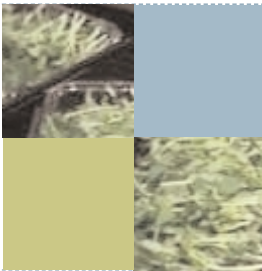




survey special
FOOD SURVEILLANCE
AUSTRALIA NEW ZEALAND

Health Department of Western Australia

Summer 2002



Microbiological safety and quality of sprouts in Western Australia

Think of healthy foods and fresh fruits and vegetables often come to mind. Health authorities in Australia as elsewhere advocate the inclusion of fresh fruits and vegetables as part of a balanced, wholesome and healthy diet.

Recent culinary influences on the Australian diet have seen sprouted seeds such as bean sprouts, alfalfa and snow peas etc become part of our everyday meals. With their stores of vitamins, minerals, protein, fibre, delicate subtle flavours and crisp textures, sprouted seeds make a valuable contribution to a healthy, nutritious and varied diet.

Like any balanced meal, the nutritional benefits of eating sprouts should be balanced with the potential risks from microbiological contamination.

There have been increasing numbers of food poisoning outbreaks associated with the consumption of sprouted seeds like alfalfa, radish, mung bean, and clover sprouts. Literature and epidemiological investigation into food poisoning outbreaks in United States, United Kingdom, Sweden, Finland, Japan, Denmark and Canada have identified sprouts as a potential problem food.

The main pathogens associated with outbreaks overseas have been *Salmonella* and *E. coli* O157:H7. A sample of the reported food borne illness outbreaks over the last 10 years includes an outbreak in Sweden and Finland in 1997 involving 492 confirmed cases as a result of *Salmonella* species. *E. coli* O157:H7 has also emerged as an organism of concern with outbreaks in Japan in 1996 and 1997, with more than



6,000 and 126 confirmed clinical cases respectively and in the US states of Virginia and Michigan where 108 clinical cases were reported in 1997.

Sprouts present special problems because of the potential for pathogen contamination and survival on seed stock and the rapid growth of microorganisms during the sprouting process. Research has demonstrated that *Salmonella* species can survive for several months on alfalfa sprouts.

Two features of sprouts enhance inherent problems associated with this product. The first is the formation of biofilms on the sprout surface and the second is the potential intercellular presence of bacteria in seeds and sprouts. Biofilm bacteria are able to form complex communities with other microbes and the biofilm imparts significantly increased resistance to antimicrobial compounds.

In May 1999, the US Food and Drug Administration recommended the use of up to 20,000 ppm of chlorine during pre-germination soak, to sanitise the seeds. However, further research has demonstrated that antimicrobial treatment of sprouts, once fully germinated, did not significantly reduce bacterial loading. Antimicrobial treatment of soaking and irrigation water may inactivate some microbes on the surface of the sprout but with little effect to these organisms inside tissues and plant structures.

The survey

The Health Department of Western Australia coordinated a major survey of the sprouts industry in Western Australia between January and March 2000.

The survey focused on the:

- Microbiological safety and quality of sprouts at retail level;
- Storage and handling practices by retailers; and
- Retailers' compliance with manufacturers handling instructions.

Samples of pre-wrapped punnets and loose bulk sprouts were taken by local government Environmental Health Officers from retail outlets and transported in chilled eskies to the PathCentre, Food Hygiene Laboratory in Perth for analysis. The samples were tested for:

- Total Plate Count (TPC);
- Coliforms;
- *Listeria monocytogenes*;
- *Salmonella* species;
- *Escherichia coli*;
- *Bacillus cereus*; and
- Coagulase positive *Staphylococcus*.

Results and discussion

A questionnaire to record product details, storage and handling conditions and practices was also completed to put microbiological results into perspective. The information recorded by the sampling Environmental Health Officer included the following:

- Sample details – description, manufacturer and place of purchase;
- Whether the product was packed for individual sale;
- Whether the label stated storage conditions (e.g. refrigerate, store below 5°C);
- Storage temperature at the point of sale; and
- Date marking on the product.

Two hundred and sixty-one (261) sprout samples were tested for microbiological quality and all samples were considered for crude microbiological assessments. However, 5 were deficient in sample details such as handling and date markings and were excluded from assessments involving these parameters.

Sampling involved the collection of pre-packed and loose bulk sprouts available at retail outlets. Figure 1 below represents the varieties of sprouts tested during the survey.

Crude microbiological assessment of results reinforced findings reported in overseas research and surveys that sprouted seeds have the potential to facilitate microbiological growth and possibly pathogenic organisms if present.

Quality indicators such as TPC and Coliforms exceeded guideline values in a significant proportion of samples (88.5%) and (96.9%) respectively. However, the guideline values of 10^7 cfu/g for TPC and 1100 cfu/g for Coliforms, while appropriate for many foods, are not useful indicators for foods such as

fresh produce, including sprouts. For example, TPC values in the range of 10^8 to 10^9 cfu/g are commonly reported for sprouts, without adverse effects to product quality.

Salmonella was detected in one sample.

Figure 2 below provides a crude summary of the microbiological quality of seeded sprouts assessed during the survey.

All sprout cultivation using conventional growing techniques demonstrated similar microbiological hazard, but not all have the same public health significance. Bean sprouts, for example, are often cooked before consumption and have reduced risks compared to alfalfa, clover, onion and radish sprouts, which are usually eaten raw as a salad or garnish.

Assessment for pathogens isolated L. monocytogenes in eight samples and Salmonella in one sample. E.coli was recovered from 7 samples (See Table 1, page 3), none of which were toxigenic strains.

Assessment criteria

For the purpose of this survey, sprouts were considered as a ready-to-eat product and the microbiological results were compared against Standard 1.6.1 – Microbiological Limits for Food (Food Standards Code), for Salmonella, and the WA Guidelines for Ready-To-Eat Foods, for the other organisms.

All samples were tested for the range of organisms listed. Samples were considered unacceptable if they exceeded the following criteria:

- Total Plate Count – more than 10^7 colony forming units per gram (cfu/g)
- Coliforms – more than 1100 cfu/g
- Listeria monocytogenes – more than 100 cfu/g
- Salmonella species – detected
- Escherichia coli – more than 100 cfu/g
- Bacillus cereus – more than 100 cfu/g
- Coagulase positive Staphylococcus – more than 100 cfu/g

Figure 1: Type of Sprouts Sampled During the Survey

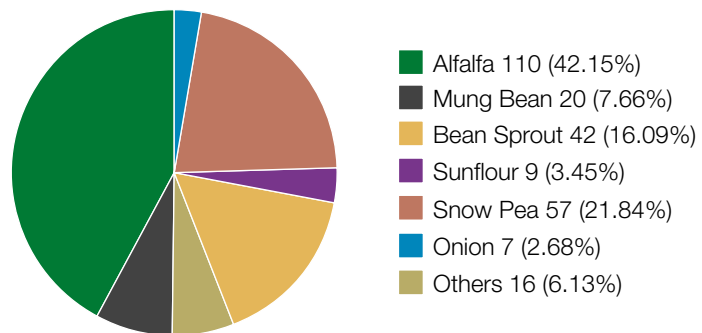


Figure 2 Microbiological Quality Summary of 261 Sprouts Samples

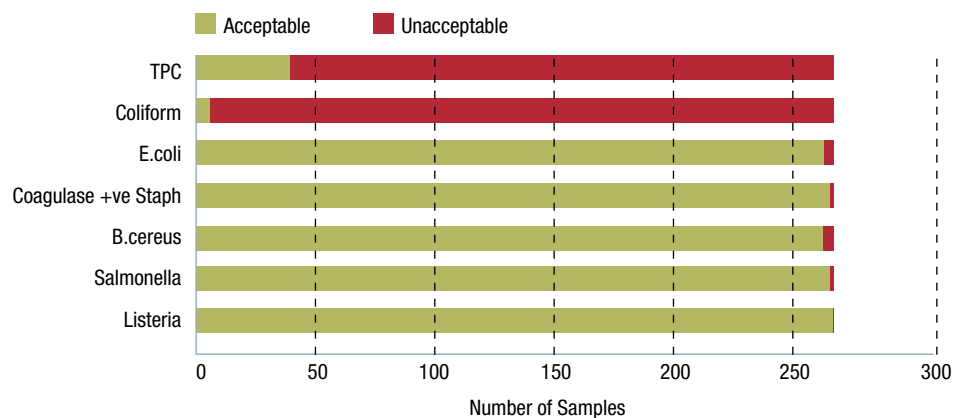


Table 1: Microbiological levels of various sprouts

Sprout Sample Type	Microbiological Test Parameters													
	TPC		Coliform		E.coli		Coagulase +ve Staph		B.cereus		Salmonella		Listeria monocytogenes	
	≥1e7	<1e7	≥1100	<1100	≥100	<100	≥100	<100	≥100	<100	Poor	Good	Poor	Good
Alfalfa (110)	107	3	109	1	3	107	-	110	-	110	-	110	6	104
Bean Sprout (42)	36	6	4	11	-	42	-	42	1	41	-	42	-	42
Mung Bean (20)	17	3	19	1	-	20	-	20	-	20	-	20	1	19
Onion Sprout (7)	7	-	7	-	-	7	-	7	1	6	-	7	1	6
Snow Pea (57)	27	30	55	2	2	55	1	1	2	55	-	57	-	57
Sunflower (9)	8	1	7	2	-	9	-	9	-	9	-	9	-	9
Others Sprout (16)	13	3	15	1	2	1	1	1	3	2	1	15	-	16
Total	215	46	253	8	7	254	2	259	7	254	1	260	8	253

Refrigerated versus Un-refrigerated

Of the 203 samples classified as refrigerated 154, or over 75% of samples, were stored at or above 10°C giving rise to concerns on the adequacy of refrigerated vegetable displays. Forty-nine (49) samples were stored at or below 8°C, of which over 93% contained elevated levels of microorganisms.

It is questionable whether refrigeration of the sprouts at the point of sale influences the overall microbiological quality. Exponential microbiological growth occurs during production before reaching refrigerated storage. Retardation of growth may be attributed to normal plateau and decline phase in the bacterial growth cycle.

The survey identified two un-refrigerated samples as containing marginal counts of Coagulase positive Staphylococcus, Figures 3a and 3b summarizing the findings. Handling is the primary source of contamination.

Bacillus Cereus was detected in 7 refrigerated and un-refrigerated samples. The level of detection did not present a risk to public health. Recovery of bacillus is not surprising considering the nature of seed horticulture and common association with soils and soil contamination.

Bacillus thrives in non-competitive environments where natural microbiological flora is significantly reduced through heat treatment or cooking and the product remains in optimum temperature range of 28-35°C. Sprout production employs ambient temperature of 18-25°C that is marginally below the optimum temperature range for B. Cereus but suitable for a range of competing organisms.

Figure 3a: Microbiological Quality of 203 Refrigerated Sprouts

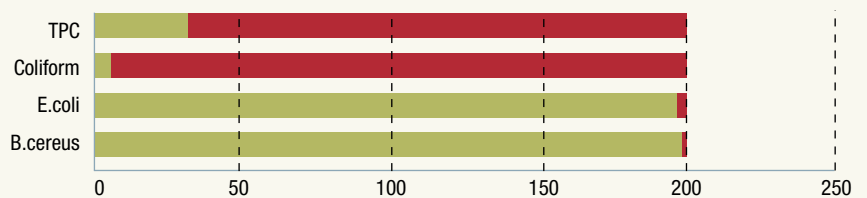
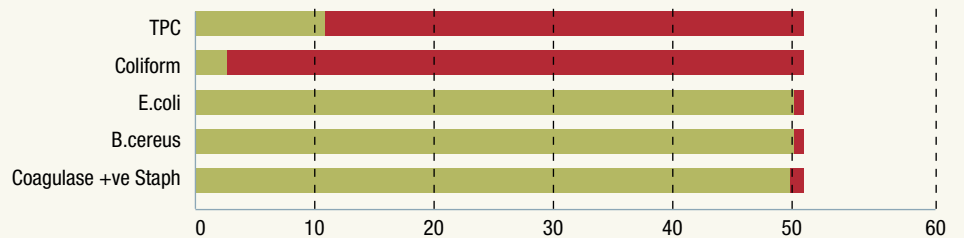


Figure 3b: Microbiological Quality of 52 Unrefrigerated Sprouts



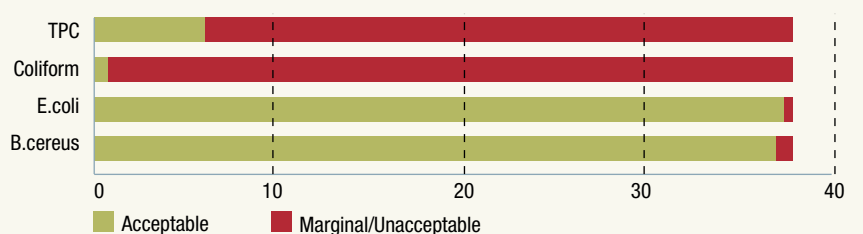
Wrapped versus Unwrapped

Similarly, there was little significance in microbiological quality between wrapped and unwrapped sprouts. Increased sample numbers for unwrapped sprouts is required to test this theory. (See Figures 4a and b)

Figure 4a: Microbiological Quality of 218 Wrapped Sprouts



Figure 4b: Microbiological Quality of 37 Unwrapped Sprouts



Summary of findings and conclusions

- Sprouted seeds should be considered a high risk food and handled and treated accordingly by producers, retailers, consumers and enforcement agencies.
- The survey provides conclusive evidence that sprouts have the potential to facilitate rapid microbiological growth, in the order of 5 to 6 logs during production.
- This survey did not isolate pathogens at levels of public health significance. However, one sample had *Salmonella* and *Listeria monocytogenes* was recovered from 8 samples at levels of less than 5 per gram. This is under the acceptable level of less than 100 per gram established in the West Australian Guidelines.
- Present sprout growing techniques facilitate rapid growth by providing ideal growing conditions of abundant moisture, suitable temperature and nutrients. A pathogen present on the seed stocks under these conditions could quickly multiply unchecked to levels that may pose a significant risk to public health. There are added risks as sprouts (aside from bean sprouts) are normally eaten raw without a bactericidal step such as cooking.
- A redeeming feature of sprouts is that they seldom constitute the major part of a meal. Sprouts are often used as garnishing or condiment and are consumed in relatively small quantities. This would tend to reduce the risk of eating an infective dose.
- Further research in sprout production is needed to discover effective means of controlling bacterial growth without significantly affecting production rates or product quality.
- Sprout growers require training on good manufacturing practices and a basic understanding of Hazard Analysis and Critical Control Point (HACCP) principles. An industry guideline would benefit existing producers and set the foundations for newcomers.
- The retail sector needs information and direction on the storage, handling and display of sprouts as evident by inappropriate retail vegetable display temperatures identified during the survey.
- Consumers require information on how to maintain and use sprouts in a safe manner.

What can be done to achieve the safety and quality of sprouts

This survey and experience from other countries have adequately demonstrated the potential risks associated with sprouts. Current horticultural and agricultural practices cannot eliminate microbiological risks, as the very nature of sprout production is conducive to the growth of microorganisms with no bactericidal process involved.

However, EHOs and industry together can improve standards and reduce the risks to public health.

Growers -

Introduce good manufacturing practice principles across industry.

- Select and use seeds from growers with horticultural practices that minimize bacterial contamination and loading.
- Adopt transportation and storage conditions and practices to minimize further contamination.
- Use sanitizers appropriate for the task at various stages of sprout production.
- Adopt a policy of continuous process review and improvement based on HACCP principles
- Regular microbiological testing for pathogen on seeds and product.
- Ensure adequate labelling on packaged sprouts detailing storage and handling instructions.
- Enable trace-back of products through batch codes.
- Detail handling and care instructions for consumers.

Retailers -

- Follow storage and handling instructions on sprouts.
- Maintain safe temperatures in storage and display compartments.
- Maintain good food safety practices, cleaning, removing damaged stock, stock rotation, etc.

Consumers -

- Purchase sprouts as the need arise – avoid long storage even in the refrigerator.
- Consume sprouts within the Use-By-Date.

EHOs -

- Inform retailers of the potential problems associated with sprouts and their role in minimizing risks.
- Ensure manufacturers and retailers exercise good food safety practices.
- Consider sprouts as a high risk food when investigating enteric diseases.

Survey participants

Metropolitan local government

Armadale, Bayswater, Cambridge, Cockburn, Fremantle, Gosnells, Joondalup, Kalamunda, Melville, Mosman Park, Mundaring, Nedlands, Perth, Rockingham, Serpentine, South Perth, Stirling, Subiaco, Swan, Victoria Park, Vincent.

Country local government

Bunbury, Busselton, Capel, Carnarvon, East Pilbara, Gerladton, Harvey, Kalgoorlie,

Kellerberin, Mandurah, Murray, Port Hedland, Roebourne.

PathCentre – Food Hygiene Laboratory

Curtin University of Technology
(staff and students)

Sprouts growers of Western Australia
Health Department of Western Australia

For more information on the survey and the production of sprouts contact

Walter Arrow, WA Health Department
Telephone: 08 9388 4921
Email: walter.arrow@health.wa.gov.au

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Food Surveillance Newsletter welcomes your enquiries and suggestions. Please contact Tony Johnson, Monitoring and Evaluation

Telephone (02) 6271 2222
Facsimile (02) 6271 2278
Email info@anzfa.gov.au

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