

**RISK PROFILES FOR THE FOODS
NEW ZEALANDERS EAT**

PROJECT F13RA3

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1 INTRODUCTION

The purpose of this project is to provide risk profiles for the foods New Zealanders eat. Such risk profiles will be a contribution to the process described in “Food Administration in New Zealand: A risk management framework for food safety” (MoH/MAF, 2000). Overall, the aim is to develop a consistent, science based strategy to address the risks present in the New Zealand food supply.

The administration of food safety in New Zealand is in transition at present, but until a new structure is agreed, the Ministry of Health (MoH) and the Ministry of Agriculture and Forestry (MAF) are working together to harmonise their regulatory regimes. Both agencies are involved in directing the progress of this project, which is being undertaken by the Institute of Environmental Science and Research (ESR).

This document is intended to explain the role of risk profiles and to set out a framework for the development of risk profiles in the future. It will also serve as the basis for a consultation process with stakeholders and relevant experts.

Risk profiles will be prepared for food safety risks which are specified in terms of the hazard, as well as the food by which the hazard is transmitted. The combination of foods and hazards will allow risk management activity to be targeted effectively.

The project is intended to be a multi-year process developing risk profiles, ranking the food/hazard combinations in terms of risk, and then prioritising them for risk management. Such management may involve qualitative risk assessments, and later quantitative risk assessments.

At this stage only microbiological hazards that cause acute illness are included. Chemical hazards present different issues for risk profiling, and will be included in the future.

This report contains an overview of risk profiles, their purpose, and content. Risk profiles address a hazard as it occurs in a food commodity. The identification of the hazards and commodities is described, in order to construct a food/hazard “matrix” of potential risk profile topics. A preliminary list of food/hazard combinations important to New Zealand and for which risk profiles are needed is presented, with justification for selections.

It is important to state that this project takes place in the context of the current food safety situation in New Zealand. This includes existing controls of any risks, and current food consumption patterns. Particular food/hazard combinations that are being effectively controlled may be profiled as low risk, and therefore not appropriate for further risk management action. However, this does not imply that the controls should be removed.

Although many of the considerations and decisions about food/hazard combinations in this project may be trivial or obvious, the intention is to establish a scientifically justifiable, consistent and transparent approach to the management of microbiological food safety risks.

2 RISK PROFILES

A risk profile contributes to the overall process of risk management, as does risk assessment. The process for risk management has been described in “Food Administration in New Zealand: A risk management framework for food safety” (MoH/MAF, 2000), as well as in a Food and Agriculture Organisation (FAO)/World Health Organisation (WHO) Food and Nutrition Paper entitled “Risk Management and Food Safety” (FAO/WHO, 1997). The following generic steps for risk management are defined:

1. *Risk evaluation*

- identification of the food safety issue
- **establishment of a risk profile**
- ranking of the food safety issue for risk management
- establishment of risk assessment policy
- commissioning of a risk assessment
- consideration of the results of risk assessment

2. *Risk management option assessment*

- identification of available risk management options
- selection of preferred risk management option
- final risk management decision

3. *Implementation of the risk management decision*

4. *Monitoring and review.*

2.1 Definition of a Risk Profile

A risk profile is defined on page 10 of “Food Administration in New Zealand: A risk management framework for food safety” (MoH/MAF, 2000).

“Each risk evaluation will require the establishment of a risk profile appropriate to the circumstances. This profile should place the activity within a particular food safety context, and provide as much information as possible to guide further action. This will include gathering of information on the nature and extent of possible risks so as to assist in establishing food safety priorities and formulation of risk assessment policy. If available information indicates that risks associated with a particular hazard or situation are negligible, the risk manager may decide at this point not to pursue further risk assessment and risk reduction measures. On the other hand, indications of a severe risk to human health may result in interim imposition of stringent sanitary measures as a risk management option, even though detailed information on risks is not available.

It will be apparent that risk profiling contains several features of an interim qualitative risk assessment based on the data available at the time. It may involve both risk managers and risk assessors working together in an informal environment, and may include information on societal values and perceptions associated with food safety issues as well as the likely

distribution of risks and benefits. As risk profiling may strongly influence further risk management activities, appropriate communication between all stakeholders (including risk assessors and risk managers) must be maintained at all times.

A decision to commission a quantitative risk assessment will largely be the consequence of risk profiling.”

The WHO/FAO document (WHO/FAO, 1997) also defines a risk profile:

“Risk profiling is the process of describing a food safety problem and its context, in order to identify those elements of the hazard or risk relevant to various risk management decisions. The risk profile would include aspects of hazards relevant to prioritising and setting the risk assessment policy and aspects of the risk relevant to the choice of safety standards and management options. A typical risk profile might include the following: a brief description of the situation, product or commodity involved; the values expected to be placed at risk (e.g. human health, economic concerns); potential consequences; consumer perception of the risks; and the distribution of risks and benefits”.

Codex are also developing ideas about risk profiling as part of a draft document working towards principles and guidelines for microbiological risk management (Codex Committee on Food Hygiene, 2000).

2.2 Content of a Risk Profile

In March 2000 a WHO sponsored “Consultation on the Interaction between Assessors and Managers of Microbiological Hazards in Foods” considered an example of a risk profile format as developed by the Canadian Food Inspection Agency (WHO/FAO Expert Consultation, Kiel, March 2000, provided by Steve Hathaway, MAF). This included the following features:

- Administrative information including initial description/statement of the issue
- Description of the commodity (may include distribution, marketplace), disease agent, outcome of exposure, food safety scenarios (i.e. particular processing, handling, consumption profile)
- Values potentially at risk (human health, may in some situations include economic values, cultural, aesthetic)
- Distribution of risk i.e. who are the producers of the risk, who benefits from the risk situation, who bears the risk?
- What characteristics of the commodity/agent might affect risk management options?
- What are known risk management characteristics of the risk producer and of the risk bearer?
- What are the current risk management practices relevant to the issue?
- What are the public perceptions of risk?
- Familiarity and substantial equivalence
- International agreements, if any, that affect the risk issue.

Further comments from the consultation were:

“A microbiological risk profile might include reference to: prevalence and concentration data on the hazard at all points in the food chain (including imported food), inputs to the food chain that impact on hazard levels, monitoring and surveillance data from the exposed human population, consumer values and perceptions of risk, and potential consequences of any risk management options that might be taken. As risk profiling may strongly influence further risk management activities, appropriate communication between all stakeholders must be maintained at all times.

The risk profile should be documented in such a way that it can be used by risk managers to prioritise a food safety issue in relation to other issues, and facilitate a decision on further actions. Prioritisation will often involve appropriate consultation with a range of stakeholder groups, either on an informal or formal basis.”

Two concurrent projects being undertaken by ESR will contribute to the Risk Profile project. The first is the Food Pathogen Hazard Data Sheets project. These sheets provide background information on foodborne microbiological hazards and are used principally by Health Protection Officers. The existing data sheets are to be updated, and several new ones written, by mid-2001. This collation of data about the various hazards will provide an important component of the risk profile for food/hazard combinations.

The second project is a Compendium of Critical Control Points for pathogens. This information will assist in consideration of risk management options.

3 THE FOOD/HAZARD MATRIX

In order to define the foods and hazards to be addressed by this project, it is necessary to identify a comprehensive set of hazards that are perceived to be relevant to risk management in the New Zealand context, and to categorise the food supply to define potential vehicles for transmission of the hazards. The resulting “matrix” is intended to identify all food/hazard combinations that are candidates for risk profiling.

The current priorities for this project are microbiological hazards, which generally cause acute disease. Chemical hazards may cause chronic illness after exposure over a long time period. There are several difficult issues associated with risk profiling for chemical hazards, and although these may be discussed in the interim, it is intended that chemical hazards will not be addressed in the short term.

Currently microbiological hazards are regarded as the greatest food safety issue in objective terms, although this is largely an empirical view by informed persons, and no rigorous basis as yet exists for ranking risks (Knowles, 1991). The US Food and Drug Administration offered the following ranking of food safety issues, based on expert judgement (Pariza, 1992):

1. Contamination by microbial pathogens
2. Nutritional imbalance
3. Environmental contaminants
4. Naturally occurring toxicants.
5. Pesticide residues
6. Food additives

The following sections set out both the hazards to be considered, and the food categorisation system, from which the food/hazard matrix (as shown in Appendix 1) was derived. This matrix will provide the topics for future risk profiling.

3.1 Microbiological Hazards in Foods

The hazards included in this project need to encompass all micro-organisms considered capable of causing foodborne disease in New Zealand. In addition, it must be borne in mind that the risk profile must cover all foods in New Zealand, including imports. Therefore organisms that are usually omitted from consideration in domestic foods, such as *Salmonella typhi* and *Cyclospora*, do need to be considered in the context of this project. The list produced below was guided by that published by the US Council for Agricultural Science and Technology (CAST, 1994) as an overview of potentially foodborne micro-organisms.

Bacteria

Aeromonas/Plesiomonas

Arcobacter

Bacillus cereus/subtilis

Campylobacter jejuni/coli

Clostridium botulinum

Clostridium perfringens

E. coli O157:H7
E. coli (non-O157 STEC)
E. coli (pathogenic, other than STEC)
Listeria monocytogenes
Mycobacterium bovis
Pseudomonas
Salmonella spp. (non typhoid)
Salmonella typhi
Shigella
Staphylococcus aureus
Streptococcus
Vibrio parahaemolyticus
Vibrio cholerae
Vibrio vulnificus
Yersinia enterocolitica

Viruses

Norwalk and Norwalk-like
Hepatitis A
Others (e.g. rotavirus)

Protozoa

Giardia
Cryptosporidium
Cyclospora
Toxoplasma
Others (e.g. *Entamoeba*)

Many of the organisms included in this list are obvious. Several cause notifiable diseases:

Botulism
Campylobacteriosis
Cholera
Cryptosporidiosis
Giardiasis
Hepatitis A
Listeriosis
Salmonellosis
Shigellosis
Typhoid and paratyphoid fever
Verocytotoxigenic *Escherichia coli*
Yersiniosis

Norwalk-like viruses are increasingly recognised as a common cause of gastroenteritis outbreaks (Greening et al., 1999). There are several other enteric disease-causing organisms which are considered foodborne, and cause outbreaks, but are not notifiable. These are

Clostridium perfringens, *Bacillus cereus*, *Staphylococcus aureus*, and *Vibrio parahaemolyticus* (Perks et al., 2000).

The remaining organisms have been included because of their importance overseas, and/or that they were considered initially by risk managers as worthy of further investigation in the New Zealand context. *Mycobacterium bovis* is a high profile issue and has been included for its importance as a consumer and international trade issue.

Mycotoxins are produced by fungal contaminants in foods; although deriving from microbial sources, it was decided that these chemicals should be considered later along with other chemical hazards.

3.2 Food Categorisation System

This project will not consider microbiological hazards in isolation, but in combination with the foods in which they may occur. Although the high risk foods for microbiological hazards are reasonably well known, this project requires that a comprehensive approach be taken to categorising the New Zealand food supply. To keep the risk profiling process manageable, the number of food types will need to be kept low.

A variety of categorisation systems have been developed, principally for the purpose of systematising food composition data. However, as this project is based on microbiological hazards in the food rather than its composition, it was decided to use as a foundation the categories adopted by the International Commission on Microbiological Specifications for Foods (ICMSF) of the International Union of Biological Sciences. This system is set out in their book “Micro-organisms in foods 6: Microbial ecology of food commodities” (ICMSF, 1998). The categories of foods considered in this book, as represented in the table of contents, was used as the initial basis for the food/hazard matrix.

The listing was then refined by considering alternative systems of categorisation including:

- Languel (see <http://food.ethz.ch/languel/into.htm>)
- INFOODS (see <http://www.fao.org/docrep/v6000t/v6000t00.htm>)
- Eurocode 2 (see <http://www.vfd2.dk/eurocode/>)
- New Zealand National Nutrition Survey (NNS)
- Draft Joint Australia New Zealand Food Standards Code
- Centres for Disease Control (CDC) 16 categories of food vehicles and a proposed expansion of the CDC food vehicle categories (Fraser et al., 1995)
- Another classification system for tabulating data on vehicles of foodborne disease (Bryan et al., 1997)

Further revisions have been made as a result of discussions with the Ministry of Health and the Ministry of Agriculture and Forestry.

4 RISK PROFILE PROJECT PROCESS

A Risk Profile for a particular food/hazard combination is a preliminary step which may result in the commissioning of a risk assessment and/or risk management activity. It is intended to place the issue within a particular food safety context, and provide qualitative information for further action. Decisions regarding particular food/hazard combinations are made according to agreed criteria, and the risk profile also provides information to allow the application of these criteria.

The flow chart shown in Figure 1 has been developed to show the process intended for this project.

Assembling a risk profile will require a reasonable amount of time and effort, and it is not intended to compile a detailed profile for each food/hazard combination in the matrix. A preliminary screening has been performed by MoH, MAF, and ESR, based on readily available data, to produce a list of food/hazard combinations for which it is considered there are foodborne risks to New Zealanders that warrant further attention, and for which detailed risk profiles will be assembled.

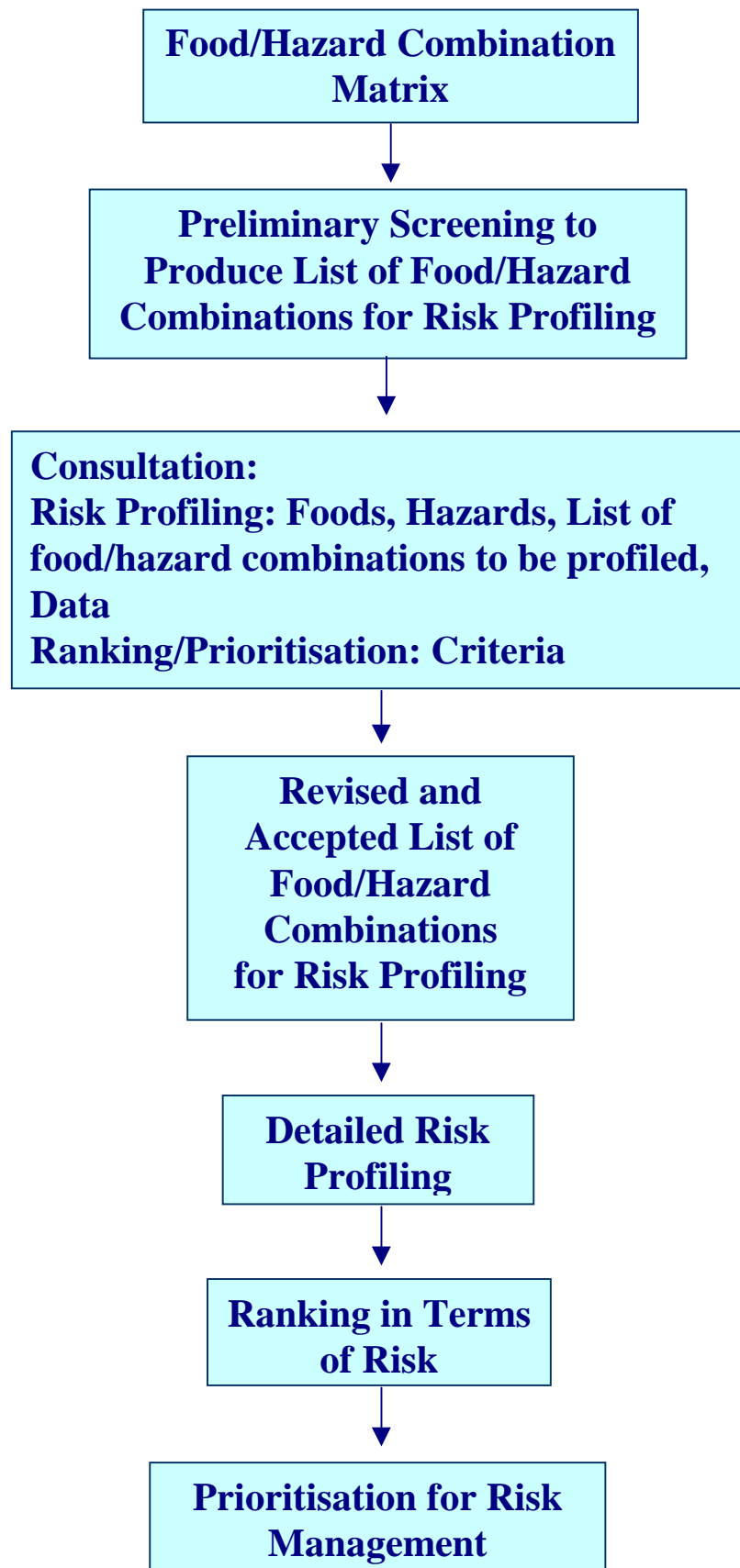
Consultation and agreement amongst stakeholders and experts will be sought to establish support for these decisions. At this consultation stage additions to the list of food/hazard combinations can be made. These may be based on stakeholder perception of risk, significance in terms of societal value, or importance in the international trade environment.

In addition the consultation process will seek agreement on the data to be included in the risk profile, and most importantly, the criteria to be used for the ranking and prioritisation exercises.

Once agreement on the list of food/hazard combinations is established, more detailed risk profiles will be developed. Application of ranking and prioritisation criteria will allow decisions as to future action, if any.

In practice, basic information on each hazard and many of the food groups will be assembled prior to their being brought together in food/hazard combinations. The process will also be facilitated by the fact that many information sources will be analysed as a whole e.g. all of the data on notifiable diseases and outbreaks will be processed at once, without attempting to exclude foods or hazards considered low risk.

Figure 1: Risk profile project process



4.1 Food/Hazard Combination Matrix

The rationale for the list of microbiological hazards and food supply segmentation was presented above. The matrix is presented as a table in Appendix 1.

4.2 Preliminary Screening to Produce a List of Food/Hazard Combinations for Risk Profiling

In order to produce the preliminary list for risk profiling, the food/hazard combinations in the matrix were considered by MoH, MAF and ESR. It was considered that five categories of evidence for foodborne transmission could be identified.

1. Current and significant risk in New Zealand with identifiable local food transmission vehicles.

This category includes food/hazard combinations for which there is evidence of adverse health effects from the hazard, as well as data to support foodborne transmission and identify food vehicles.

2. Current and significant risk in New Zealand but with only suspected local food transmission vehicles.

Food/hazard combinations in this category include those for which there is evidence of adverse health effects from the hazard, but the vehicle(s) for foodborne transmission are only suspected. Evidence identifying the suspected foodborne vehicles should show the presence of the hazard in food in New Zealand, but the foods are not linked to cases of illness.

3. Current and significant risk in New Zealand with no suspected local food transmission vehicles, but evidence for foodborne transmission overseas.

Food/hazard combinations in this category include those for which there is evidence of adverse health effects from the hazard, but no evidence for foodborne transmission within New Zealand is currently available. However, there should be evidence for foodborne transmission by specific foods from overseas studies.

4. Suspected to be a current risk in New Zealand.

These food/hazard combinations include those for which there is evidence for the presence of the hazard in a specific New Zealand food, but no data is available to link any exposure from the food supply to adverse health effects. The absence of data on adverse health effects may be due to lack of surveillance rather than an absence of adverse health effects.

5. "Other factors"

Included in this category are those food/hazard combinations for which a risk profile should be considered on the basis of their importance in the international trade environment, or else stakeholder perception.

Evidence for adverse human health effects from microbiological hazards derives principally from the notifiable disease and outbreak databases maintained by ESR. Information linking these diseases to specific transmission vehicles (including foods) is limited, although the information from outbreak investigations is more extensive and reliable.

Information on the presence of the hazards in the New Zealand food supply derives from research and public health activity conducted by:

- Ministry of Health
- Ministry of Agriculture and Forestry Food Assurance Agency
- Institute of Environmental Science and Research (ESR)
- Australia New Zealand Food Authority (ANZFA)

Evidence for adverse health effects from some microorganisms may be lacking because they do not cause notifiable diseases and therefore data on human health effects are not collated. Food/hazard combinations in this category may need to be the subject of further research to clarify the presence or absence of risk.

4.3 Consultation

The overall purpose of the consultation is to achieve general agreement on the process, and the list of food/hazard combinations to be addressed. Additions and/or changes to the list will be sought. It is hoped that the number of priority food/hazard combinations for profiling will be manageable; if not it may be necessary to conduct a further screening exercise.

4.4 Detailed Risk Profiling

Once the list of food/hazard combinations to be the subject of risk profiles is agreed, further information will be gathered. This information will cover:

1. information on the hazard;
2. information on the food;
3. food consumption information;
4. the New Zealand food industry;
5. further information on the hazard in the New Zealand food supply;
6. information from overseas on adverse health effects of the hazard (and, if available, in specific foods) and the occurrence of the hazard in foods;
7. information on the adverse economic consequences of the hazard; and,
8. societal aspects.

Before a risk profile is commenced, the literature (and the internet) should be consulted for published risk assessments of the hazard, or food/hazard combination that have been conducted elsewhere. Depending on their age, these may provide useful reviews of data on various parts of any risk profile. A useful source of such risk assessments is the Food Safety Risk Assessment Clearinghouse:

http://www.foodriskclearinghouse.umd.edu/risk_assessments.htm

4.4.1 Information on the hazard

Information on each hazard will be assembled, regardless of the hazard/food combinations for which Risk Profiles are undertaken. This information will be assembled as part of the Hazard Data Sheets Project during 2000-2001.

These data sheets will include (where available) information on the likelihood of various health outcomes from infection with the hazard.

4.4.2 Information on the food

Information relevant to individual foods will be collated. Basic information on the food as a matrix for microbial growth is considered most useful, as well as information on processing, the forms in which the food is consumed, and ingredients that are likely to be combined with the food.

4.4.3 Food consumption information

The primary source of food consumption data for New Zealand is the National Nutrition Survey (1997). Further information, if needed, could be derived from:

- Life in New Zealand Survey (1991);
- Simulated typical diets prepared for the 1997/98 Total Diet Survey;
- Ministry of Health Food and Nutrition Guidelines;
- New Zealand Dietetics Association Clinical Handbook; and,
- Australian National Nutrition Survey.

4.4.4 New Zealand food industry

Basic overview data on the New Zealand food industry can be assembled from information from Statistics New Zealand, both from their publication "Business Activity Statistics 1999" and from more detailed information requests. This includes data on numbers of businesses and employees.

Information on the supply chain for food commodities in New Zealand can be obtained from industry sources, both from publicly available material and contacts. Production quantities and processing information will be useful for a risk profile, particularly information on microbiological pathogen control activity.

4.4.5 Further information on the hazard in the New Zealand food supply

Preliminary information on the hazard in the New Zealand food supply will already have been reviewed in order for the food/hazard combination to be the subject of a risk profile. It is likely that further analysis could be useful. In particular, data from the domestic and imported food monitoring programmes and foodborne illness and food complaints programme operated by the Ministry of Health could provide further useful information. Industry data, such as that provided to the New Zealand Microbiological Database could also provide further information for some food types (meat, dairy, poultry).

4.4.6 Information from overseas on adverse health effects of the hazard (and, if available, in specific foods) and on the occurrence of the hazard in foods

This type of information can be gathered from the scientific literature and overseas regulatory agency monitoring programmes. Communicable disease monitoring programmes in the United Kingdom and the United States (FoodNet) could provide useful comparisons, and leads to food vehicles.

4.4.7 Information on the adverse economic consequences of the hazard

Estimates of the adverse economic effect of specific food/hazard combinations are likely to be few. Several countries, including New Zealand (Scott et al., 2000), the United States (Buzby et al., 1996) and Australia (ANZFA, 1999) have published overall estimates of the economic costs for infectious diseases caused by foodborne hazards but these do not distinguish between food vehicles. Comparisons between countries also need to be made cautiously, due to differences in the way economic estimates can be generated.

4.4.8 Societal aspects

The cultural or social aspects of the foods under investigation should also be reviewed for a risk profile. Particular foods may be of special significance to, or have benefits for, social, cultural or ethnic groups and this information may be pertinent to prioritisation for risk management. Consumer perceptions of food safety risks may also be useful. However, ranking according to risk should proceed from scientific data alone.

The distribution of risks and benefits should also be reviewed. This would include information on special “at-risk” groups in the population.

4.5 Ranking in Terms of Risk

Once risk profiles have been assembled for the various food/hazard combinations, the combinations will then need to be ranked in terms of risk. The criteria that will be applied at this stage will utilise scientific objective data from the risk profile, and it is likely that the availability of these data will not be uniform.

Information of the types discussed in this section is limited, both in New Zealand and internationally. It is likely that developing better information will be an important focus of this project, and future related projects.

In general it is considered that the data available in the risk profiles will be incomplete and only allow grouping of food/hazard combinations into broad categories of risk, perhaps high, medium and low.

Where a food/hazard combination is considered to be low risk, it will be considered for further research activity, or considered not appropriate for further action.

Criteria that are considered useful are discussed below.

4.5.1 Human health effects

The primary criterion for ranking food safety risks is in terms of human mortality and morbidity. Although the number of New Zealand cases of infectious intestinal disease caused by many of the foodborne pathogens considered by this project have been estimated (Lake et al., 2000) these are not assigned to individual foods as transmission vehicles. Consequently ranking can initially only be attempted for risks from hazards across all food groups (or at least food groups commonly associated with particular hazards). Ranking in terms of human health effects should also take account of trends where possible; for instance the rapid increase in the incidence of infections by STEC may be an important consideration (although a lack of evidence for foodborne transmission of this organism in New Zealand may mean development of a risk profile is not a priority).

A fundamental decision for ranking risks in human health terms is whether to assign priority on the basis of number of cases or severity of outcome. For example, how should a risk that causes high numbers of cases of low severity be ranked against a risk that causes low numbers of cases but with outcomes of high severity? One option may be to assign economic value to these cases, thus providing a common unit of measurement for comparison, but this may be unacceptable to some groups.

There will be a number of risks for which no New Zealand data on human health effects exist, usually because they fall outside the group of notifiable diseases. One example is toxoplasmosis, for which the importance of foodborne transmission is increasingly recognised (Dubey, 2000; Cook et al, 2000).

4.5.2 Economic effects

The economic effects of various infectious intestinal diseases and their foodborne components have been estimated for New Zealand (Scott et al., 2000). This does not allow assignment of costs to individual food/hazard combinations.

The New Zealand analysis of human health effects in economic terms takes account of direct and indirect medical costs, the cost of lost production and leisure time in days lost to illness, and the economic value of a statistical life. No attempt was made to age adjust the cost of mortality; for example the death of an elderly person may be assigned a different value to that of the death of a young person. In the analysis referred to all mortality was assigned an equal value.

The value of diminished quality of life, as might occur in long term illnesses resulting from intestinal disease was not included in the published estimate. This can represent a significant cost, especially where the rates of long-term sequelae are high, as for infection with STEC.

The assignment of economic value to adverse health effects is a policy tool in development and this project will not get involved in theoretical discussions. Nevertheless this type of information is essential when considering the costs and benefits of public health activity, and so data on human health effects alone will be insufficient. Although assigning monetary value to human morbidity and mortality may be seen as undesirable by some groups, not to do so severely constrains the analysis of policy options (Kuchler and Golan, 2000).

Additional adverse economic effects that could be included are:

- Costs to farming and industry associated with controlling hazards in particular foods
- Costs to exporters of controlling the presence of the hazard in particular foods

An alternative approach for ranking according to risk is the calculation of Disability (or Quality) Adjusted Life Years (DALY or QALY). The basis of these scales is the concept of loss of (healthy) life years, integrating the effects of mortality and morbidity. Mortality is accounted for by the number of life years lost, while morbidity is considered to reduce the value of life during the period of disease and possible chronic sequelae. A severity weight, expressed as a factor between 0 and 1, is assigned to each health outcome to account for the different levels of impact that specific diseases may have on individual or population health.

This analysis is similar to that undertaken for economic studies, but without invoking monetary values. An analysis of the DALY value for *Campylobacter* infections in the Dutch population has been undertaken (Havelaar et al., 1999).

4.5.3 Quality of data

Any ranking in terms of risk will need to consider the quality of the data on which the ranking is made. This would include the age of the data, the sources, and whether data gaps exist that need to be filled, perhaps by additional research.

4.6 **Prioritisation for Risk Management**

Prioritisation of food/hazard combinations for risk management should be considered a separate process from ranking according to risk. There may be a range of factors (alone or in combination) that determine the highest priority for risk management e.g. availability of control measures at reasonable cost is a major issue influencing further action. Although morbidity and mortality may be the most important parameters for ranking in terms of risk, they may not always be so for subsequent risk management actions.

As stated in the introduction, ranking according to risk considers the food/hazard combination as it exists in the present, and does not consider the potential effects of changes in control measures.

Information in the risk profile should indicate the scale of the problem in relation to specific foods so that risk management can be targeted. The information may be sufficient to justify immediate action to manage the risk. If the information in the risk profile is insufficient to take action, then a qualitative or quantitative risk assessment can be undertaken.

It is important to clarify that the prioritisation for risk management (which considers options for action), and actual risk management actions that are subsequently taken, are two different activities.

4.6.1 Potential control options

There are a variety of control options available to manage risks from food/hazard combinations. These may be based at the level of the consumer, the food industry, or regulatory organisations.

Risk management options may include:

- Commissioning a qualitative or quantitative risk assessment;
- Immediate public health action to control a current issue;
- Preventive public health action to prevent the rise or occurrence of a problem; or,
- Risk communication directly with industry or consumers (may include communication that indicates that the risk is low and no action is necessary).

A consideration for assessing control options is the distribution of a particular risk between the food industry and consumer activity. A risk may be well controlled within a food industry sector and most illnesses occur due to domestic handling. In such situations control would be most effective if directed towards the consumer. Unfortunately New Zealand data on such distribution of risk is limited, although overseas research may be useful.

Currently in New Zealand the major focus of control for food safety is voluntary or mandatory preventive activity by the food industry in the form of HACCP-based food safety programmes. A number of consumer-based activities are also undertaken, principally by Public Health Service Providers, and these are beginning to be co-ordinated at a national level by the New Zealand Food Safety Partnership. This group includes representatives from the food industry, as well as national and local public health organisations.

4.6.2 Consumer perceptions and societal aspects

Consumer perceptions of a risk from a particular food/hazard combination may influence the management of that risk. Three studies on New Zealand consumers' food safety knowledge have been conducted in the last decade (Hodges, 1993; Kerslake 1995; Bloomfield and Neal, 1997).

Overseas experience is that consumer perceptions of food safety risks are often at variance to the ranking by experts in the field (Fein et al, 1995; Frewer, 1995; Fife-Schaw and Rowe, 1996). This may make getting agreement on priority food safety risks difficult. However consumer input into the decision making process will be essential for the overall strategy to be effective.

5 PRELIMINARY LIST OF FOOD/HAZARD COMBINATIONS TO BE CONSIDERED FOR RISK PROFILING

The food/hazard combinations in the matrix have been reviewed by ESR in order to identify those considered to be in Category 1. These are listed below, with justification for the selections. The evidence is largely drawn from notified infectious disease data, and outbreak disease surveillance and investigations. Outbreak data for 1997-1999 from the EpiSurv database maintained by ESR were analysed, and only those outbreaks where the food vehicle was linked via epidemiological data or laboratory confirmation were included.

5.1 Category 1: adverse health effects, identified food vehicles

Bacillus cereus/subtilis in dried flavourings (outbreak investigation (herbs and spices on peppered steak))

Bacillus cereus in rice (outbreak investigation AK1999009-rice)

Bacillus cereus in mixed dishes (outbreak investigations AK1998075-pizza, AK1999043-sweet and sour pork, WK1997002-rice curry/pasta salad)

Campylobacter in poultry (whole and pieces) (notified cases of campylobacteriosis, case-control study linking consumption of chicken with *Campylobacter* infection (Eberhardt-Phillips et al., 1997), outbreak investigations AK1999153-undercooked chicken, WN1999040-undercooked chicken kebab, NL1998006-undercooked microwave chicken)

Campylobacter in edible offal (notified cases of campylobacteriosis, prevalence in New Zealand food (pate survey), outbreak investigation RO1998023-lamb's fry and gravy)

Campylobacter in poultry bird offal (notified cases of campylobacteriosis, prevalence of *Campylobacter* in food (duck liver), outbreak investigations WN1999104-duck liver etc.)

Campylobacter in mixed dishes (notified cases of campylobacteriosis, outbreak investigations WN1999027-chicken fettucine, WN1999032-chicken sushi, WC1998001-fish in sauce, NL1998004-lamburger)

Clostridium perfringens in processed ready to eat meats (outbreak investigation AK1999001-medallion ham))

Clostridium perfringens in processed meats requiring further cooking (outbreak investigation (curries etc. (Whyte, 1997))

Clostridium perfringens in mixed dishes (outbreak investigations CB1999017-Chinese banquet, AK1998027 lasagne-mince)

Listeria monocytogenes in processed ready to eat meats (notified cases of listeriosis, outbreak investigation (Feb/March 2000))

Listeria monocytogenes in mollusca, raw (notified cases of listeriosis, outbreak investigation (mussels) (Lennon, 1984))

Listeria monocytogenes in cured smoked and dried seafood (notified cases of listeriosis, outbreak investigation (mussels))

Salmonella in poultry (whole and pieces) (notified cases of salmonellosis, outbreak investigation CB1999015-chicken and contaminated bakery products, prevalence of *Salmonella* in food (National Poultry Quality Assessment project))

Salmonella in mixed dishes (notified cases of salmonellosis,, outbreak investigation WN1999003-chicken meal, AK1999039- filled rolls)

Staphylococcus aureus in processed meats requiring further cooking (outbreak cases (freeze-dried food outbreak))

Staphylococcus aureus in fermented milk and rennet products (outbreak investigation CB1998007-yoghurt)

Staphylococcus aureus in processed ready to eat meats (outbreak cases (Hutt Valley outbreak))

Staphylococcus aureus in mixed dishes (outbreak investigation WN1999035-stuffed potato)

Yersinia enterocolitica in pork (notified cases of yersiniosis, case control study linking pork to *Yersinia* infection (Satterthwaite et al., 1999), outbreak investigations AK1998017-cooked ham, WN1999046-ham and pork luncheon)

Norwalk like virus in mollusca, raw (outbreak investigations AK1999200-oysters and others, imported product (Chilean oysters))

Norwalk like virus in mixed dishes (outbreak investigations TK1999009-green salad, AK1999133-pizza, AK1999190-salads).

6 PRELIMINARY MODEL FOR RANKING OF FOOD/HAZARD COMBINATIONS IN TERMS OF RISK

Any criterion for ranking according to risk will be primarily hazard based, as little information allocating proportional exposure to a hazard from individual food vehicles is available.

As a preliminary ranking model it is proposed that food/hazard combinations be assessed against a criterion which takes into account the likelihood of death or severe long term illness from infection with the hazard, as a proportion of the number of illness cases that occur from infection with the hazard. Although strict economic analysis may not give these particular hazards a priority, it is proposed that potential mortality and long term illness be considered the highest priority for ranking in terms of risk.

This criterion would group the microbiological hazards considered by this project as high, medium and low, according to the likelihood of mortality or long term morbidity as a proportion of total cases.

High proportion of severe outcomes:

Bacteria

Clostridium botulinum

E. coli O157:H7

E. coli (non-O157 STEC)

Listeria monocytogenes

Salmonella typhi

Vibrio cholerae

Vibrio vulnificus

Viruses

Hepatitis A

Protozoa

Toxoplasma

Medium proportion of severe outcomes

Bacteria

Campylobacter jejuni/coli

Salmonella spp. (non typhoid)

Yersinia enterocolitica

Low proportion of severe outcomes

Bacteria

Aeromonas/Plesiomonas
Arcobacter
Bacillus cereus/subtilis
Clostridium perfringens
E. coli (pathogenic, other than STEC)
Pseudomonas
Shigella
Staphylococcus aureus
Streptococcus
Vibrio parahaemolyticus

Viruses

Norwalk and Norwalk-like
Others (e.g. rotavirus)

Protozoa

Giardia
Cryptosporidium
Cyclospora
Others (e.g. *Entamoeba*)

Within these groups, further differentiation of food/hazard combinations for risk could be made on the basis of economic consequences of infection with the hazard according to the published estimates for New Zealand (Scott et al., 2000). These estimates only cover some of the hazards listed above. Listing these in order of decreasing economic consequence provides the following priority listing.

High proportion of severe outcomes:

Listeria monocytogenes
E. coli O157:H7
Salmonella typhi
Hepatitis A

Medium proportion of severe outcomes:

Campylobacter jejuni/coli
Salmonella spp. (non typhoid)
Yersinia enterocolitica

Low proportion of severe outcomes:

Norwalk and Norwalk-like viruses

*Bacillus cereus/subtilis, Clostridium perfringens, Staphylococcus aureus**

Shigella

* These three pathogens were grouped as a single entity for economic analysis.

Although it is not possible to apportion exposure to the risk from these hazards according to food vehicles, it could be appropriate to further rank the risk from individual food/hazard combinations according to the strength of the link to transmission in the individual food or food group.

7 CONCLUSION

Risk profiling is a fundamental contribution to the first of the four steps of risk management:

1. Risk evaluation
2. Risk management option assessment
3. Implementation of the risk management decision
4. Monitoring and review

Recognition of the value of risk profiling is international, and we are aware of risk profiling activity in Canada, Denmark and Australia.

It will be important that risk profiles are developed as part of a comprehensive strategy for food safety. Ranking and prioritisation decisions can only occur when all current risks are considered.

Food safety issues affect all consumers, and their control involves numerous agencies and stakeholders. To be effective, a comprehensive strategy must be the subject of consultation and agreement by those involved. It is intended that the risk profile process will lay the foundation for an effective risk management strategy for food safety in New Zealand.

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APPENDIX 1: FOOD/HAZARD MATRIX

FOOD GROUP	SUB GROUP	BACTERIA															VIRUSES				PROTOZOA									
		<i>Bacillus cereus/subtilis</i>	<i>Campylobacter jejuni/coli</i>	<i>Clostridium botulinum</i>	<i>Clostridium perfringens</i>	<i>Escherichia coli</i> O157:H7	Non-O157 STEC	<i>Listeria monocytogenes</i>	<i>Mycobacterium bovis</i>	<i>Salmonella</i> (non-typhoid)	<i>Salmonella typhi</i>	<i>Staphylococcus aureus</i>	<i>Vibrio parahaemolyticus</i>	<i>Vibrio cholerae</i>	<i>Vibrio vulnificus</i>	<i>Yersinia enterocolitica</i>	<i>Shigella</i>	Non STEC <i>E. coli</i>	<i>Pseudomonas</i>	<i>Aeromonas/Plesiomonas</i>	<i>Streptococcus</i>	<i>Arcobacter</i>	Norwalk-like	Hepatitis A	Others (e.g. rotavirus)	<i>Giardia</i>	<i>Cryptosporidium</i>	<i>Cyclospora</i>	<i>Toxoplasma</i>	Others e.g. <i>Entamoeba</i>
Red meat and meat products	Beef, veal																													
	Lamb, mutton, hoggett																													
	Pork																													
	Venison																													
	Ratites (ostrich, emu)																													
	Rabbit																													
	Other red meats																													
	Edible offal																													
	Processed, ready to eat																													
Poultry and poultry products	Processed, require further cooking																													
	Meat extracts																													
	Birds whole, pieces																													
	Birds offal																													
Egg and egg products	Processed, ready to eat																													
	Processed, require further cooking																													
	Fully retorted (botulinum-cooked) poultry products																													
Shell eggs																														

FOOD GROUP	SUB GROUP	BACTERIA	VIRUSES	PROTOZOA					
		<i>Streptococcus</i>	Others (e.g. rotavirus)	Others e.g. <i>Entamoeba</i>					
		<i>Aeromonas/Plesiomonas</i>	Hepatitis A	<i>Toxoplasma</i>					
		<i>Pseudomonas</i>	Norwalk-like	<i>Cyclospora</i>					
		Non STEC <i>E. coli</i>	<i>Arcobacter</i>	<i>Cryptosporidium</i>					
		<i>Shigella</i>		<i>Giardia</i>					
		<i>Yersinia enterocolitica</i>							
		<i>Vibrio vulnificus</i>							
		<i>Vibrio cholerae</i>							
		<i>Vibrio parahaemolyticus</i>							
		<i>Staphylococcus aureus</i>							
		<i>Salmonella typhi</i>							
		<i>Salmonella</i> (non-typhoid)							
		<i>Mycobacterium bovis</i>							
		<i>Listeria monocytogenes</i>							
		Non-O157 STEC							
		<i>Escherichia coli</i> O157:H7							
		<i>Clostridium perfringens</i>							
		<i>Clostridium botulinum</i>							
		<i>Campylobacter jejuni/coli</i>							
		<i>Bacillus cereus/subtilis</i>							
	Ice								
Non-alcoholic beverages	Coffee & Tea								
	Coffee & Tea replacers								
	Milk-based hot drinks								