6. Development of a Web-based risk-management tool

6.1 Background

In response to the risk-management questions posed by CCFH, the primary application of a risk-management decision tool would be to demonstrate in a simplified manner the proportional effect of different control measures, either alone or in combination, on likely reductions in foodborne illness. This should allow countries to evaluate combinations of control measures by applying a risk-based approach. This decision tool should also be of considerable benefit to industry in designing HACCP plans.

Requested features of the web-based tool specified by CCFH were:

- simplified modelling of risks associated with final product without selected interventions;
- simplified modelling of risks associated with final product with selected interventions;
- comparison of different food chain scenarios;
- the proportionality of risk reduction associated with various control measures; and
- modelling of "what-if" scenarios.

In order to meet this request, an electronic discussion group was formed by FAO/WHO prior to the Technical Meeting. The aim of this e-group was to discuss the possibilities for development of a prototype user-friendly risk-assessment tool for *Salmonella* and *Campylobacter* in chicken meat. While the technology exists to develop these tools, there are a number of questions to be addressed in relation to their scope and limitations, functionality and performance.

Specifically, the following questions were considered by the electronic discussion group:

- Is this really a feasible list of requirements?
- How "simplified" would such a tool have to be to meet these requirements, and would it ultimately still have a value?
- Should we be considering this as one unique tool covering the whole chain, or a series of tools that focus on one segment of the chain, e.g. one for production, one for processing, etc., which may or may not be linked?

Based on discussions in the electronic discussion group, the following were put forward at the Technical Meeting:

- It is a feasible list of requirements.
- The level of simplification required and appropriate is still under consideration.
- The tool will consist of one unique tool.
- The tool will deal only with industrial processing.
- There are many existing detailed and complex risk assessment models (e.g. FAO, Netherlands, UK, Canada).
- The goal for this tool is to create a user friendly risk-management tool suitable for use via the Web.

- The model should be developed in such a manner so as to:
  - Enable users to input initial contamination levels at a common starting point.
  - Allow exploration of various assumptions about what happens during evisceration and chilling (and other specific steps to be named).
  - Provide default values for certain interventions.
  - Allow the user to override these with their own data or assumptions.
  - Provide only relative risk reduction compared to a baseline scenario.
  - Allow the user to compare or rank the effectiveness of different intervention options.

6.1.1 Examples of existing tools

Two recently developed Web-based tools were briefly introduced to the group.

- Food Standards Agency (FSA) Slaughterhouse Hygiene Assessment Tool.
- FAO/WHO (JEMRA) Risk Assessment for *Cronobacter* spp. in Powdered Infant Formula Tool.

6.1.1.1 Food Standards Agency (FSA) Slaughterhouse Hygiene Assessment Tool

The tool would be used to record measures in place to control *Salmonella* and *Campylobacter* from farm to carcass chill. It was developed by the FSA in consultation with the United Kingdom industry, to be used by United Kingdom poultry processors as a self audit. The tool was still in development, and only a limited example was seen by the group. The tool sets specific questions at each process step and the user had a choice of possible interventions. The questions were based on interventions for which there is literature support for controlling *Salmonella* and/or *Campylobacter*. The scores given for each answer reflect the degree of control. The total score for each set of questions within a section are multiplied by a "stage multiplier". The value of the multiplier is a reflection of the degree of risk at that step. Access through the Web would be linked directly to literature that supports each intervention, when the tool came online.

6.1.1.2 FAO/WHO (JEMRA) Risk Assessment for *Cronobacter* spp. in Powdered Infant Formula

This is an online risk assessment tool. The tool explicitly examines the impact of different preparation and handling strategies on *Cronobacter* spp. in Powdered Infant Formula (PIF) and describes the outputs in terms of the relative risk posed to infants. In addition to explicitly considering the preparation and handling of PIF, it provides tools to explore the possible impact of microbiological criteria through the specification of sampling plans for *Cronobacter* spp in PIF. The microbiological criteria can be explored in isolation or in combination with the preparation and handling tools to determine the impacts upon risk.

Users enter parameters such as concentration values, preparation and handling, and sampling plan information. The tool then uses a risk assessment model to produce a report showing the relative risk of the scenarios provided.

The tool is publicly available at www.mramodels.org/esak.

6.1.2 Prototype tool for a *Campylobacter/Salmonella* Web-based tool

An early prototype was presented to the experts for the purpose of generating discussion. The prototype included a few sample processing steps with options to input initial concentration and prevalence levels, identify process changes such as growth and cross-contamination, and introduce interventions.

The main features demonstrated by the prototype tool were:

- a user friendly interface (Web-based) for the end user; and
- a user friendly model development tool for the risk modeller.

The user would have the option to use default data, where available, based on the CCFH document and other literature. The user could also override those inputs with their own data. The software then uses those inputs to produce a risk-based report.

The prototype tool models changes in concentration and prevalence during processing. It currently starts after de-feathering, but this could be changed if found appropriate. The final concentration is used to compute two doses: one considering the interventions selected and a baseline dose assuming no interventions. These doses were applied to a dose-response model. The relative risk reduction between the result with interventions and without interventions is reported back to the user, as well as the mean concentration and prevalence values at each step.

Comments from individual experts on what the model developers should consider in the further development of the prototype tool included the following:

- It should make recommendations on sampling schemes and microbiological methods for users to determine input data so that inputs are comparable between users.
- The model should start further up the chain (e.g. pre-harvest) to expand the choices of management options.
- The model should be expanded to include consumer handling (e.g. cooking, cross-contamination).
- Have the model account for interactions between applying multiple interventions (synergistic, antagonistic, reduced effectiveness).
- The model should account for cross-contamination.
- The model should account for multiple flocks (e.g. cross-contamination between flocks).
- The implication of uneven carcass size within a flock should be considered.
- The model should account for the use of different scalding procedures.
- Different products should be included – e.g. cut-up products.

The following concerns from individual experts were raised:

- Who will be using the model? Will it be used by industry, government, and/or risk managers, and for what purpose?
- Which questions will the tool ask the users in order to provide input to the model?
- There is currently a lack of data (e.g. concentration data for *Salmonella*) to fill into the model. Would this prevent the tool from being usefully used?
- How will the model be validated?
- There is currently no consensus model on which to build the tool.
- Will the tool be updated as new information becomes available?
- It is difficult to rely on one model covering all plants with all the different machinery and GHPs in place.
- The *Campylobacter* issue is much more complicated than the *Cronobacter* spp issue, thus the model will be more complicated.
- Could the model be used for comparisons between countries?
- Different serovars may require different dose-response models.

Mechanisms by which to address some of these concerns include the following:

- The tool will provide default data, which can be used if the user has no data of their own. The data will be based on the best available information.
- The same dose response model will be used for all *Salmonella* serovars. Statistically, there are no differences between dose response models for different *Salmonella* serovars.
- Using relative risk makes the influence of the dose response less important.
- The model will be designed to compare different scenarios. Countries can add input data sampled for different situations, such as climate.
- The tool can be updated with new information when available and models can be adjusted if necessary.

6.2 Suitability of outputs of the meeting for the prototype tool development

The Experts agreed that the prototype tool was feasible and that the work on further development of a prototype should continue, based on the following arguments:

- We need this kind of tool for risk-based management.
- There are potential users, both governments and stakeholders. For developing countries, the tool would also be of value. It can be used to train industry and government at the same time used to encourage discussion of risk management.
- The tool will help countries that have targets or market demands, to explore which interventions could be applied.
- The tool might help with trade situations by providing a common framework.
- The tool will be useful for ranking the effectiveness of interventions.
- The tool will be useful for exploring the combining effects of interventions.
- A model is never complete as is it always a simplification that uses science, assumptions and expert opinions, but it is the best that can be provided to assist management decisions. Countries cannot do experiments with all interventions and so models are useful to help evaluate interventions.
- The model captures the best consensus knowledge on the processes and the interventions.

Next steps:

- A prototype tool will be delivered to the CCFH working group through the JEMRA process.
- The current version of the prototype tool will be expanded to start at the entry to slaughter and include all processing steps described in the Codex draft guidelines. It will allow for the hazard-based controls agreed upon in the CCFH document and other hazard-based controls compatible with the model to be compared for their impact on relative risk reduction.
- The modellers need to consider
  - how to model microbiological effects that may occur at each step (e.g. cross-contamination, growth, and inactivation);
  - how to model synergistic, antagonistic and reduced effectiveness of multiple interventions; and
  - can an effective model for *Salmonella* be developed using only prevalence data?

- The prototype requires inputs for initial carcass-level contamination (Log cfu/carcass); between-flock prevalence; and within-flock prevalence. The modellers will not provide guidance on determining those inputs from sample data.
- The prototype should provide estimated default values for microbiological effects (e.g. Log reduction; cross-contamination during scalding) for the prototype to assist the evaluation of the model.
- Evaluation of the scientific data of baseline values and other interventions not currently included as hazard-based controls should be determined by subject-matter experts, and should not be the responsibility of the modellers.
- Model development will require interaction with risk managers and subsequent peer review.