610 chilled chicken portions (breasts, thighs, drums and wings/nibbles) collected vertically through the supply chain over a sampling period from September 2003 to June 2004 (10 months). Samples originated from seven chicken processors in New Zealand representing all major processing companies and brands. These included 310 portions sampled at the end of primary processing and a further 300 purchased from retail outlets to investigate changes in the prevalence and levels of *Salmonella* vertically through the supply chain. *Salmonella* was tested according to the method used extensively in the Poultry industry (Meat Industry Microbiological method for *Salmonella*).

In contrast to previous surveys of *Salmonella* in raw chicken in New Zealand and literature information, all three hundred samples of chicken portions purchased from retail outlets were negative for *Salmonella.* Most were sampled on the same day or one day after dispatch from processors to retail outlets. At the same time, out of 310 portions provided by the primary processors, only one thigh sample was positive for *Salmonella* Agona. This amounted to a very low prevalence rate of 0.3%. The count was also very low, <6 MPN per portion.

This result was significant in that not only was *Salmonella* prevalence in uncooked chicken portions very low, there was also no evidence of major cross contamination of *Salmonella* from other meat species detected at retail. Otherwise there could be more *Salmonella* isolation compared to that elucidated from the processors' samples. The results showed a vast improvement over previous surveys where rates of 17% (Campbell and Gilbert 1995) and 34% (Anonymous 1999) were reported for *Salmonella* in raw chicken. This study also confirmed the trend to lower prevalence rates for *Salmonella* in poultry (2% in poultry for 2003 reported by the NMD programme for poultry). This is evidence of good food safety controls being implemented by the New Zealand poultry industry.

Wong TL. (2004) Vertical chain estimation of prevalence of Salmonella in chicken portions. ESR Client Report FW0476. Christchurch: ESR.

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

These two projects involved surveillance of retail meat products for *Salmonella* and shiga toxin-producing *E. coli* (STEC) over a two-year period (2003 to 2005) spanning four seasons and national in focus. The aim of the project is to gather data on the proportionality of exposure to these pathogens from different meat species and to identify the most appropriate meat species for implementation of risk management options.

Salmonella was enumerated from beef, bobby veal, chicken, lamb/mutton and pork while STEC was enumerated from four meat species (chicken was excluded). The target sample numbers are 230 per meat species in a minced or diced matrix, half being tested in 2003/04 and the other in 2004/05. The STEC project also included enumeration of generic *E. coli*.

Salmonella was tested according to the method used extensively in the meat industry (Meat Industry Microbiological method for *Salmonella*). STEC testing involved enrichment and multiplex PCR for organisms carrying the *stx*1, *stx*2, *eae*A and *hyl*A virulence genes. Samples that were screened positive by PCR were treated with Dynal beads for *E. coli* O157:H7 before concentration by the immunomagnetic separation procedure. Other STECs were isolated be means of CT-SMac selective agar and screened for enterohaemorrhagic activity on EHEC agar. Generic *E. coli* was enumerated using the Petrifilm method. Enumeration for both pathogens was performed using the MPN method.

After the first year, 118 beef, 89 bobby veal, 116 chicken, 115 lamb and 115 pork samples were tested. Availability of bobby veal was limited to a few local outlets only as most bobby veal is processed for export.

There were four *Salmonella* isolations made, two each from chicken and lamb. The serotypes isolated from chicken were *Salmonella* sp, 6,7:k:- and *S*. Enteritidis PT9a (count of both types was <0.31 MPN/g). The serotype isolated from lamb in Dunedin was *S*. Brandenburg, now endemic in sheep in Otago and Southland. The count was 4.2 MPN/g. *Salmonella* sp 4:-:2 was isolated from minced lamb in Christchurch with a count of <0.31 MPN/g. With the *Salmonella* project 50% completed, the prevalence of *Salmonella* in raw retail meats were very low, with only 1.7% (2/116) of chicken and 1.8% (2/114) of lamb positive. No *Salmonella* was detected from beef, bobby veal or pork samples to date.

The STEC project revealed the presence of *E. coli* O157:H7 in lamb (2/115, 1.7%) and pork (1/115, 0.9%). Prevalence of other STECs (non-*E. coli* O157:H7) in lamb was 10/115(8.7%), pork 9/115 (7.8%), beef 3/118 (2.5%) and bobby veal 2/89 (2.2%). All STEC isolates carried either the *stx*1 or *stx*2 gene or both, with most also carrying either the *eae*A and *hyl*A gene or both. The serotypes of non-O157 STECs were diverse, namely ONT:H26, ONT:HNM, O163:H19, O26:H11, O128:H11, O(rough):H2, O38:H26, ONT:H10, O178:H7, O15:HNM, O171:H2. These isolates will be genotyped by PFGE for further correlation with human isolates.

4.9 Survey of Ready-to-eat Dairy Products for Quantitative Levels of *Listeria monocytogenes*

Listeriosis is an infrequent disease in New Zealand, but rates highly for risk management action as it has a high fatality rate. It is also a current concern to many of our major trading partners. Ready-to-eat meats have previously been associated with an outbreak (and other incidents) of listeriosis in New Zealand and it is thought likely that other ready-to-eat foods may also contribute to foodborne listeriosis.

The strategic aim of the NZFSA to reduce the level of foodborne illness in New Zealand requires the provision of robust data. The NZFSA "*Listeria* in Ready-to-Eat Meats" Steering Group recognised that there is only limited data available for New Zealand ready-to-eat foods and recommended a comprehensive survey of retail ready-to-eat foods.

The primary objectives of the current survey were to:

- Examine products at retail for the presence and quantitative levels of *Listeria monocytogenes* in order to accurately estimate exposure,
- Evaluate the effectiveness of HACCP-based food safety programmes, and
- Inform risk management strategies.

The survey undertaken in 2003/04 focused on dairy products (cheese) in which *Listeria* can grow and which have a relatively long shelf life. Soft cheeses have been the cause of a number of outbreaks of listeriosis overseas.

A total of 307 soft and semi-soft cheeses were tested. Samples were collected nationally (Auckland, Wellington and Christchurch) and a wide range of large and small manufacturers were included. The samples were purchased from retail outlets and held until the end of their shelf life before analysis. The types of cheese included in the survey were domestically produced surface ripened soft cheeses (camembert, brie), soft and semi-soft blue cheeses, mozzarella, ricotta and low-salt feta.

No cheese sample tested positive for *Listeria monocytogenes* and all except one sample were also negative for other *Listeria* species. The positive sample, a blue cheese, contained low levels (less than 100 per gram) of a non-pathogenic species (*Listeria welshimeri*).

Wilson MW. (2004) Listeria monocytogenes*: survey of selected soft and semi-soft cheese. ESR Client Report FW0477. Christchurch: ESR.*

4.10 Analytical Development: Norovirus Detection

Noroviruses (NV) have been identified as the most common cause of foodborne viral gastroenteritis in New Zealand. Contamination of foods by human faecal material can occur at two stages: primary contamination of food products prior to harvest and secondary contamination by infected foodhandlers during food processing, preparation and distribution or by indirect transmission via fomites or asymptomatic foodhandlers to food. The overall aim of this project is to develop and validate sensitive, robust and reproducible detection methods for NV in shellfish, with the ultimate goal in three years of a laboratory with established protocols and quality systems suitable for regulatory use in New Zealand.

The major stages in the methodology are:

- Processing, concentration and recovery of NV from a shellfish matrix,
- Extraction of viral RNA, and
- Detection and identification of NV by molecular methods.

In each method, loss of virus occurs at every stage of the recovery procedure. These losses have to be balanced against the ability to concentrate virus and to avoid co-concentration of inhibitors. Six published virus recovery methods (based on protease digestion, alkaline elution, acid elution, ultracentrifugation, magnetic bead with alkaline elution and oligo-dT concentration columns) were evaluated for their efficiency in recovering NV from seeded shellfish. Triplicate shellfish samples were used in each experiment and each experimental trial was carried out at least twice.

Over 70% virus was recovered using the protease digestion method on shellfish seeded with high virus concentrations. However, this method dilutes rather than concentrates the sample and is expected to have a high limit of detection. None of the remaining 5 methods were as efficient at virus recovery, with most giving less than 20% recovery. The alkaline elution and acid elution methods rated second equal in the evaluation. Both of these concentration methods have been used successfully for detection of NV in naturally contaminated shellfish in New Zealand. Further evaluation of these two methods and the protease digestion method will be carried out using shellfish seeded with low NV copy numbers before a final decision is made on which method is to be the recommended method for New Zealand.

Options for the development and implementation of a generic NV real-time RT-PCR assay were explored. The requirements were for an assay that would detect the majority of known NV strains circulating in New Zealand, and also be sufficiently sensitive to detect low levels of NV in contaminated shellfish and other foods. Various assay formats and primer and probe sets were evaluated for the generic NV assay. Generic assays using published Japanese and French primer sets for Genogroup I (GI) and Genogroup II (GII) NV strains were found to identify most New Zealand genotypes. The GII assay was successfully trialled in a shellfish matrix. Preparation of a NV standard for quantitation of NV by real-time molecular methods was also investigated. Two commercially available NV preparations of known concentration were purchased for use as GI and GII NV quantitation standards. Specific real-time GI and GII RT-PCR assays were developed and set up to identify and quantify these standards.

The ESR Environmental and Food Virology Laboratory participated in three European Community Reference Laboratory (ECRL) Ring Trials for quantitation of F-RNA bacteriophage and three ECRL Ring Trials for detection of NV in faecal material and shellfish. ESR's results for both the phage and NV trials were in accordance with expected results and within acceptable limits.

Four Client Reports were prepared during the year:
Greening GE. (2003) Improved methods for recovery and detection of Norovirus from shellfish and foods: Part 1. Rationale for testing protocol. ESR Client Report FW0387a.

Greening GE. (2004) Improved methods for recovery and detection of Norovirus from shellfish and foods: Part 2. Rationale for Norovirus detection and quantitation methods. ESR Client Report FW0450.

Greening GE. (2004) Improved methods for recovery and detection of Norovirus from shellfish and foods: Part 3. Evaluation of virus recovery methods. Interim Report.

Greening GE. (2004) Improved methods for recovery and detection of Norovirus from shellfish and foods: Part 4. Development of a quantitative generic Norovirus real-time RT-PCR assay. ESR Client Report FW0451.

5 CHEMICAL FOOD SAFETY

Recent 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. This has been reflected by the establishment of a European Food Safety Authority, as well as the New Zealand Food Safety Authority (NZFSA) in July 2002.

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 2003/2004 were:

- 2003-2004 New Zealand Total Diet Survey
- Multi-residue Pesticide Screen Survey
- Glyphosate in Targeted Foods
- WHO Global Environment Monitoring System/ Food
- Genetically Modified Food Analysis and Capability Development
- Sulphite, Sorbate and Benzoate Dietary Exposure and Risk Assessment
- Acrylamide (Methodology)
- Nitrates and Nitrites Dietary Exposure and Risk Assessment
- Use of Ethylene Oxide in Spices Available in New Zealand
- Bisphenol A Surveillance in Canned Foods and Exposure Assessment
- Develop Capacity and Testing for Insoluble Impurities in Tallow

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.

The first year of the NZTDS was dedicated to preparation, planning and stakeholder consultations. This second year of the NZTDS has primarily involved sampling, sample preparation and analyses. Work was undertaken in quarterly segments to manage sampling, preparation and analytical flows, and to maintain quality. Results have been reviewed and on occasion, reanalyses have been undertaken to confirm initial results. NZFSA have applied a strict project management approach and key deliverables for 2003/04 that reflect this are:

Vannoort RW. (2003) 2003/04 New Zealand Total Diet Survey Analytical results – Q1. 20 November 2003. ESR Client report FW 03/77.

Vannoort RW. (2004) 2003/04 New Zealand Total Diet Survey Analytical results – Q2. 20 April 2004. ESR Client report FW 04/16.

Vannoort RW. (2003) 2003/04 New Zealand Total Diet Survey Analytical results – Q3. ESR Client report FW 04/47. The draft for this report has been completed, and the report should be finalised in mid July 2004.

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

5.2 Multi-residue Pesticide Screen Survey

The 2003/04 multi-residue survey (MRS) was undertaken as a pilot survey for 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 products were selected on the basis of likely residues, lack of NZFSA information about actual residues, food consumption and other intelligence. In the first year of this programme, seven foods were sampled:

- tomatoes (imported; domestic, glasshouse and other);
- lettuce,
- table grapes,
- bananas,
- potatoes,
- broccoli, and
- wine.

Primary products sampled were from a range of production methods, including organic.

Foods were sampled at each of three locations (Auckland, Palmerston North, Christchurch) at two different times of year.

All 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.

5.3 Glyphosate in Targeted Foods

Glyphosate, the active ingredient in Roundup, is a systemic herbicide and will reach potato tubers if used preharvest, so it is possible that residues may remain at harvest. This work was intiated because of the express concerns voiced by New Zealand consumers via the Consumers Forum. The purpose of this project was to ascertain whether glyphosate is being used on potatoes for preharvest weed control or as a desiccant to enhance the drying off of leafy tops before harvest, in a manner inconsistent with its conditions of registration.

A total of 56 samples were purchased in November 2003 and March 2004 from the main potato-growing regions in New Zealand, namely, Pukekohe (28), Manawatu (18) and Canterbury (10). Aqueous potato extracts were derivatised and analysed by gas chromatography with mass selective detection. Recovery of glyphosate and the breakdown

product aminomethylphosphonic acid (AMPA) from samples spiked at 0.05 mg/kg ranged from 43-169% and 26-165% respectively.

A total of 56 samples were analysed giving a 95% probability of detecting glyphosate if 6% of all potatoes contain glyphosate. None of the samples analysed were found to contain glyphosate or AMPA above the level of quantitation (0.05 mg/kg).

There is no evidence of off label, preharvest use of glyphosate on New Zealand grown potatoes.

Thomson BM. (2004) Glyphosate in targeted foods.ESR Client Report FW0394. Christchurch: ESR.

5.4 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 2003-2004 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 mainly relates to import surveillance of peanuts (aflatoxins), shrimps and prawns (cadmium, copper and selenium) and soy sauce (chloropropanols). Data were also submitted on fish species (mercury), and

residue monitoring data on kiwifruit, provided by Zespri International. Data on residues of ethylene oxide (2-chloroethanol and 2-bromoethanol) on spices and herbs from an NZFSA funded project were also submitted this year.

WHO are continuing to develop improved software tool for the capture of food contaminant data at the country level. During 2003-2004 ESR carried out an assessment of a new WHO product (OPAL III) designed to capture data related to analysis of single food samples for chemical contaminants.

Preliminary 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 2003-2004 year and a proposed work plan for the 2004-2005 have been drafted for submission to the WHO Regional Office for the Western Pacific in Manila.

5.5 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 New Zealand Food Safety Authority (NZFSA) has a surveillance/monitoring programme in place to ensure labeling compliance. It is therefore 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 the contract period the NZFSA did not require any samples to be analysed by ESR for compliance with FSANZ labelling standards for Genetically Modified Food and it was decided to maintain capability in the detection of GM components in food matrices by increased participation in international proficiency trials.

ESR participated in two separate proficiency programmes during the 2003/2004 year; GeMMA (Genetically Modified Material Analysis Scheme) run by the UK Central Science Laboratory, and the T034 GMO Proficiency Testing Programme run by the Asia Pacific Laboratory Accreditation Cooperation (APLAC). The former involved analysis of eleven samples covering a range of food matrices (mixed flour, dry cake mix, baked biscuit crumb, dry pastry mix) for the presence of Roundup Ready™ Soya and maize flour for the Bt11 transformation. At the time of reporting results for all soya trails have been received, with the ESR laboratory correctly identifying the presence or absence of Roundup Ready™ Soya in

all cases. The APLAC trail involved analysis of two freeze-dried powders for Roundup Ready™ Soya, with ESR providing correct qualitative results for both samples.

Within the ESR Food Group's larger Research Programme is a project to investigate the stability of genes during cooking. Several objectives within this project were developed within the NZFSA/ESR contract to assess the effect of cooking on transgene stability. Using a genetically modified food as the basis for the investigations, this work aimed to facilitate methodology and capability development to detect genetically modified components within complex food matrices.

Potato tissue was selected, as GM potato has the potential to enter the NZ food chain through imported approved GM foods. Potato tissue was analysed in a raw state and after cooking (microwave, deep frying, boiling, pressure cooking). While DNA was readily extracted from raw potato via a range of protocols, only one extraction technique extracted a small amount of degraded DNA from cooked potato. It was speculated that the extraction problems might be due to carbohydrate alteration during the cooking process.

This project has highlighted the potential problems that may be encountered in extraction of DNA from cooked potato tissue should this be necessary for GM testing for labeling compliance. The problems are likely to be solvable but more work will be necessary to identify appropriate extraction methods and to optimize them for this tissue in order to obtain DNA of a suitable quality and quantity for PCR-based testing for GM components.

Podivinsky E. (2004) Genetically modified food analysis and capability development. ESR Client Report FW0466. Christchurch: ESR.

5.6 Sulphite, Sorbate and Benzoate Dietary Exposure and Risk Assessment

Preservative compounds are added to foods due to their antibacterial, antifungal, antioxidant activities or their ability to inhibit enzymatic or non-enzymatic reactions in foods. The most widely used food preservatives are sulphur dioxide and other sulphiting agents, sorbic acid and its salts, and benzoic acid and its salts.

Thirty foods assessed as being the likely major contributors to dietary preservative exposure were purchased from retail outlets in Auckland, Hamilton, Wellington, Christchurch and Dunedin and prepared as normally consumed.

Mean estimates of dietary exposure were well below the respective Acceptable Daily Intakes (16, 1 and 3% of the ADI for sulphite, sorbate and benzoate respectively). Of the 4000 plus daily dietary exposure scenarios, generated by combining the results of the current survey with the 24 hour diet recall data from the 1997 National Nutrition Survey, none resulted in a sorbate or benzoate exposure in excess of the ADI, while only 2.5% of sulphite exposure scenarios were above the relevant ADI. Estimates of dietary exposure from the current survey were low compared to most international estimates, however, most of these estimates were determined using Codex or national maximum permitted values, rather than measured residual values.

The results of the current survey indicate that dietary exposure to the preservatives, sulphite, sorbate and benzoate, represent a low level of public health risk. It should be noted that the

exposure estimates determined in the current survey would be influenced by the assumptions made. The limiting of the number of foods to 30 will result in an underestimate of exposure, while assumptions such as the mapping of results for refrigerated orange juice to all orange juice will result in a degree of overestimation of exposure. It is uncertain what the cumulative effect of all assumptions will be.

Mean levels of preservatives in survey foods were similar to or lower than levels previously determined in New Zealand or levels reported from other countries.

Information gathered as part of the survey detected ingredient labelling and permitted use discrepancies with the Food Standards Code for some samples. Labelling non-compliances were more commonly associated with a general lack of ingredient labelling, noting that some of the foods sampled would be exempt from labelling. While this information has been reported on in the current report, it should be noted that the survey design was intended to estimate dietary exposure, not regulatory compliance.

Cressey P. (2004) Sulphite, sorbate and benzoate dietary exposure and risk assessment. ESR Client Report FW0421. Christchurch: ESR.

5.7 Acrylamide (Methodology)

The presence of significant amounts of acrylamide in many foods is of concern within the international food safety and regulatory communities as it is a potential carcinogen. World health organisations have recommended that levels of acrylamide in foods should be as low as reasonably achievable but as of now there is insufficient data to determine actual risk from exposure.

Acrylamide is formed when foods containing reducing sugars and asparagine are cooked at elevated temperatures and it is likely that the human race has been exposed to this contaminant in a range of starchy cooked food since fire was first controlled. At present countries are testing food to obtain a better understanding of exposure, assessing practical approaches that could be used to reduce exposure and developing better assessments of potential risk. This project will provide New Zealand with appropriate data to allow effective intervention once potential risk and information on practical interventions are available.

A number of reports on acrylamide levels in foods have been published in the last three years. These levels have been determined by a number of methods and Regulatory Authorities show no preference for any particular methodology. Most methods used have been based on gas chromatography with mass spectrometry detection or liquid chromatography with mass spectrometry detection.

Two proficiency trials have been carried out on the detection of acrylamide in food samples. In both trials, participants used methods based on both gas chromatography and liquid chromatography and the results reported indicated all the methods used had similar reliability on the samples tested.

The first part of this project assessed the methods available and identified from these, the one most appropriate for the equipment available at ESR in Christchurch. The Food Safety Group has gas chromatographic systems with mass spectrometry detection (GC-MS)

capability and it was therefore proposed that the project on the determination of acrylamide in New Zealand foods be based on this equipment. Of the published methods using GC-MS procedures, the procedure reported by the Swiss Food Control Agency for the Canton of Zurich seems to be the simplest procedure and it was proposed and accepted that this method be used for this project. It has a relatively simple extraction and clean-up procedure with no use of derivatising reactions. The method has a good range of internal checks to ensure that individual sample results are reliable.

The second part of the project has validated this proposed procedure at ESR to ensure results obtained are reliable and the final stage of this project in the 2003/04 year, has looked at a small number of foods that could contain acrylamide. A more complete selection of foods will be tested during the 2004/05 year.

Love JL. (2003) Recommended method for the determination of acrylamide in foods. ESR Client Report FW0388. Christchurch: ESR.

Love JL, Grounds P. (2004) Validation of acrylamide method and sampling plan – 2003/04 year. ESR Client Report FW0443. Christchurch: ESR.

5.8 Nitrates and Nitrites Dietary Exposure and Risk Assessment

Nitrites in foods have the possibility of reacting with the secondary amines commonly present as a natural component of many foods to form nitrosamines, many of which are potent carcinogens. Within the food nitrate can be converted to nitrite and it is considered desirable to limit dietary exposure to both.

Many foods contain nitrate and nitrites both from up-take of fertilizers and from the addition of curing salts to protein products. The purpose of this project was to estimate intakes of nitrates and nitrites from food (exogenous intakes), estimate the effect of the human body converting some of the nitrate into nitrite (endogenous), compare the results with Australian, international and previous New Zealand data, and comment on results relating to the growing methods of vegetables (eg nitrates in organic versus non-organic vegetables). This project was also undertaken because of concerns expressed via the Consumer Forum.

Processed foods such as meats and cheeses are permitted to contain added nitrates or nitrite. Nitrates occur naturally in vegetables and plants. One hundred processed foods and meats and 100 vegetable samples purchased in Christchurch and Auckland from 24 November to 16 December 2003 were prepared as for consumption and analysed for nitrite and nitrate concentration using standard, validated methodology of high pressure liquid chromatography with UV detection. The limits of detection were 5 mg/kg for both nitrate and nitrite (as sodium nitrate) except for some cheese samples where a higher limit of detection was necessary.

Foods that were analysed raw, or without further cooking, included ham, luncheon, salami, corned silverside (precooked), hamburger, cottage cheese, dip, cheddar cheese, cabbage, lettuce, watercress, celery, and carrots. Bacon, sausages and beef mince were fried without added fat, raw corned silverside, saveloys, potatoes, broccoli, spinach, silverbeet and pumpkin were boiled before analysis.

Nitrate was detected in at least one sample of each food except for cheddar cheese and cream cheese-based dips in which none was detected. Nitrite was detected in half the processed foods and meats analysed but was not detected in any of the vegetable samples above the limit of detection with the exception of one sample of broccoli at 27 mg/kg nitrite. Ninety seven percent of the processed foods and meats analysed complied with the Australia New Zealand Food Standards, with two meat samples containing low levels of nitrate and one with excessive nitrite. Levels of nitrate and nitrite in the New Zealand samples were low or comparable with the results obtained in the 21st Australian Total Diet Study with the exception of one sample of New Zealand ham. The results from vegetables from the present survey were lower than or comparable with nitrate results from overseas.

An elevated concentration of nitrate was found in hydroponically compared with organic or conventionally grown lettuces. There was no apparent difference in nitrate concentration between organically and conventionally grown lettuces.

Concentration data were combined with 24-hour dietary recall information from the 1997 National Nutrition Survey to generate 4398 individual exposure scenarios for exogenous nitrite, for nitrate, and for total nitrite including a proportion from the endogenous conversion of nitrate. Dietary exposure was determined for New Zealand adults only.

The mean dietary exposure to nitrate (0.719 mg/kg body weight/day as sodium nitrate) is approximately 14% of the Acceptable Daily Intake (ADI). For exogenous nitrite (excluding any contribution from the endogenous conversion of nitrate) the mean dietary exposure is approximately 13% of the ADI. When a contribution from the conversion of dietary nitrate to nitrite is included, the mean dietary exposure to nitrite is 49% of the ADI for an individual with an average conversion rate (5%) and 156% of the ADI for those individuals with a high conversion rate (20%). The ADI is exceeded for approximately 10% of average converters and 50% of those with a high rate of conversion. Over 97% of exposure to nitrate from the foods selected for this study was from the consumption of vegetables. The two most significant contributors to both nitrate and nitrite exposure were potatoes (32%) and lettuce (29%).

Thomson BM. (2004) Nitrates and nitrites dietary exposure and risk assessment. ESR Client Report FW0392. Christchurch: ESR.

5.9 Use of Ethylene Oxide in Spices Available in New Zealand

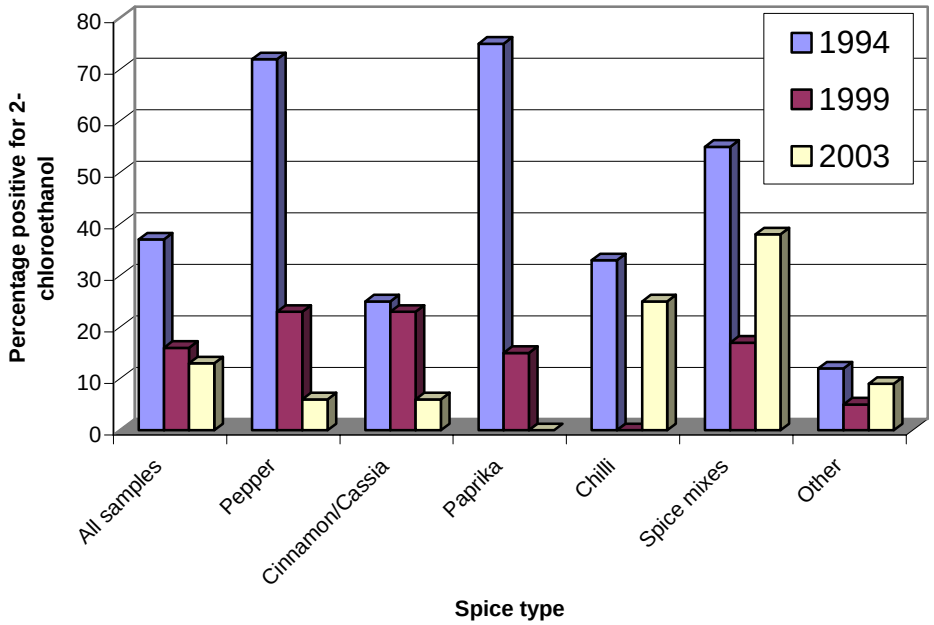
Spices and herbs are produced in many parts of the world, but notably from developing countries. Some of these countries do not have sophisticated food safety systems in association with their agricultural production and it is possible for spices to be contaminated with pathogenic microorganisms. The options for sterilisation of contaminated spices include steam sterilisation, gamma irradiation and chemical treatment with ethylene oxide. Ethylene oxide (ETO) is classified by the International Agency for Research on Cancer (IARC) as a Group 1 carcinogen (carcinogenic to humans).

Ethylene oxide's chemical reactivity and volatility mean that residues disperse quickly, making it attractive for sterilising food and medical equipment. In food, the major decomposition reactions are with chloride to produce 2-chloroethanol or with bromide to produce 2-bromoethanol. These compounds are much more stable than ethylene oxide and are commonly used as indicators of past ethylene oxide usage in spices and herbs.

In the current survey 150 samples of spices and herbs were sampled from supermarkets and specialty outlets and analysed by gas-chromatography mass spectrometry for the ethylene oxide reaction products; 2-chloroethanol and 2-bromoethanol. 2-Bromoethanol was only detected in two samples and in both cases 2-chloroethanol was also present and at higher concentrations. 2-Chloroethanol was detected in approximately 17% of samples analysed at levels in the range 2-600 mg/kg. The prevalence of 2-chloroethanol residues was similar to the previous New Zealand survey, carried out in 1999, although levels of 2-chloroethanol were generally lower than in the 1999 survey. Both prevalence and levels of 2-chloroethanol in the current survey were lower than those found in an earlier survey, carried out in 1994.

Three spices (pepper, cinnamon/cassia and paprika) are monitored for microbiological contamination when imported into New Zealand. This is due to the fact that these spices are more likely than others to be consumed without cooking. Prevalence of 2-chloroethanol in these spices (6%, 6% and 0% respectively) was consistently lower than in the 1999 (23%, 23% and 15% respectively) and 1994 (72%, 50% and 75% respectively) surveys. Higher prevalence of 2-chloroethanol than in 1999 was observed in chilli products and spice mixes, although the prevalence of residues in these spice classes was still lower than in 1994. Trends in the prevalence of 2-chloroethanol in various types of spice are shown graphically in Figure 4.

Figure 4: Trends in 2-chloroethanol prevalence in the spices (percentage of samples greater than or equal to 5 mg 2-chloroethanol/kg)



Population level estimates of dietary exposure to ethylene oxide, 2-chloroethanol and 2-bromoethanol, based on spice and herb import volumes and the results of the current survey, suggest that dietary exposure to these compounds is currently similar to or less than exposure levels in 1999.

Cressey PJ. (2003) Ethylene oxide residues in spices and herbs available in New Zealand. ESR Client Report FW0386. Christchurch: ESR.

5.10 Bisphenol A Surveillance in Canned Foods and Exposure Assessment

Endocrine disrupting chemicals are of international concern. Bisphenol A is a synthetic endocrine disrupting chemical - it mimics the action of the hormone, estrogen. Bisphenol A is used as a principal material in the preparation of plastics such as polycarbonate and epoxy resins. Canned food may be contaminated by bisphenol A leaching from the lacquer on the inside surface of epoxy coated cans. In a 2001 study, bisphenol A was identified as the highest priority estrogenic contaminant in a recent risk assessment of NZ dietary exposure, accounting for about 35% of all estrogenicity from food. This assessment was based on Japanese and Swedish data in the absence of New Zealand data. The current survey addressed this data gap.

Eighty-one samples of canned foods originating from 13 different countries were purchased from retail outlets in Christchurch, New Zealand between November 2003 and February 2004. Cans were inspected for the use of lacquers and details of sugar and fat content were recorded from can labels. The can contents were analysed for bisphenol A concentration using a deuterated internal standard, extraction with acetonitrile and quantification by gas chromatography/mass spectrometry.

All cans included at least one lacquered surface. Generally, canned vegetables, sauces and vegetable based infant foods come in cans with lacquered ends and sides whereas fruits, spaghetti, baked beans, and fruit based infant foods are sold in cans with lacquered ends and tinned sides.

BPA was detected in all foods except soft drinks. BPA concentrations above the limit of detection were found in 25 of the 80 samples analysed. Concentrations ranged from <10- 29 µg/kg, except for individual samples of tuna, corned beef and coconut cream that were 109, 98 and 191µg/kg respectively. All concentrations detected were below the EU (3000 µg/kg) and Japanese (2500 µg/kg) migratory limits for BPA in food.

The levels found in New Zealand foods are low or comparable with the few available international results for fruits, vegetables, soups, corned beef, spaghetti, baked beans, condensed milk and soft drinks. Canned ham, that had high levels in the UK study, was not found on New Zealand supermarket shelves and levels of BPA in New Zealand meat products, such as tongue and luncheon, were below the limit of detection in the current survey. The high level of BPA found in individual samples of tuna and coconut cream from New Zealand supermarket shelves have not previously been reported in overseas studies.

The mean exposure to BPA from 4399 individual exposure scenarios was 0.008 µg/kg body weight/day. From these scenarios, most people (59%) are not exposed to BPA because they do not consume canned foods. The highest level of exposure was 0.29 µg/kg body

weight/day, well below the *t*-TDI of 10 µg/kg body weight/day. The estimated daily exposure of 0.063 µg/kg body weight/day for the 97.5th percentile of BPA exposure in the current study is lower but consistent with two comparative international results.

The results of this survey suggest that the levels of BPA identified in canned foods are unlikely to be of concern to adult health, and there is no reason for consumers to change their consumption patterns as a result of these findings. This health implication is limited to adults until consumption information for other population groups is available.

When the concentration data found in the current survey are applied to an estrogenicity model, for an adult male, the contribution of BPA to the total estrogenicity from 16 food components decreases from 34 to 7%. The estimate of total estrogenicity from food decreases from 8.2 to 6.9 ng/L of estradiol equivalents for a male, compared to normal circulating plasma levels of estradiol of 15-40 ng/L. The impact of this level of estrogenicity remains unclear but the contribution from BPA has been refined downwards as a result of this survey.

Thomson BM. (2004) Bisphenol A surveillance in canned foods and exposure assessment. ESR Client Report FW0393. Christchurch: ESR.

5.11 Develop Capacity and Testing for Insoluble Impurities in Tallow

Bovine spongiform encephalopathy (BSE) belongs to the group of diseases known as the transmissible spongiform encephalopathies (TSE). In 1995 several atypical cases of human TSE, Creutzfeldt-Jacob Disease (CJD) were reported in the United Kingdom and it is now accepted that this form of CJD is caused by consumption of food produced from BSE infected cattle and is transmitted as a deformed version of a naturally occurring protein known as a prion. BSE is believed to be absent from New Zealand but has been found in a number of countries within Europe. In common with a number of other countries, both Australia and New Zealand have banned the importation of bovine meat products for human consumption from BSE risk countries.

In May 2003, the Canadian authorities identified one beef cow in Alberta that had been affected with BSE and most countries immediately banned the importation of products derived from Canadian cattle.

New Zealand imports significant amounts of tallow from North America and internationally, tallow is defined as being protein free if the total level of insoluble impurities is below 0.15%. The New Zealand Food Standards Authority therefore considered refined Canadian Tallow complying with this standard as representing no significant risk to consumers as there is no evidence that the one affected animal is anything other than an isolated case and this product is essentially free of protein. Therefore importation of Canadian tallow could continue but it required certification that the insoluble impurities were below 0.15%.

The method in the Official Methods of the American Oil Chemists Society (AOCS) for insoluble impurities, method Ca 3a-46, involves dissolving the lipid material into petroleum ether, filtering out the insoluble dirt, meal and other foreign material and weighing this residue after drying at 101±1ºC. This report documents the validation of this test within ESR.

Alternate methods, listed in the Codex Standard for named animal fats, are the IUPAC method 2.601 from the 1979 publication, "Standard methods for the analysis of oils, fats and derivatives" and the method in ISO Standard 663:1999 (2000) on the determination of insoluble impurities content in animal and vegetable fats and oils. These methods were not assessed further.

Chappell A, Love JL. (2003) Validation of the method to determine insoluble impurities in tallow. ESR Client Report FW0367. 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 the New Zealand Food Safety Authority 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 the New Zealand Food Safety Authority 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.

6.1 Current Awareness – Chemistry

Two issues during the year highlighted the importance of reliable trace analysis methodology and interpretation. A proposed procedure for improvement of the extraction of acrylamide from food was eventually found to produce incorrect results because of generation of acrylamide during the extraction procedure. The reliability of some nitrofuran (nitrofurazone) antibiotic analyses has also been questioned; semicarbazide is a metabolite of nitrofurazone and has been used as a marker of illegal use of the drug, resulting in destruction of many shipments of foods (particularly prawns, poultry, egg products). It now appears that traces of semicarbazide may be present in foods from a variety of other sources, and earlier analytical interpretations may have been incorrect.

There has been considerable controversy over reports that farmed salmon contained substantially greater levels of persistent environmental contaminants (e.g. organochlorines and polybrominated fire retardants) than salmon caught in natural habitats. Farmed salmon could generally be eaten only once per month, if the organochlorine intake guidelines of the US EPA were followed. However, the US FDA and the UK Food Standards Authority (FSA) advocate less stringent intake guidelines and advised that the results were no cause for concern. This controversy is an illustration of the complexities confronting food safety authorities, as consumption of oily fish has consistently been linked to a variety of positive health outcomes. An expert group reporting to the FSA was unable to formulate a quantitative risk-benefit approach to fish consumption, but recommended increased population consumption of oily fish (1-2 portions per week for girls, and women of reproductive age, the population groups most at risk from contaminants).

Nutritional issues can become safety concerns in the case of infant food. In Israel a thiamine-deficient soy-based infant formula, manufactured in Germany, has caused illness (including two deaths) in 15 infants. The problem product appeared to be confined to Israel but NZFSA issued a cautionary statement. Several reports have appeared from China describing infant deaths associated with infant food made from inappropriate or diluted ingredients.

The US FDA has announced that it is undertaking an assessment of the health significance of the low levels of furan which have been found in a variety of foods. Furan is an animal carcinogen, which appears (like acrylamide) to be formed in foods by the action of heat. The highest levels found (up to 0.125 mg/kg) were in canned or bottled vegetable products, including baby foods and soups. Significant levels (up to 0.084 mg/kg) are also found in brewed coffee. FDA have stressed that their preliminary estimate of consumer exposure is well below the level that would be expected to cause harmful effects.

Reports from surveys by the FSA indicate that aflatoxin levels in nuts and nut products in the UK are decreasing. However, the need for continued vigilance has been demonstrated by a tragic poisoning in Kenya, where contaminated corn caused over 80 deaths and 180 hospitalisations from a girls' school.

Mitchell JW, Wong TL.(2004) Food Safety Current Awareness (Microbiology and Chemistry) 6-monthly report January 2004. ESR Client Report FW0403. Christchurch: ESR.

Mitchell JW and Wong TL. Food Safety Current Awareness (Microbiology and Chemistry) 6-monthly report July 2004. ESR Client Report FW0447. Christchurch: ESR.

6.2 Current Awareness – Microbiology

Presented in this summary are some highlights from the publications and events over the past year that have an impact on food microbiology. They must reflect, to some extent, the interest of the compiler and are not intended to be comprehensive.

Salmonella, *E. coli* O157:H7, Hepatitis A virus and *Listeria monocytogenes* continued to grab headlines overseas. There were numerous large food recalls due to these hazards in the food supply overseas. Of particular interest to New Zealand were tahini recalls in the UK and in Australia after *Salmonella* Montevideo were isolated and found to have caused illness to consumers. Here in New Zealand, *S* .Montevideo and *S*. Orion 15+ were found in imported Lebanese tahini and tahini-based ready-to-eat products. Eight cases of *S*. Montevideo were notified as a cluster in the Auckland region resulting in a recall of tahini and an urgent introduction of an emergency food standard for this class of foods.

Foodborne transmission of Hepatitis A was the cause of a large-scale outbreak in Pennsylvania, USA where at least 555 cases were identified and three deaths were recorded. A case-control study indicated green onions as the source of the outbreak. Transmission is usually person-to-person through the faecal-oral route, as was the case in another outbreak in Massachusetts in 2001, where an infected food handler was implicated. However, in the outbreak in Pennsylvania, faecal contamination of fresh produce served in a restaurant appeared to be the cause. These events highlighted the importance of sickness policy and personal hygiene of food handlers in food services as well as implementation of good agricultural practice or safety assurance programmes for growing, harvesting and marketing fresh produce.

E. coli O157:H7 continued to dominate reports of contaminants found in foods and associations with outbreaks overseas. In Denmark, it was suspected that a milkborne outbreak was due to inadequate pasteurisation of milk leaving behind very low levels of *E.*

coli O157:H7 in the milk sold from a dairy. In the USA, ground beef recalls continued due to contamination of trimmings produced from beef originated from cattle raised in feedlots. Much higher prevalence of the pathogen was found in and on cattle from this source. As a result, the research strategy has now shifted to the pre-processing stage, i.e. the farm or feedlot level, to reduce carriage of pathogen to processing and post processing.

Research on how pathogens such as *Salmonella* and *E. coli* O157 can contaminate fruits and vegetables, whether by internalisation or surface contamination during growing and harvesting, continued overseas. *Salmonella* Enteritidis can be inadvertently internalised during a heat treatment/washing process in an effort to control insect pests. Spray irrigation can be a hazard when used for growing leafy vegetable crops. Lettuce plants can be contaminated with *E. coli* O157:H7 during spray irrigation and *Salmonella* can enter tomatoes through mould growth injury to the skin. However watering with contaminated water directly to soil does not result in transmission of *Salmonella* to tomatoes.

Spread of *E. coli* O157:H7 in country fairs also hit headlines in countries where the pathogen is endemic in the farm animal populations. As the pathogen is resistant to drying and can be found on the hide of animals, dust carriage and lack of hand washing facilities in fairs appear to be risk factors that need to be controlled in those environments.

Alternative initiatives to control pathogens in food production, such as using phages for biocontrol of *Campylobacter* and *Salmonella* on chicken skin, are gaining significant attention. Incorporation of extracts from basil into plastic food wraps was reported to have anti-microbial effects on meat and cheese and use of activated lactoferrin to remove bacterial contaminants from beef carcasses, have been studied and found to show some promise in their respective niches. A recent study from the University of Guelph showed that non-immunised egg yolk powder added to regular poultry feed eliminated *Salmonella*, *Campylobacter* and *E. coli* O157 from the chicken gut.

There was also a flurry of activity in the web on communication of food safety to the wider public, such as Site of Safety of food products in Europe, Eurosurveillance Weekly, OzFoodNet, The Canadian Food Inspection Agency, Food Safety activities in Central Europe, etc. Europe has also set up an early warning system to track foodborne viruses and other common source outbreaks. The aim is to gain insight into the epidemiology of enteric viruses in Europe and the role of food in transmission by harmonising and enhancing epidemiologic surveillance.

Mitchell JW, Wong TL.(2004) Food Safety Current Awareness (Microbiology and Chemistry) 6-monthly report January 2004. ESR Client Report FW0403. Christchurch: ESR.

Mitchell JW and Wong TL. Food Safety Current Awareness (Microbiology and Chemistry) 6-monthly report July 2004. ESR Client Report FW0447. Christchurch: ESR.

6.2.1 Hepatitis E virus

Hepatitis E virus (HEV) is the major etiologic agent of enterically transmitted non-A, non-B hepatitis in humans worldwide, and is a spherical, non-enveloped, single stranded RNA virus. Similar to Hepatitis A, HEV cause waterborne and foodborne outbreaks that are most

common in developing countries with inadequate environmental sanitation. The virus is endemic in much of Asia, northern Africa and Mexico.

In humans, HEV infections are generally acute and self-limiting with a mortality rate of about 1%. However, in pregnant women mortality is as high as 20%. Transmitted by faecal/oral (enteric) route the virus has been isolated from raw sewage in Spain, France, Greece, Italy, Austria and the United States. Epidemics and sporadic cases of HEV are responsible for the majority of enterically transmitted acute hepatitis in regions where HEV is considered endemic.

Studies have shown that 1-4% of the general human population (USA) have antibodies to HEV, indicating a likely exposure to the virus at some time. It has been hypothesised that HEV is a zoonotic disease (passed from animals to humans). Studies in Japan show that the virus may be transmitted by close contact with infected swine and from the consumption of infected or contaminated raw or undercooked pork, wild boar liver and deer meat.

There are significant data indicating the presence of HEV and/or HEV-antibodies in various animal species. The limited data available regarding the potential modes of transmission of HEV from animal to humans make it difficult to determine the zoonotic risk. However, it does appear that there is the potential for HEV zoonotic transfer to humans from the consumption of HEV-contaminated pig or deer products.

It is likely that HEV is prevalent in New Zealand swine populations and may be present in New Zealand deer populations. Faecal excrement from HEV infected herds could lead to the transmission of HEV into the environment, indeed HEV has been found in sewage in Europe presumably as a consequence of animal faecal contamination.

In New Zealand consumption of raw deer or pork is unlikely, but the undercooking of meat, and the serving of it very rare could pose a risk if the meat was contaminated with HEV.

Fitzmaurice PS. (2004) Hepatitis E virus. ESR Client Report FW0458. Christchurch: ESR.

6.3 Current Awareness – Genetically Modified Foods

The amount of information emerging on genetically modified (GM) organisms each year is overwhelming, and it is a major effort just keeping up to date. This area of work is intended to assist the New Zealand Food Safety Authority to keep up with developments overseas, principally in the areas of detection, regulation and labelling of GM foods. Summary reports, with internet links or references to further material, are written every few months. The work has been ongoing since 1998, and the more recent reports have been made available to the public via the Ministry of Health website (http://www.moh.govt.nz) and the NZFSA website (http://www.nzfsa.govt.nz/policy-law/publications/reports/index.htm).

ESR also performs some *ad hoc* additional work on GM foods. This mainly involves providing independent review and comments on Draft Risk Analysis Reports of GM foods when they are released by Food Standards Australia New Zealand.

Two summary reports were produced during the 2003-2004 year:

Podivinsky E. (2004) Current awareness of genetically modified food issues. July - December 2003. ESR Client Report FW0412. Christchurch: ESR.

Podivinsky E. (2004) Current awareness of genetically modified food issues. January - June 2004. ESR Client Report FW04 . 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 New Zealand Food Safety Authority to communicate food safety information to the consumer as part of a process of increasing consumer awareness and allowing them 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.

During the 2003/2004 year, the information booklet, **A Guide to Calculating the Shelf Life of Foods** (1995) was updated. The New Zealand Food Safety Authority and health protection officers regularly deal with enquiries on the shelf life and date marks on foods. The Guide contains background information on the factors that influence shelf life and a procedure to assist the food industry to calculate the shelf life of foods. Although the shelf life and date mark requirements are detailed in legislation, the guide provides assistance to meet these requirements and should be read in conjunction with the **Australia New Zealand Food Standards Code, 2000**.

Traditional sectors of the food industry have gained valuable experience in calculating the shelf life of perishable foods but with changes in legislation and the expanding range of ready-to-eat, short shelf life foods there are increasing numbers of foods requiring date markings and specific storage conditions.

The increased availability of ready-to-eat foods with extended refrigerated shelf lives has resulted in the need for the food industry to employ measures to minimise the potential for *Listeria monocytogenes* and *Clostridium botulinum* to be present in foods in numbers that result in a hazard to health. The updated guide contains sections on points that should be considered when determining the shelf life of foods that are capable of supporting growth of these organisms. The guide provides a ‘step by step’ approach to determine ‘real world’ conditions to calculate the shelf life.

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 by the NZFSA, are undertaken when not engaged in reactive emergency response investigations.

No significant emergencies occurred during 2003/2004 that required the use of this fund. Some of the available resources were reassigned for the development of capability to test for allergenic food material.

7.1 Allergen – Laboratory Capability

Food allergies are defined as adverse immunological responses to a food and are believed to affect approximately 2% of adults and 6% of children. The main foods know to be responsible for allergic reactions are peanuts, eggs, milk, wheat (gluten), soy, fish, crustacea and tree nuts. Australia New Zealand Food Standard 1.2.3 requires mandatory labelling of foods containing any of these allergenic materials and sulphite in excess of 10 ppm.

The current project was initiated to develop testing capability for as many of the key allergenic materials as possible, with initial focus on wheat (gluten), milk, peanuts, soy and egg. The methods to be validated are all based on Enzyme-linked Immunosorbent Assay (ELISA) technologies. Commercially available kits were assessed for accuracy, precision, sensitivity and specificity. Once validation is completed, ESR will seek IANZ accreditation for this area of testing.

The project is ongoing.

8 NZFSA/HPO TECHNICAL SUPPORT

ESR has for many years provided the New Zealand Food Safety Authority, 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 regulatory 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 pf export wine, as required by the Wine Act.

The Science Service covers the following areas of science support:

- Database Review/Monitoring Protocols
- Data Transmission
- Food Complaints
- Food Consultation/Courier
- Export Wine Certification
- Annual report

8.1 Database Review/Monitoring Protocols

This project had two components, one that would allow for ESR to have appropriate involvement in any discussions on the rationalisation of databases used by the NZFSA and inherited from its predecessor organizations, and the other related to the development of monitoring protocols to support monitoring and surveillance projects. ESR was not required to be involved in any database developments by NZFSA during 2003/2004.

During the year, one monitoring protocol for the sampling of food for testing as part of monitoring and surveillance projects was developed. In this protocol, it was noted that sampling is a specialist scientific skill that has its own extensive literature comparable to that associated with analytical chemistry and microbiology. Therefore, the sampling protocol was not designed as a substitute for expertise but rather, it aimed at ensuring limitations associated with the planned approach to sampling within projects would not obviously compromise conclusions from these surveillance and monitoring projects. Any project where the results will depend critically on proper sampling will need input at project design from an expert with relevant sampling and statistical expertise.

All measurement results have an associated uncertainty that indicates the range within which the true result will lie, given the reported measurement result. Both the sampling process and analytical method will contribute to this uncertainty. The smaller the uncertainty, the better the measured result represents the true result. In respect to the uncertainty associated with sampling, this includes contributions that are both random in nature and biases inherent in the methodology used. For instance, taking all samples from the same retail outlet will have an

unknown bias associated with the point of manufacture, transport and distribution system, and with storage and stock turnover at the retail outlet. Taking and testing further samples from the same outlet will not reduce uncertainties of this nature. However, without knowing the significance of this bias, the uncertainty associated with the results is unknown and it is impossible to extrapolate from the test results obtained to the local or national food supply. Proper planning and more appropriate sampling removes this problem and can generate results that give a true indication of the local or national situation.

The relative magnitude of the two components, sampling and analytical, to the uncertainty of the results obtained needs to be considered when developing the sampling procedures and validating analytical procedures. The greatest effort at reducing the uncertainty must be directed at the component contributing the greater amount of uncertainty to the result if it is to be effective.

The written protocol looks at the issues that need to be considered in the design of sampling plans and suggests likely limitations to the project when number of samples taken is minimised. It also provides references to more in-depth analyses of these situations and guidance as to when these should be consulted.

Love J. (2004) Protocol for Developing Sampling Plans: Food Surveillance and Monitoring Projects. ESR Client Report FW0423. Christchurch: ESR.

8.2 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 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.

8.3 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 the make-up of the food is not what would be reasonably expected (Composition). The most example of this is meat products believed to contain excessive amounts of fat.
- The belief that the food product is not what it claimed to be (Authenticity). An example of this would be a product sold as olive oil which was believed to be oil from another type of plant
- The belief that a food contains additives which it shouldn't (Adulteration)

During the 2003/2004 year, 190 food complaints were submitted to ESR laboratories for investigation. The largest proportion of these were from the Auckland area (38%), followed by Canterbury (16%). The patterns of foods associated with complaints and the types of complaints made are remarkably consistent from year to year. In 2003/2004 the types of foods most commonly associated with food complaints were bread and bakery products, meat and meat products, takeaway food and seafoods. Canned products were not as prominent amongst food complaints as during the 2002/2003 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 2003/2004 47% of all food complaints were related to foreign objects, this represents a significant change from the 2002/2003 year when 67% of all food complaints submitted to ESR related to foreign objects. The types of foreign objects most commonly identified were insects or spiders (including eggs, pupae and caterpillars), glass fragments and metallic fragments or items. About 13% of foreign objects submitted as food complaints appeared to be normal components of food, which had been burnt or not fully incorporated.

An increased proportion of samples were submitted for microbiological examination this year, either due to suspected microbial contamination or spoilage. Complaints in these categories accounted for 38% of food complaints submitted during the 2003/2004 year, compared to 16% in the 2002/2003 year.

Wilson MW, Whyte RJ, Hough AJ. (2004) Food complaints and foodborne illness: six month summary report July to December 2003. ESR Client Report FW0407. Christchurch ESR.

Wilson MW, Whyte RJ, Hough AJ. (2004) Food complaints and foodborne illness: six month summary report January to June 2004. ESR Client Report FW0483. Christchurch ESR

8.4 Food Consultation/Courier

The Food Consultation work area provides a mechanism by which staff of Public Health Units and the New Zealand Food Safety Authority 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 2003/2004 year, requests for information or advice were many and varied with topics ranging from the safety of foods in the Wild Foods Festival to queries about cleaning of salad vegetables, the meaning of "Brix", caffeine levels in chocolate, re-use of fats and oils and the merits of glove use by foodhandlers, to name a few.

The majority of requests over the year, however, continue to ask for scientific support in the area of Food Safety Programme evaluations. Prior to a Food Safety Programme being submitted for approval, a Health Protection Officer (HPO) must assess it. This can be technically demanding as HPOs must review the particular food production process and determine whether all potential hazards have been identified and appropriate controls implemented to prevent hazards from occurring. Enquiries ranged from glazed ham and fruit juice production through to more specialised foods such as Lebanese spreads and sundried tomatoes.

Advice was also sought by HPOs following up on outbreaks of suspected or proven food poisoning events. Information was requested on hazards to look for when visiting food premises that have been implicated in food poisonings.

Several small studies were carried out within this work area including:

- Validation of the accuracy of T-stick temperature probes
- Illness from consumption of poisonous plants
- Testing of spices for the food colouring, Sudan I
- Testing of tahini for *Salmonella*

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

- *Campylobacter* transmission routes: a review of possible sources of *Campylobacter* infection in New Zealand.
- 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.
- Outbreak due to food handler contamination: an account of a recent food poisoning and discussion on how to swab test infected food handlers.
- Bacterial spores; hidden hazards in our foods: discussion on controls needed to prevent growth of *Clostridium perfringens*, *Bacillus cereus* and *Clostridium botulinum* in foods.
- Povi production – is it safe?: results of a study of the Polynesian delicacy, Povi masima.
- Salmonella typing: the science involved and examples of how typing can help resolve food poisonings.
- Developments on acrylamide in foods: a summary of current research.
- Food allergens: what are they and how can we detect them?
- Glass analysis: testing options available and some case studies.

- Emerging and novel methods of controlling foodborne pathogens: discussion on new methods for destroying bacteria in food such as high-pressure treatment, high intensity light, bacteriophage etc.

This year HPOs were also invited to give presentations. Topics included the Wild Foods Festival, Foodsafe Partnership, *Campylobacter* outbreak at a school camp, and the development of "4°C", a food industry newsletter.

Consultation provided as part of this service is summarised in four quarterly reports:
Whyte R. (2003) Food consultation. Quarterly progress report July to September 2003. ESR Client Report FW0380. Christchurch: ESR.

Whyte R. (2004) Food consultation. Quarterly progress report October to December 2003. ESR Client Report FW0404. Christchurch: ESR.

Whyte R. (2004) Food consultation. Quarterly progress report January to March 2004. ESR Client Report FW0428. Christchurch: ESR.

Whyte R. (2004) Food consultation. Quarterly progress report April to June 2004. ESR Client Report FW0468. Christchurch: ESR.

8.4.1 Validation of T-Stick™ Temperature Probes for Accuracy

T-Sticks™ are designed for quickly testing that the internal temperature of food has reached 60ºC, 71ºC, 75ºC or 77ºC and this project was designed to check these for accuracy. The T-Sticks™ indicating the two lower temperatures were found to be reliable but the T-Sticks™ marked for 75ºC actually changed colour at 72ºC and the T-Sticks™ marked for 77ºC did not change colour until approximately 79ºC.

Prolonged immersion at a temperature just below the temperature at which the positive colour change was observed within the defined time of 3 to 10 seconds did not result in false positive indications that the temperature had reached the temperature of positive colour change. However, it was noted that T-Sticks™ did show a weak colour change at temperatures below that causing a strong positive change. Some experience will be needed by users if they are to distinguish these weak colour changes from the colour change that provides a true positive indication that the temperature has reached the indicated temperature for that strip.

Our conclusion is that these temperature probes could be useful to support food safety and HACCP programmes but their use will need training and experience and they are not a replacement for an accurate, calibrated thermometer for temperature critical measurements.

Saunders D, Lin H. (2003) Validation of T-Stick™ Temperature Probes for Accuracy. ESR Client Report FW0356. Christchurch: ESR.

8.4.2 Illness from consumption of poisonous plants

The data on morbidity and mortality events from consumption of poisonous plants in New Zealand is currently not centrally collated. In 2001, ESR was commissioned by the New Zealand Ministry of Health to develop a national Chemical Injury Surveillance System (CISS), which is to include poisonous plant exposure. Several pilot studies have been conducted, but the system is still to be formalised.

Of all the information sources searched, useable data were only sourced from the New Zealand Health Information Service (NZHIS), New Zealand National Poisons Centre (NZNPC) and ESR databases. Much of the data is still unspecific, and is only useful as an indicator of the frequency and types of poisoning incidences in New Zealand. Potentially, these data could be under-reported or over-reported, depending on the methods of collection and categorisation. For example, calls to the NZNPC are not supported by evidence (e.g. subsequent illness, formal plant identification) and rely on information and plant identification by the caller. In this instance, there is possibly an over-reporting of actual exposures, particularly for plants that are well known, such as nightshade.

The hospital discharge data may also contribute to over-reporting due to the difficulties in separating out illness from consumption of a poisonous plant from other foodborne illnesses. Severe under-reporting is demonstrated by the ESR database results. This is a direct result of incorrect classification or entry of cases. Naturally, there will also be many poisoning events that occur throughout the country that are not reported to any formal agency.

With the data limitations in mind, the main conclusions are:

- There is a low reported frequency of morbidity due to the consumption of poisonous plants.
- Poisoning associated with food plants is relatively uncommon.
- Infants under 5-years-old are most at risk for consuming poisonous plants.
- Unintentional consumption of poisonous plants has not caused any fatalities in the last nine years.

Turner N, Whyte R. (2003) Morbidity and mortality from consumption of poisonous plants in New Zealand. ESR Client Report FW0363. Christchurch: ESR.

8.4.3 Determination of Sudan I in spice

Sudan I and Sudan IV are oil soluble colours that have been found by European Food Control Agencies in a number of highly coloured spice samples. This project was aimed at providing data on the situation in New Zealand. The Australian New Zealand Food Standards Code does not permit the addition of Sudan I or Sudan IV to food including spice.

Forty-three spice samples were taken by Health Protection Officers from throughout New Zealand and submitted to ESR in Christchurch for testing. The method used for detection and quantitation of Sudan I involved HPLC with diode array detection and was able to detect and confirm positive results down to 1 mg/kg. One of the forty-three results, a chilli powder packed in Australia from Indian ingredients contained 170 mg/kg of Sudan I and three other chilli powders from Australian and Indian suppliers probably contained Sudan I but at a level below that at which the identification could be positively confirmed.

Any regulatory enforcement regime will have to consider analytical detection limits needed for adequate public health protection. The ESR analytical procedure allows confirmation of the presence of Sudan I in spice at 1 mg/kg and above, which is well below the level needed to produce a visible colour.

As there appears to be no published modern methods for the determination of Sudan I in foods, any regulatory proposal will probably have to define the method or include performance guidelines for analytical methods.

Love JL, Saunders DA. (2003) Determination of Sudan I in spice. ESR Client Report FW0390. Christchurch: ESR.

8.4.4 Testing of tahini for *Salmonella*

In July 2003, routine sampling by a commercial food business revealed the presence of *Salmonella* in their hummus product. Wider sampling was carried out by the local Public Health Unit, resulting in *Salmonella* Montevideo being isolated from tahini imported from Egypt. Public and retail recalls were instigated by several food businesses that had used the contaminated product.

During August 2003, eight cases of *S.* Montevideo were notified as a cluster of isolates in Auckland. Three of these were linked to the same café and *Salmonella* was subsequently confirmed in both opened and unopened jars of tahini on the premises. One case was linked to another takeaway outlet and *S.* Montevideo was also isolated from opened tahini jars and from hummus prepared from the tahini. Three out of five unopened jars sampled from a wholesale premises were also positive for *S.* Montevideo. A food recall followed.

Investigations were made and it was found that the contaminated product had been repacked from one or more brands of bulk imported Lebanese tahini. Suspect batches were sampled from the respective importers. The results are summarised in Table 2.

Table 2: Analysis of Lebanese tahini for *Salmonella*

Brand	Number of samples analysed	Number positive for *Salmonella* (% positive)	*Salmonella* types found
Hiba	5	5 (100%)	*S.* Montevideo
Al-Rabih	4	2 (50%)	*S.* Montevideo, *S.* Orion 15+
Greenhill	20	0 (0%)	

A food recall for Al-Rabih tahini was instigated on 3 September 2003.

Testing of tahini and tahini-based products continued and *S.* Montevideo was isolated from a batch of imported Halawa confectionary (same brand as previously recalled tahini) and a recall resulted.

An emergency food standard was introduced for tahini and halva by the NZFSA on 25 September 2003 mandating sampling of the product at the border.

8.5 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 introduction of the Act, 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 2003-June 2004 year 3061 samples were received (an increase of 17% from the previous year) and 4 samples did not comply. In previous years non-compliance has been higher (23 in 2001-2002) but this was largely due to the stricter provisions of the Food Regulations which were applicable at the time. The Code non-compliance problems related to inaccurate labelling of alcohol content (3) and excess sulphur dioxide (1).

A more substantial problem is encountered with the accuracy of labelling of alcohol content for the EU, where a very tight tolerance (±0.5%) is required. A further 155 samples did not meet this tolerance. Strict EU requirements for levels of sulphur dioxide and added citric acid were not met by a further 16 samples.

Some minor changes have been observed in the composition of New Zealand export wines over the last several years. There appears to be a trend towards red wines with a small amount of residual sugar. The proportion of "bone dry" (sugar <1 g/l) red wines has reduced from 94% in 2000-2001 to 82% in 2003-2004. Over a longer time frame an upward trend has been observed in the alcohol content of New Zealand export wines. In 1990 median alcohol levels for both red and white wines were 11.8%, while in 2003-2004 the median levels were 13.1% (white) and 13.5% (red). The levels in white wines appear to have stabilised in the last several years, but the levels in reds may still be increasing.

Mitchell JW (2004). Export wine certification. 2003-2004 Annual report. ESR Client Report FW0470. Auckland: ESR.

APPENDIX 1 NEW ZEALAND FOOD SAFETY AUTHORITY – ESR SCIENCE CONTRACT 2003-2004. SERVICE DESCRIPTIONS, WORK AREAS AND AGREED OUTPUTS

MICROBIOLOGICAL RISK PROFILING

Risk profiles for 2003/2004

- *Delivery of completed risk profiles*

Campylobacter pathways discussion document

- *Delivery of completed report*

Pasteurisation of dairy products discussion document

- *Delivery of completed report*

Risk ranking policy document

- *Provide risk communication material for use in stakeholder consultations with respect to microbiological risk ranking.*
- *Participate in stakeholder meetings as requested.*
- *Methodology document for developing NZFSA risk ranking policy completed*

CHEMICAL RISK PROFILING

Chemical risk ranking methodologies

- *Delivery of completed report*

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: *Campylobacter*

- *Delivery of completed report (September 2004)*

Undercooked chicken livers as a vehicle for campylobacteriosis

- *Completion of template for communication of risks to chefs and chef training schools*
- *Provision of final report to NZFSA.*

Development of a preliminary draft risk model for *Campylobacter* in poultry in New Zealand

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

Expanded risk profile of Salmonella in chicken nuggets

- *Final project report supplied to NZFSA*

Development of a preliminary draft risk model for *Salmonella* in poultry in New Zealand

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

Vertical chain estimation of prevalence of *Salmonella* in raw poultry from end of primary/secondary processing to retail outlets

- *Final report submitted to NZFSA (August 2004)*
- *Scientific publication prepared (September 2004)*

Microbiology of uncooked retail meat products: *Salmonella*

- *Brief progress report submitted to NZFSA*

Microbiology of uncooked retail meat products: STEC

- *Brief progress report submitted to NZFSA*

Survey of ready-to-eat dairy products for quantitative levels of *Listeria monocytogenes*

- *Final report submitted to NZFSA*
- *Scientific publication prepared*

Analytical development – Norovirus Detection

- *Analyse results, prepare and submit final year 1 report to NZFSA*

CHEMICAL FOOD SAFETY

New Zealand Total Diet Study (NZTDS)

- *Finalised Q1- Q3 raw data reports submitted to NZFSA for website*
- *Prepare for, present at and follow up 3rd WHO TDS workshop, Paris*

Multi Residue Pesticide Screen Survey

- *Chapter written for draft annual report*

Glyphosate in targeted foods

- *Final report to NZFSA*

WHO GEMS/Food

- *Audit New Zealand data held by WHO GEMS/Food for completeness and accuracy*
- *Assess OPAL III software and provide brief assessment report to NZFSA*
- *Complete annual report and proposed work plans for submission to WHO*

Genetically Modified Food Analysis and Capability Development

- *NZFSA provided throughout the year with copies of any research paper, conference abstract or similar that may result from the research programme on 'Cooking Genes'*
- *Final written overview provided of research results, with particular reference to capability maintenance/development for detection of GM components in food*

Sulphite, sorbate and benzoate dietary exposure and risk assessment

- *Final report to NZFSA*

Acrylamide (methodology)

- *Report on methodology options and recommended method*
- *Report on the validation of the selected method and on test results found for the selected samples*

Nitrates and Nitrites Dietary Exposure and Risk Assessment

- *Analytical results to FoodNet. These will be tagged with an appropriate project code.*
- *Final report on measured results and resultant exposure estimates*

Use of Ethylene oxide in spices available in New Zealand

- *Final report to NZFSA*

Bisphenol A surveillance in canned foods and exposure assessment

- *Final report to NZFSA*

Develop capacity and testing for insoluble impurities in tallow

- *Report on validation of method*

CURRENT AWARENESS AND EMERGING ISSUES

Chemical/Microbiological/ GMFs Current Awareness

- *Separate six-monthly summary reports on chemistry/microbiology and on genetically modified foods are to be delivered within one month of the end of the 6-month period*

Risk Communication

- *Write/present information for/to consumers in line with communication strategy*
- *Write/update Food Myths & Facts booklet*
- *Involvement in Consumer Fora as required*
- *Prepare and submit an article (joint authorship between Ian Shaw & Sandra Daly) on communication of food risk in New Zealand*

EMERGENCY RESPONSE

- *Specific reporting and the format of project documentation will be commensurate with the scope of the service request, having particular regard to the urgency of the request. All projects will require documentation of an expert opinion.*

NZFSA/HPO TECHNICAL SUPPORT

Database review/Monitoring protocols

- *Documented Sampling and Testing Protocols as agreed.*
- *Participation as required in any review of the way ESR's databases interact with other databases within the food safety community.*

Data transmission

-

Food complaints

- *Summary reports (graph) to track monthly use of the project.*
- *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.*
- *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 2002-3)*

- *Monthly sample number data is to be sent to the NZFSA project leader so that project funding adjustments can be negotiated if necessary in response to unexpectedly high or low sample number.*

Annual report

- *Submission of final report*