

## Food Safety: the essential ingredient

### Sprouted seeds and salmonellosis

#### Recent outbreak

Contaminated seed sprouts have been implicated in a recent outbreak of salmonellosis in Western Australia. In this case *Salmonella* Oranienberg was the organism responsible. This is a timely reminder of the challenges in production of raw, ready to eat foods from primary products.

Seed sprouts have been implicated as a cause of foodborne illness. Since 1973 at least 37 other outbreaks have been linked to sprouts. Most of the incidents have occurred in the USA with *Salmonella* and *Escherichia coli* O157:H7 being the organisms most frequently implicated.

Australia has not previously had a well documented incident identifying sprouts as a vehicle for *Salmonella* spp. or any other pathogen. However, Australia was the source of alfalfa seeds which caused hundreds of cases of salmonellosis in Sweden and Finland when sold as sprouts in 1994. (Lancet 1995. 345. 462-463). The investigating authority isolated the pathogen from the germinated sprout but not the seeds.

Sprouted seeds are one of those foods listed in Standard 1.6.1 of the Australian Food Standards Code (<http://www.foodstandards.gov.au/foodstandardscode/index.cfm>) for which a microbiological criterion has been set. For cultured seeds and grains (bean sprouts, alfalfa etc), *Salmonella* is not to be detected in 5 samples of 25 g.

#### Microorganisms on seeds

It is generally recognised that microorganisms, including potential pathogens, are protected in cracks and crevices in the seeds from what would normally be lethal concentrations of chlorine or other sanitisers. The US Food and Drug Administration (FDA) recommends treatment of seeds for sprouting with a 20,000mg/L calcium hypochlorite solution while the US National Advisory Committee on Microbiological Criteria for Foods recommends the same concentration of free chlorine, or its equivalent, for 15 minutes.

### What's inside

Sprouted seeds and salmonellosis

Irradiation concerns still an issue

Microbiological criteria for foods in the European Union

Conference focus

Australian Food Safety Centre of Excellence to join ComBase consortium

So far there is no single treatment that has been shown to completely eliminate pathogens on seeds or sprouts without affecting germination or yield. Seeds are easier to sanitise than the sprouts themselves because contamination levels should be low and the seeds are more resistant to the severe chemical treatments necessary to achieve significant reductions in bacterial numbers.

As has been discussed previously (Food Safety & Hygiene, March 2005), further research into the use of combined treatments is necessary if a satisfactory method is to be found for totally eliminating microorganisms from sprouts. Guidelines for producers are available (NSW Food Authority Plant Products manual, Industry Contact Centre on 1300 552 406 or [www.foodauthority.nsw.gov.au](http://www.foodauthority.nsw.gov.au)). Retailers and consumers can play their part in reducing risk by ensuring that sprouts in their control are stored below 5°C.

### Irradiation concerns still an issue

One method of decontamination of seeds for sprouting that warrants further investigation is irradiation. The FDA has approved the use of ionising irradiation to control microbiological pathogens in seeds for sprouting.

At least one study (Journal of Food Protection 2000. 63. 871-875) did show that a five decimal reduction of both *Salmonella* spp. and *Escherichia coli* O157:H7 was obtained when sprouts were irradiated to 2kGy. Not all studies have revealed quite such promising results and most workers in the area concede that more work needs to be done. As well as investigation of the efficacy of the treatment, research into the nutrient and flavour changes at the minimum effective irradiation dosage is required.

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## The Australian Food Safety Centre of Excellence News

### Australia to join the ComBase consortium

On the 24th February 2006, the ComBase Executive Committee, comprising representatives from the UK Food Standards Agency, Institute of Food Research, Norwich, UK and US Department of Agriculture met with partners of the Australian Food Safety Centre of Excellence in Sydney to discuss Australian involvement as a full member of the ComBase consortium. The current US and UK full members expressed considerable enthusiasm for the proposal which was agreed in principle with details of a Memorandum of Understanding to be developed by correspondence.

The ComBase Initiative ([www.combase.cc](http://www.combase.cc)) is a collaboration between the Food Standards Agency and the Institute of Food Research, UK, the USDA Agricultural Research Service and its Eastern Regional Research Center, USA and the Australian Food Safety Centre of Excellence which joined the Consortium in February 2006.

Its purpose is to make data and predictive tools on microbial responses to food environments freely available via web-based software. The ComBase Database (accessible via the *ComBase Browser*) consists of thousands of microbial growth and survival curves that have been collated in research establishments and from publications. They form the basis for numerous microbial models presented in *ComBase Predictor*, a useful tool for industry, academia and regulatory agencies. They can be used in developing new food technologies while maintaining food safety; in teaching and research; in assessing the microbial risk in foods or setting up new guidelines.

The most recent Institute of Food Technologists Scientific Status Summary (Food Technology 2004, 58, 11, 48-55) does not deal with irradiation of sprouts but does review recent activity in food irradiation and addresses issues of concern. The reviewers note that despite more than 50 years of research, food irradiation continues to generate controversy inhibiting broad acceptance. They concur with previous findings (see Food Safety and Hygiene, May 1998) that food irradiation is a safe and effective process that can be used to improve the safety of the food supply.

Concerns addressed in the summary include potential misuse of technology to clean up poor standard product, environmental concerns affecting all irradiation facilities, and the effect on nutrients.

### Radiolytic products formed during irradiation

The subject of radiolytic products formed as a result of irradiation of food components receives special attention in this Scientific Status Summary because of claims of potential mutagenicity. The reviewers note that the vast majority of radiolytic volatile compounds found in irradiated foods are hydrocarbons that are commonly found in unprocessed and thermally processed foods.

Two groups of components have generated some concern. These are benzene and its derivatives and alkylcyclobutanones (ACBs). Expert committees in the USA and Canada have concluded that the levels of benzene found in irradiated foods are lower than naturally present in some foods and do not constitute a significant risk.

The ACBs, however, have not been found in raw or heat processed foods and are considered unique radiolytic products. While the Scientific Status Summary mentions one report that indicates that some of these compounds are potential mutagens, both Health Canada and the European Commission's Scientific Committee on Food have concluded that the genotoxicity of ACBs has not been established.

Despite the positive tone of this summary and numerous other reviews published over many years, the torturous path of irradiated foods to find industry and public acceptance seems set to continue.

## Microbiological criteria for foods in the European Union

The European Commission (EC) is consulting with the World Trade Organization (WTO) on revised European Union (EU) microbiological criteria regulations which came into force on 1 January 2006. They are part of a package of food hygiene laws which attempt to achieve harmony across member states.

According to the UK Food Standards Agency (FSA News, November 2005), the new regulations do not require any increased end product testing for release of foods. Food businesses can, in the main, set their own sampling and testing plans as part of a risk based food safety plan constructed on HACCP principles.

The new regulation sets a fixed sampling plan only in the case of certain products including carcasses, minced meat, meat preparations and mechanically separated meats. In these cases, food operators will be required to perform a minimum of one test per week. The target of this regulation is to reduce the incidence of *Salmonella* spp. in the food chain.

In some cases (see table), a criterion will apply to the internal manufacturing process. However most will apply to product in the market place. If a standard is not met, authorities will require that the product be withdrawn from the market.

It is of interest to compare the EU regulation with the microbiological guidelines set down in the Australian Food Standards Code which are legally enforceable. While there is a degree of commonality in the food categories for which guidelines or criteria are set down, there is little common ground when one looks at the bacteria selected for analyses as can be demonstrated in the table below.

Food category		Microorganism	
Australia	EU	Australia	EU
Powdered infant formula	Dried infant formula	<i>Bacillus cereus</i> , coagulase positive staphylococci, coliforms <i>Salmonella</i> (10 samples)	<i>Salmonella</i> (30 samples)
No guideline	Minced meat and meat preparations made from poultry meat intended to be eaten cooked		<i>Salmonella</i> Absent in 10g From 1/1/2010 Absent in 25g
All raw milk cheese	Cheese made from raw milk	<i>Listeria monocytogenes</i> , <i>Salmonella</i>	Coagulase positive staphylococci
No guideline	Precut fruit and vegetables		<i>Escherichia coli</i>
Packaged heat treated meat paste and paté	Ready to eat foods able to support the growth of <i>Listeria monocytogenes</i>	Coagulase positive staphylococci, <i>L. monocytogenes</i> * <i>Salmonella</i>	<i>L. monocytogenes</i> *

\* The Australian guideline requires 'absent in 25g' (5 samples). The EU criterion requires 'absent in 25g' before the food has left the immediate control of the operator who has produced it; and fewer than 100cfu/g for products placed on the market during their shelf life.

These differences highlight what a crude instrument microbiological specifications are in food safety control. While some of the apparent differences could be attributed to the different data and epidemiology for the countries concerned, the main difference would appear to be the arbitrary nature of selection of criteria.

The concern expressed by the food industry in Europe over the way microbiological criteria may be used as an enforcement tool is greater still if their customers decide to introduce their own specifications using a weak data base.

## Conference focus

Prepared by Michelle Bull, Belinda Chapman, Ailsa Hocking and Nai Tran-Dinh of Food Science Australia

The **2nd International Conference on Microbial Risk Assessment: Foodborne Hazards** was supported by the Australian Food Safety Centre of Excellence and held in Sydney on 20–23 February 2006 in conjunction with the **Australian Institute of Food Science and Technology 12th Australian Food Microbiology Conference**.

The Conferences presented an excellent mix of papers and opinions from the food industry, government bodies, research institutions and universities. Provided below are the key messages from some Conference presentations.

## 12th Australian Food Microbiology Conference Overview

In one of the opening addresses, Michael Eyles pointed out that in the nearly 30 years since the First Australian Food Microbiology Conference, great progress has been made in most areas of food microbiology, while some things still remain a challenge.

Over this period, the number of pathogens that are known to cause foodborne disease has increased, and naturally the understanding of these foodborne diseases has increased. However, the causes of a substantial proportion of foodborne outbreaks investigated are still unknown and the incidence of outbreaks has not substantially decreased.

Numerous presentations discussed novel approaches to studying food microbiology, particularly the application of various scientific disciplines to food microbiology. Microbial and microbe-food interactions were discussed from several perspectives, including material science, microbial membrane interactions and the use of scanning probe microscopy.

New techniques in food microbiology were discussed, including the use of molecular biology techniques for determination of causes of foodborne disease outbreaks and in determination of microbial loads in foods. Microarray techniques are also being used to understand the pathogenicity and resistance properties of foodborne pathogens. Despite the advent and adoption of new techniques in food microbiology, traditional methods remain in use and advances are being made towards greater efficiency and rapidity.

The growing need for surveillance, reporting and dissemination of information regarding foodborne disease outbreaks was highlighted by several discussion papers. OzFoodNet and the relevant state authorities provide improved information and analysis of data relating to foodborne disease outbreaks.

## Food structure, microbial attachment and growth

**Tim Brocklehurst** (Institute of Food Research, United Kingdom)

*12th AIFST Food Microbiology Conference*

Even though they might look it, foods are typically not homogenous. Tim Brocklehurst, lead scientist at the Institute of Food Research in Norwich in the UK, who has spent many years researching the effect of food structure on the survival and growth of spoilage and pathogenic microorganisms presented some of his findings. Foods such as mayonnaise, butter and margarine might look smooth and creamy to our eye, but even these simple foods contain complex microstructures that become important when placed in the context of the length scale of a single bacterial or fungal cell or spore. The microstructure of such foods determines the physicochemical attributes of the food that microorganisms "see", including pH and preservative gradients, depending on where they are located in the food. In more complex foods, such as vegetables, bacterial cells preferentially attach to the cut cell wall rather than the cell lumen and this can influence the extent of microbial growth that occurs. The key message is that an improved understanding of the effect of food microstructure on the growth and survival of microorganisms is vital for the development of smart food preservation strategies.

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## Cleaning and sanitation – an underestimated necessity

Stephen Jay (Silliker Microtech, Australia)

12th AIFST Food Microbiology Conference

At its simplest level, the importance of elbow grease cannot be underestimated in the achievement and maintenance of a hygienic processing or manufacturing environment. Stephen Jay, of Silliker Microtech, showed that cleaning and sanitation is an underestimated necessity in the food industry. Accompanied by a slide show of shame (no names, but lots of grease and grime), Stephen recruited many in the audience to his way of thinking – we don't consider enough the importance of good hygiene in producing microbiologically safe and stable foods. And despite the simple basics, there is much to think about when it comes to the application of cleaning and sanitation regimes. Do you need a soap, detergent, solvent, abrasive cleaner, iodophore or aldehyde to do the job? What type of water is available? For that matter, what is the temperature of the water available? What concentration of sanitiser will you use? For this you might need to know the volume of your clean-in-place (CIP) system, as well as the flow rate, in order to ensure you have the correct contact times. Stephen reminded us that there is a lot of information available from the suppliers of sanitisers and cleaning agents, and that food industry microbiologists are also available to provide advice.

## The need to introduce spoilage modelling into risk assessment

Kostas Koutsoumanis (Aristotle University of Thessaloniki, Greece)

2nd International Risk Assessment Conference

Food spoilage can be described using the concepts of the specific spoilage organisms (SSO), the spoilage domain (SD), the chemical spoilage index (CSI) and the spoilage level (SL). The spoilage level for different foods can be different, even given the same SSO and SD. In his presentation, Kostas illustrated this concept with an example. For cut steaks, *Pseudomonas* spoilage is evident around  $10^7$  cfu / g, where spoilage of mince by the same organisms is not evident until the SL reaches  $10^9$  cfu / g. The true shelf-life of a food can then be defined as the time taken for the SSO to climb from an initial level to a final spoilage level, as observed for that particular food. Prediction of the likely shelf-life of a food is important not just in terms of spoilage, but also in terms of food safety. Many foodborne pathogen risk assessments fail to take into account the decreasing likelihood of consumption with increasing spoilage (decreasing shelf-life). This in turn means that, in some cases, the risk of consuming a pathogen in a particular food may be overestimated.

## Risk assessment techniques applied to the optimisation of thermal processing

Jeanne-Marie Membré (Unilever Safety and Environmental Assurance Centre, Sharnbrook, UK)

2nd International Risk Assessment Conference

An interesting application of risk assessment methodologies for the optimisation of thermal processes was presented by Jeanne-Marie Membré of Unilever. For manufacturers with detailed and specific information about their particular products and processes, Membré presented options for adjusting the time/temperature parameters of thermal processing for safe foods – these ranged from conservative and simple to more complex.

The simplest option is to take the Food Safety Objective (FSO) approach. A formula can be used to describe this.

$$H_0 - \sum R + \sum I \leq \text{FSO}$$

With this option, the manufacturer performs a hazard identification for the product, determines the acceptable level of that hazard in the product at consumption (FSO), determines the initial numbers ( $H_0$ ) and the amount of potential growth of the hazard in the final product (EI). The level of reduction of the hazard ( $\sum R$ ) required during the thermal process is then calculated. A conservative estimate of the heat resistance of the hazard can be used e.g. a 6 decimal reduction in 2 min at 70°C. This approach is straight-forward and may allow changes in the temperature/time parameters of a thermal process where the known hazard incidence and concentration is well below the assumed worst-case scenario.

The most complex option is to take a probabilistic approach, such as described by Membré *et al.* (2006). With this option, it is possible to combine the inputs describing realistic hazard incidence and concentration with the heat resistance of the hazard and the variability of thermal processes. Outputs describing the likely prevalence and the likely concentration of the hazard after processing are presented as probability curves which provide a more realistic situation than absolute values. The model can also be used to run 'what-if' scenarios, allowing assessment of the effect of uncertainty around individual inputs. This probabilistic approach is time consuming to develop and challenging to communicate at the operational level. However the information it provides information is in a form that supports decision making during optimisation of thermal processes.

## Reference

Membré, J.M., Amézquita, A., Bassett, J., Giavedoni, P., de W. Blackburn, C. and Gorris, L.G.M. (2006) A probabilistic modeling approach in thermal inactivation: estimation of postprocess *Bacillus cereus* spore prevalence and concentration. *Journal of Food Protection* 2006. 69. 118-129.

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