FOOD WATCH
WESTERN AUSTRALIAN FOOD MONITORING PROGRAM

Microbiological Guidelines for Ready-to-Eat Foods

*The Australia New Zealand Food Authority Food Standards Cod*e (the Code) details microbiological standards for some foods at the point of manufacture, including smallgoods, ice-cream and cheese. The Code is not comprehensive and does not reference all food poisoning bacteria. In addition, no guidance is provided by the Code for ready-to-eat foods such as sandwiches, cakes, salads and meals at the point of sale.

This makes it difficult for food businesses, food safety auditors and Environmental Health Officers (EHOs) to assess the safety of food in the marketplace.

The Microbiological Guidelines for Ready-to-Eat Foods has been developed by the Western Australian Food Monitoring Program to provide microbiological levels of acceptability and to describe appropriate actions necessary to protect public health.

These quidelines are loosely based on those produced by the Public Health Laboratory Service in the United Kingdom (Gilbert 1992). They provide valuable information to food businesses that will support development of suitable food safety programs, for example FoodSafe Plus.

Food safety auditors can also use the Guidelines to check that food safety programs are working and food produced is safe to eat.

EHOs can use the Guidelines to assess food safety standards through surveillance of particular foods and as part of food complaint and food poisoning investigations.

The Guidelines evaluate results of microbiological tests routinely used to assess the safety of food and should be read in conjunction with the Special Notes on page 2.

The Bacteria Fact File overleaf explains why specific bacteria are of concern to public health and why they are monitored in particular industries.

Food handling tests

Two microbiological tests are commonly used in the food industry to establish the adequacy of food handling as a trend over time. These are:

- The Standard Plate Count (SPC). This counts all bacteria present in a food, both good and bad. Therefore foods made using bacterial cultures can naturally have a high SPC. This test is sometimes called a Total Plate Count (TPC).
- The Total Coliform Count (TCC). Coliforms are found in faeces of animals and humans and also in soil and on plants. Not all types cause food poisoning.

The tests indicate that conditions are suitable for microbiological growth and can be used to assess whether food has:

- ✗ Been stored out of refrigeration for a prolonged period
- ✗ Not been properly cooked
- ✗ Been contaminated after cooking.

A high SPC with a high TCC may indicate that a food has not been cooked properly and/or may have been contaminated from poor food handling.

A high SPC and low TCC may indicate poor refrigeration during storage.

A low SPC with a high TCC may indicate possible cross-contamination between raw and cooked foods.

As a general guide, a SPC of less than one million and a TCC of less than 100 are considered satisfactory. However, these levels are not appropriate for some foods, for example salami, and the advice of a food microbiologist should be obtained for an accurate interpretation.

The SPC and TCC are best used to monitor trends over time. For example, if results of weekly samples are rising, then they may indicate a problem is developing.

Guidelines for ready-to-eat foods

The following guidelines are used to assess the microbiological safety of foods and should be read in conjunction with the 'Special Notes'.

Test Type	*Satisfactory*	*Fairly Satisfactory*	*Unsatisfactory*	*Unacceptable*
	Unlikely to cause disease.	*Unlikely to cause disease. Indicate possible hygiene problems with food handling preparation.*	*May cause disease in some people. Food not manufactured hygienically.*	*Likely to cause disease in most people.*
	Action: Nil.	*Action: If these results are produced regularly, examine hygiene and handling practices.*	*Action: Investigate production practices.*	*Action: Withdraw any food still on sale. Follow up any known contacts. Investigate production practices.*
Bacillus cereus	**Less than 100/g**	**Between 100 and 1000/g**	**Between 1000 and 10 000/g**	**More than 10 000/g**
Campylobacter spp.	**Not detected in 25g**	—	—	**Present in 25g**
Clostridium perfringens	**Less than 100/g**	**Between 100 and 1000/g**	**Between 1000 and 10 000/g**	**More than 10 000/g**
Escherichia coli (E. coli)	**Less than 10/g**	**Between 10 and 70/g**	**More than 70/g**	**Contains verotoxigenic** *E. coli*
Listeria monocytogenes (At point of manufacture)	**Not detected in 25g**	—	**Less than 10/g**	**More than 10/g**
Listeria monocytogenes (At retail)	**Not detected in 25g**	**Less than 10/g**	**Between 10 and 100/g**	**More than 100/g**
Salmonella spp.	**Not detected in 25g**	—	—	**Present in 25g**
Coagulase positive Staphylococcs	**Less than 100/g**	**Between 100 and 1000/g**	**Between 1000 and 10 000/g**	**More than 10 000/g**
*Vibrio parahaemolyticus**	**Not detected in 25g**	—	**Less than 1000 in 25g**	**More than 1000 in 25g**

***Levels indicated are for Kanagawa Positive strains of** *Vibrio parahaemolyticus* **in uncooked mollusc. Cooked seafood should not contain** *Vibrio parahaemolyticus* **in 25g of food.**

Special notes

1. Two acceptability guidelines for *Listeria monocytogenes* have been set. The first is for ready-to-eat foods at point of manufacture and the second is for the same food at point of sale.
2. Ready-to-eat foods should be free of Verotoxigenic *E. coli* regardless of the serotype. Verotoxigenic *E. coli* such as O157:H7 are believed to have an infective dose of only 10 organisms.
3. The guideline levels for *Vibrio parahaemolyticus* are for Kanagawa positive strains in uncooked mollusc. It is recommended that all *V. parahaemolyticus* be typed for Kanagawa Reaction as Kanagawa negative strains appear to be non-virulent (Twedt 1989). Cooked ready-to-eat foods should be free of *V. parahaemolyticus* in 25g. The presence of this organism in cooked food indicates that the food was either not cooked properly or not produced under hygienic conditions.
4. When investigating food poisoning outbreaks always take into account epidemiological data and clinical results in addition to the results of food analysis if attempting to establish the source of the outbreak.
5. Micro-organisms are not always evenly distributed in food. Therefore, even if the food falls into the Fairly Satisfactory category it may be the source of infection.

For more information about each type of bacteria see the 'Bacteria Fact File' overleaf.

Bacteria Fact File

The Bacteria Fact File is a quick reference to identify the main features of bacteria that cause most concern in the food industry. It is not a comprehensive guide so advice on particular foods and processes should be obtained from a competent food microbiologist or food technologist.

	Bacteria type			
	Bacillus cereus	*Campylobacter spp.*	*Clostridium perfringens*	*Escherichia coli (E. coli)*
Special features of organism	Produces two types of toxin that cause illness. The toxin causing the *vomiting* type of disease is heat stable. The toxin causing the *diarrhoeal* type of disease is destroyed by heat. Also produces spores that can survive the pasteurisation process.	This is the most commonly reported food poisoning in Australia. The most common species of concern are *Campylobacter jejuni* and, to a lesser extent, *Campylobacter coli.*	Does not need oxygen to grow. Produces spores that survive normal cooking temperatures.	Found in the gastrointestinal tract and are generally harmless except when they are displaced to other parts of the body, e.g. urinary tract or meninges (membranes covering brain and spinal cord) or when they produce toxins. There are five types of *E. coli* that cause diarrhoea or produce toxins. Vero-toxigenic *E. coli* (VTEC), also called haemorrhagic *E. coli* (EHEC), causes most concern. At least 14 different serotypes of VTEC have been isolated so far in Australia, including 0157:H7 and 0111:H8.
Food poisoning symptoms	Two types depending on toxin produced: 1. Emetic – acute vomiting with some diarrhoea starts 1–3 hours after eating contaminated food. 2. Diarrhoeal – diarrhoea starts 9–18 hours after eating contaminated food.	Diarrhoea, abdominal pain, malaise, fever and sometimes nausea and vomiting. Symptoms may start between one and 10 days after eating infected food. There may be blood in the diarrhoea and the abdominal pain can be very severe resembling appendicitis. Some patients require hospitalisation.	Sudden onset of abdominal pain followed by diarrhoea and nausea. Vomiting and fever are usually absent. Symptoms start about 10 hours after eating contaminated food and last for one day or less.	Verotoxigenic *E. coli* causes bloody diarrhoea, abdominal pain and intermittent, irregular fever. It can lead to haemolytic uraemic syndrome (HUS) which causes severe kidney dysfunction. Some patients have required kidney dialysis and others have died from this severe disease.
Where is it found?	Cereals and other foods, e.g. rice, cornflour, milk. Dust and soil.	Animals, most frequently cattle, poultry, puppies and kittens. Particularly found in lakes, water birds and rivers.	Soil and gastrointestinal tract of healthy people and animals (cattle, pigs, poultry and fish).	Cattle and sometimes humans. All mammals have *E. coli* as part of normal gut flora. The toxin-producing *E. coli* may be found in gut flora of cattle, sheep and pigs.
Best growth conditions	Temperature range: 4–55°C, optimum 30–40°C. pH range: 5.0–8.8, optimum 6.0–7.0. A_W: Minimum = 0.93. Cooking stimulates germination of spores. If foods are kept warm the newly germinated bacteria will multiply.	Temperature range: 32–45°C, optimum 42–43°C. pH range: 4.9–9.0, optimum 6.5–7.5. A_W: Minimum = 0.987, optimum 0.997. Warm, moist conditions.	Temperature range: 12–50°C, optimum 43–47°C. pH range: 5.5–9.0, optimum 7.2. A_W: Minimum = 0.93, optimum 0.95–0.96. Anaerobic conditions – does not need oxygen.	Temperature range: 7–46°C, optimum 35–40°C. pH range: 4.4–9.0, optimum 6.0–7.0. A_W: Minimum = 0.95, optimum 0.995. Warm, moist conditions at temperatures closely resembling the human body, i.e. 37°C.
Some ways to prevent it being a problem	❑ Store cooked rice or milk products below 5°C or above 60°C. ❑ After cooking, cool food quickly, i.e. food at 60°C should be cooled to 21°C within two hours, and then further cooled to 5°C within the next four hours. ❑ Store milk products below 5°C.	❑ Cook foods thoroughly, i.e. cook to at least 70°C for two minutes (internal temperature). ❑ Keep raw food separated from cooked food. ❑ Keep food covered, especially in coolroom. ❑ Avoid cross-contamination of foods by equipment, utensils, hands, etc.	❑ Avoid inadequately heated or reheated meats, e.g. stews, meat pies and gravies made of beef, turkey or chicken. ❑ Cook foods thoroughly, i.e. cook to at least 70°C for two minutes (internal temperature). ❑ Store hot foods above 60°C.	❑ VTEC is commonly transmitted by poorly cooked or processed beef products, e.g. burgers, salami, etc. ❑ Cook foods thoroughly, i.e. cook to at least 70°C for two minutes (internal temperature). ❑ VTEC is also transmitted through foods contaminated with manure, e.g. salad vegetables, apple juice, etc., so wash thoroughly. ❑ Always use new cultures to make yogurts, salamis, etc.

NOTE: *Shigella spp,* Hepatitis A and *Giardia spp*. These enteric pathogens may also be transmitted in food and are often associated with a contaminated food handler or personal contact.

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	Bacteria type			
	Listeria monocytogenes	*Salmonella spp.*	*Staphylococcus aureus*	*Vibrio parahaemolyticus*
Special features of organism	These resilient bacteria can multiply slowly at refrigerated temperatures, doubling in number every 1–2 days at 3ºC. *Listeria* bacteria multiply most quickly between 25 and 30ºC (room temperature). Laboratory may analyse a sample for *Listeria* species in general and not specifically for *Listeria monocytogenes*. As some species of *Listeria* do not cause disease and are harmless, it is important to establish the type and, if found to be *Listeria monocytogenes*, the most probable number present. Therefore, when a sample contains *Listeria monocytogenes*, request the laboratory to perform a Most Probable Number (MPN) test on the sample. There are many serotypes of *Listeria monocytogenes* that cause disease, including types 1/2a, 1/2b and 4b. Type 4b is responsible for most human illness.	There are over 2000 serotypes of *Salmonella* that are capable of causing food poisoning, the most common being *S. typhimurium*. Salmonellosis is the second most commonly reported notifiable food poisoning disease in Australia.	Some strains of *Staphylococcus aureus* produce heat-stable toxins. The more *Staphylococcus aureus* bacteria present, the more toxin is produced.	Salt tolerant and is commonly associated with seafood. In the laboratory, disease-causing strains of *Vibrio parahaemolyticus* produce a characteristic haemolytic reaction (the Kanagawa reaction). Therefore only Kanagawa positive results are of concern.
Food poisoning symptoms	Listeriosis is an uncommon disease with symptoms that resemble flu with mild fever. This may lead to meningo-encephalitis and/or septicaemia with symptoms including intense fever, intense headache, nausea and vomiting. Up to one-third of cases have resulted in fatalities. People at highest risk are the newborn, elderly, and immuno-compromised including alcoholics and pregnant women. In pregnant women the infection can be transferred to the foetus. The infant may be stillborn, born with septicemia or develop meningitis.	Symptoms start between 6 and 72 hours after eating contaminated food, usually about 12–36 hours. Symptoms include fever, headache and general aching of the limbs, diarrhoea and some vomiting.	Symptoms are produced when the toxin is ingested. Symptoms may start between 2 and 6 hours after eating contaminated food and include severe vomiting, with diarrhoea, abdominal pain and cramps, sometimes followed by collapse.	Symptoms start about 12–24 hours after eating infected food and include watery diarrhoea and abdominal cramps sometimes with nausea, vomiting, fever and headache and occasionally bloody stools.
Where is it found?	*Listeria monocytogenes* is found commonly in the environment, e.g. in animal forage, water, mud, silage, infected domestic and wild mammals, fowl and humans. High-risk foods include pate, smallgoods, soft cheeses, cooked diced chicken and pre-prepared salads.	Salmonella is a normal gut organism in many animals. During slaughter, bacteria from gut contents and faeces can contaminate the meat. Vegetables and drinking water may be contaminated by excreta, sewage and manure.	In skin glands, mucous membranes, i.e. nose, throat, cuts, and boils of humans and all warm-blooded animals.	In seafood, coastal marine environments, intestines of marine animals.
Best growth conditions	Temperature range: -0.4–45ºC, optimum 37ºC. pH range: 4.39–9.4, optimum pH 7.0. A_W: Minimum = 0.92. It is possible for ready-to-eat foods, e.g. pate, cooked diced chicken, smallgoods, prepared salads and cheese products to contain levels of *Listeria* at the factory which are not detectable by microbiological analysis. Organisms may have time to multiply during the food's transport, storage and display. This is why there are separate guideline levels for point of manufacture and retailer.	Temperature range: 5.2–46.2ºC, optimum 35–43ºC. pH range: 3.8–9.5, optimum 7.0–7.5. A_W: Minimum = 0.94, optimum 0.99.	Temperature range: 7–48ºC, optimum 37ºC. pH range: 4.0–10.0, optimum 6.0–7.0. A_W: Minimum = 0.83, optimum 0.98.	Temperature range: 5–43ºC, optimum 37ºC. pH range: 4.8–11.0, optimum 7.8–8.6. A_W: Minimum = 0.940, optimum 0.981. Requires a minimum 0.5% salt environment.

Some ways to prevent it being a problem	❑ Cook foods thoroughly, i.e. cook to at least 70ºC for two minutes (internal temperature).
	❑ Avoid sources of cross-contamination between raw and cooked foods, for example:
	  ❑ Use separate cutting boards and utensils for cooked and raw food.
	  ❑ Cover all stored food.
	❑ Manufacturers of ready-to-eat foods with products remaining in the distribution system for more than a few days should:
	  ❑ Separate cooked and raw processes completely.
	  ❑ Use separate equipment in each area.
	  ❑ Routinely test end product for *Listeria monocytogenes*.
	  ❑ Ensure product is kept below 5ºC at all times (e.g. during storage, transport and display).
	  ❑ Calculate use-by dates so that if low numbers (undetectable at the factory) multiply during the food cold chain, levels will not reach 100 under recommended storage conditions. Also allow a safety margin for temperature abuse.
	  ❑ Ensure the destination of every batch is recorded to facilitate a food recall if necessary.
		❑ Cook meats and eggs thoroughly.
		❑ Avoid sources of cross-contamination between raw and cooked foods, e.g.
		  ❑ Use separate cutting boards and utensils for cooked and raw food.
		  ❑ Cover all stored food.
		  ❑ Wash salads and vegetables before use.
			❑ Practise good personal hygiene, e.g. thorough handwashing, cover cuts/wounds, etc.
			❑ Store all high-risk foods below 5ºC or above 60ºC.
				❑ Obtain raw seafood from suppliers who have a food safety program in place and monitor the microbiological status of seafood-growing areas.
				❑ Avoid use of seawater in foodhandling areas, e.g. cruise ships.

NOTE: *Shigella spp*, Hepatitis A and *Giardia spp*. These enteric pathogens may also be transmitted in food and are often associated with a contaminated food handler or personal contact.

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http://www.anzfa.gov.au
http://www.foodsafety.gov

For more information contact:

Food Hygiene Laboratory
PathCentre
QEII Medical Centre
Nedlands WA 6009

Tel: (08) 9346 2165
Fax: (08) 9346 3960

or

Food Safety
Environmental Health Service
PO Box 8172
PERTH BUSINESS CENTRE WA 6849

Tel: (08) 9388 4999
Fax: (08) 9388 4955

WA Food Monitoring Program
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