



# Microbiological quality guide for ready-to-eat foods

A guide to interpreting microbiological results

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## Summary

The NSW Food Authority's monitoring and surveillance program (ie survey program) often involves the collection and microbiological analysis of samples for which there are no maximum permissible levels stated in food legislation.

Many prepared ready-to-eat foods are such an example and the NSW Food Authority uses the guidelines in this document for safety and quality assessments of this food group. These guidelines identify four categories of microbiological quality for ready-to-eat foods and the follow-up actions appropriate for each category. The guidelines apply to food that is expected to be consumed by the general population. The categories and subsequent action or activities are summarised in the table below.

	<b>Result category</b>	<b>Interpretation</b>	<b>Action</b>
<b>Pass</b>	Good	Results are within expected microbiological levels for this type of product (lower range) and present no food safety concern.	None
	Acceptable	Results are within expected microbiological levels for this type of product (upper range) and present no food safety concern.	None
<b>Fail</b>	Unsatisfactory	Results are outside the expected microbiological levels for this type of product, present no food safety concern, but might indicate poor food handling practices.	Further samples are taken for testing. If these return good or acceptable results no action is taken. If these return unacceptable results the business is inspected to determine if food handling controls and hygiene practices are adequate. A product withdrawal may be considered while further testing occurs.
	Potentially hazardous	Results are outside of the expected microbiological levels for this type of product and present a potential food safety concern.	Inspect supplier to determine if food handling controls and hygiene practices are adequate; consider a product recall.

## Introduction

Standard 1.6.1 of the Australia New Zealand Food Standards Code lists the maximum permissible levels of indicator organisms<sup>1</sup> such as standard plate count, coliforms and *E. coli* and also foodborne microorganisms that pose a risk to human health in nominated foods, or classes of foods.

Ready-to-eat food is not a nominated food or class of food within Standard 1.6.1. This product group is defined as:

*Food that is ordinarily consumed in the same state as that in which it is sold and does not include nuts in the shell and whole, raw fruits and vegetables that are intended for hulling, peeling or washing by the consumer<sup>2</sup>.*

Some ready-to-eat foods also are regarded as 'potentially hazardous'. Such foods can support the growth of pathogenic (food poisoning) bacteria and must be kept at certain temperatures to minimise the growth of any pathogens that may be present in the food or to prevent the formation of toxins in the food.

There is a wide variety of ready-to-eat foods. Examples include, but are not limited to, sandwiches, kebabs, sushi, takeaway foods and bakery products. Ready-to-eat foods usually include a number of ingredients which may or may not be cooked. Due to the variety of ready-to-eat foods, the interpretation of microbiological results obtained from testing must account for the method of processing and the individual components of the food.

To assist with interpreting the microbiological analyses of such foods as part of our monitoring and surveillance program (ie surveys), the NSW Food Authority uses criteria that are based on interpretive guides published by the United Kingdom's Health Protection Agency and by Food Standards Australia New Zealand (FSANZ).

### Purpose and scope

The purpose of this document is to:

- outline the criteria used by the NSW Food Authority to guide assessments of the microbiological quality for ready-to-eat foods,
- provide an indication of the type of follow-up actions taken in response to findings, and
- assist with communicating science and survey results to food businesses and consumers.

The guide applies to those samples taken as part of our monitoring and surveillance program from foods that have been prepared for consumption by the general population.

There may be different criteria for foods consumed by vulnerable populations, such as immunocompromised individuals, infants and pregnant women. Likewise, results for food samples taken as part of a food incident investigation will be interpreted with regard to specific circumstances. This guide can provide useful background but all relevant information should be considered.

The guide is not intended to be used for food products or types that are covered by existing legislative requirements such as those stated within the Australia New Zealand Food Standards Code developed by FSANZ or Safety Manuals developed by the NSW Food Authority. Further information on these requirements can be found at each agency's website, [www.foodstandards.gov.au](http://www.foodstandards.gov.au) and [www.foodauthority.nsw.gov.au](http://www.foodauthority.nsw.gov.au).

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<sup>1</sup> Indicator organisms are groups of microorganisms that are used to assess the hygienic status of food. Their presence does not necessarily indicate the presence of pathogenic microorganisms.

<sup>2</sup> Standard 3.2.2 of the Australia New Zealand Food Standards Code definition of ready-to-eat food.

## Microbiological testing

Foods may contain a variety of microorganisms, many of which are harmless. Even those that can cause illness can be present in foods at low levels and if this food is consumed, illness is unlikely. In addition, some foods, such as fermented foods like cheese and yoghurt, contain beneficial microorganisms. As such, when deciding on the type of analysis to perform it is important to understand the food and how it is produced.

### Choice of tests

As ready-to-eat foods vary widely, the decision on what to test will vary from product to product. Some of the factors influencing the choice of test include:

- Type of ingredients in the finished product
- Status of ingredients (ie cooked vs raw)
- Type of cooking/processing undertaken
- Level of handling after cooking or processing
- Presence of preservatives, including acids and salt
- Presence and type of packaging
- Distribution and storage of finished product

Below is a brief discussion on the most common tests performed on ready-to-eat foods and their relevance to different types of product and ingredients. This discussion does not provide an in-depth analysis of the testing methods or foodborne pathogens. The reference section in this document lists relevant texts where further information is available.

### Standard plate count

Standard plate count (also referred to as aerobic plate count or total plate count) can provide a general indication of the microbiological quality of a food. A standard plate count will not differentiate between the natural microflora of a food, spoilage microorganisms, organisms added to fermented foods or pathogenic microorganism. It can not be used to predict the safety of the product and will be influenced by the storage conditions of the product. Depending on the product, a high standard plate count may indicate that the product may have been prepared unhygienically or stored inappropriately. When assessing standard plate count results (Table 1), the processing and/or ingredients present in the foods needs to be considered. Using this information, foods can be divided into three groups:

Category A – applies to ready-to-eat foods in which all components are fully cooked for immediate sale or consumption (eg meat pie)

Category B – applies to ready-to-eat foods that are fully cooked with further handling or processing before consumption (eg custard filled pastry)

Category C – food that contained uncooked fermented ingredients or fresh fruit and vegetables (eg takeaway fruit and yoghurt mix)

Assessing a standard plate count result requires knowledge of the food and processing conditions. Care should be taken when assessing a single result as series of results over time generally provide a better understanding. Individual survey reports will justify the undertaking (or not) of a standard plate count test.

### Indicator organisms

#### *Enterobacteriaceae*

*Enterobacteriaceae* are a group of bacteria that can be found in many environments. Some *Enterobacteriaceae* can be found in the intestinal tract of humans and animals. They can also be found in soil, vegetable matter and marine environments. The group includes both pathogenic and non-pathogenic bacteria.

In ready-to-eat foods that are fully cooked, *Enterobacteriaceae* are used as an indication of either post-processing contamination or inadequate cooking.

As they can be found in raw foods, their detection may not be an indication of any processing failure. As such it would be inappropriate to test ready-to-eat foods containing raw components (particularly fresh fruits and vegetables) for *Enterobacteriaceae*.

#### *Escherichia coli*

*E. coli* is an organism that is part of the normal microflora of the intestinal tract of humans and warm-blooded animals. As such, their presence in ready-to-eat foods (fully cooked or those containing raw fruits or vegetables) can be an indication of poor hygiene and sanitation or inadequate heat treatment.

### Pathogens

#### Coagulase positive staphylococci (CPS)

*Staphylococcus aureus* can be routinely isolated from humans and associated environments. As such, the presence of coagulase positive staphylococci (a subgroup of *S. aureus*), is an indication of human contact. Some CPS strains produce a toxin which can cause food poisoning. Even minimal handling of foods can result in coagulase positive staphylococci being present in foods at low levels. This is unlikely to be a food safety concern provided the food is either consumed immediately or stored under temperature control. Extensive handling and/or temperature abuse may result in increased levels and increased food safety risk if toxin production occurs.

In raw or fermented foods, coagulase positive staphylococci are likely to be outgrown or inhibited by the naturally occurring microorganisms. In fully cooked foods that support the growth of coagulase-positive staphylococci, the absence of competing microorganisms may provide the opportunity for growth and toxin production. Coagulase-positive staphylococci appear to be of greatest concern in products such as custard or cream-filled pastries, mayonnaise-based salads and processed meats.

#### *Clostridium perfringens*

*C. perfringens* can be isolated from a variety of environments and foods. As the spores of *C. perfringens* can survive cooking, it is of most concern in cooked foods that have been temperature abused as this provides the opportunity for spores to germinate and grow. Potential temperature abuse scenarios include:

- holding cooked foods at warm temperatures for extended periods of time, and
- cooling foods too slowly.

*C. perfringens* is of particular concern for cooked meats (large joints or rolled meats), gravy and meat and vegetable dishes such as stews and pies. *C. perfringens* can be present in herbs and spices and where these are added after cooking low levels of *C. perfringens* may be detected. As *C. perfringens* can be present in a variety of foods, their detection at low levels in foods with raw components is not unexpected.

#### *Bacillus cereus*

*B. cereus* can be detected in many raw foods of plant origin and in raw milk. As with *C. perfringens*, their spores will survive cooking, and poor temperature control after cooking may result in germination of the spores and subsequent growth. *B. cereus* is of greatest concern in plant or cereal based ready-to-eat foods and cream based sauces. Ready-to-eat foods containing raw components may contain low levels of *B. cereus*.

### *Vibrio parahaemolyticus*

*V. parahaemolyticus* is present in the marine environment and is of relevance to foods containing seafood. It is common for raw seafood to contain low levels of *V. parahaemolyticus* and this would not be an indication of poor food processing practices. Effective cooking of seafood will destroy *V. parahaemolyticus* and their presence in cooked food may be an indication of post-cooking contamination or insufficient heat treatment.

### *Campylobacter*

*Campylobacter* can be found in the intestinal tract of wild and domesticated animals. They can be found in raw meats and poultry and have been known to be present on eggs and in raw milk and untreated water. In ready-to-eat foods the presence of *Campylobacter* may be an indication of undercooking or cross contamination due to poor hygiene practices, especially poor handling of raw and cooked animal products.

### *Salmonella* species

*Salmonella* species are enteric bacteria and can be found in the intestinal tract of animals, including birds. As such, *Salmonella* can frequently be isolated from raw foods of animal origin. Environmental contamination can also result in *Salmonella* being present in a wide variety of foods, although generally at lower numbers. Their presence in ready-to-eat foods may be a result of undercooking, poor handling practices and cross contamination. *Salmonella* can occasionally be isolated from fresh fruit and vegetables, and these may be a source of contamination when included in ready-to-eat food.

### *Listeria monocytogenes*

*L. monocytogenes* is widespread in the environment and can be isolated from a wide variety of foods. As such it can be expected to be present in ready-to-eat foods that contain raw ingredients. The risk posed by *L. monocytogenes* is dependent on the food and how long it is stored. Prior to interpreting results (Table 1), the food should be categorised as follows:

- Food Group 1 – ready-to-eat foods that will support the growth of *L. monocytogenes* and has been stored prepared for greater than one day (eg packaged sandwiches),
- Food Group 2 – ready-to-eat food that will not support the growth of *L. monocytogenes* and has been stored prepared for greater than one day (eg salads and dips with a low pH), or
- Food Group 3 – ready-to-eat food that will be consumed immediately and has not been stored prepared for greater than one day (eg freshly made sushi).

## Guideline levels for microorganisms

The following table (Table 1) has been developed based on the guidance documents developed by both the UK Food Protection Agency and FSANZ. The table provides guidance on the status of the food, although other factors may need to be considered prior to determining further action. This is further detailed in the next section.

**Table 1: Guideline levels for determining the microbiological quality of ready-to-eat foods**

Test	Microbiological result (cfu/g unless otherwise stated)			
	Good	Acceptable	Unsatisfactory	Potentially hazardous
Standard Plate Count				
Category A	<10 <sup>4</sup>	<10 <sup>5</sup>	≥10 <sup>5</sup>	N/A
Category B	<10 <sup>6</sup>	<10 <sup>7</sup>	≥10 <sup>7</sup>	N/A
Category C	N/A	N/A	N/A	N/A
Indicators				
<i>Enterobacteriaceae</i>	<10 <sup>2</sup>	10 <sup>2</sup> to <10 <sup>4</sup>	≥10 <sup>4</sup>	N/A
<i>E. coli</i>	<3	3 to <10 <sup>2</sup>	≥10 <sup>2</sup>	N/A
Pathogens				
Coagulase +ve staphylococci	<10 <sup>2</sup>	10 <sup>2</sup> to <10 <sup>3</sup>	10 <sup>3</sup> to <10 <sup>4</sup>	≥10 <sup>4</sup>
<i>C. perfringens</i>	<10 <sup>2</sup>	10 <sup>2</sup> to <10 <sup>3</sup>	10 <sup>3</sup> to <10 <sup>4</sup>	≥10 <sup>4</sup>
<i>B. cereus</i>	<10 <sup>2</sup>	10 <sup>2</sup> to <10 <sup>3</sup>	10 <sup>3</sup> to <10 <sup>4</sup>	≥10 <sup>4</sup>
<i>V. parahaemolyticus</i>	not detected in 25 g	If detected then as per below		
	<3	3 to <10 <sup>2</sup>	10 <sup>2</sup> to <10 <sup>4</sup>	≥10 <sup>4</sup>
<i>Campylobacter</i> spp	not detected in 25 g			detected in 25 g
<i>Salmonella</i> spp.	not detected in 25 g			detected in 25 g
<i>L. monocytogenes</i>				
Food Group 1	not detected in 25 g			detected in 25 g
Food Group 2	not detected in 25 g	detected but <10 <sup>2</sup>		≥10 <sup>2</sup>
Food Group 3	not detected in 25 g	detected but <10 <sup>2</sup>		≥10 <sup>2</sup>

## Categories of microbiological quality

Based on the potential food safety risk, and using information from guidance documents, the interpretation and potential action for each of the categories of microbiological quality is presented in Table 2. Good or acceptable results will be considered as passing the microbiological guidelines and no further action will be required, while unacceptable and potentially hazardous results would fail the guidelines with further action and activities needed.

**Table 2: Potential action based on the microbiological category of ready-to-eat foods**

	<b>Result category</b>	<b>Interpretation</b>	<b>Action</b>
<b>Pass</b>	Good	Results are within expected microbiological levels for this type of product (lower range) and present no food safety concern	None
	Acceptable	Results are within expected microbiological levels for this type of product (upper range) and present no food safety concern	None
<b>Fail</b>	Unsatisfactory	Results are outside the expected microbiological levels for this type of product, present no food safety concern, but might indicate poor food handling practices	Further samples are taken for testing. If these return good or acceptable results no action is taken. If these return unacceptable results the business is inspected to determine if food handling controls and hygiene practices are adequate. A product withdrawal may be considered while further testing occurs.
	Potentially hazardous	Results are outside of the expected microbiological levels for this type of product and present a potential food safety concern	Inspect supplier to determine if food handling controls and hygiene practices are adequate; consider withdrawal of the product from sale

## References

Food Standards Australia New Zealand (2001). Guidelines for the microbiological examination of ready-to-eat foods. Retrieved June 10 2009 from, [http://www.foodstandards.gov.au/\\_srcfiles/Guidelines%20for%20Micro%20exam.pdf](http://www.foodstandards.gov.au/_srcfiles/Guidelines%20for%20Micro%20exam.pdf).

Gilbert, R.J. et al. (2000). Guidelines for the microbiological quality of some ready-to-eat foods samples at the point of sale. *Communicable Disease and Public Health* 3, 163-167.

Hocking, A.D (ed.) (2003). Foodborne Microorganisms of Public Health Significance (6<sup>th</sup> edition). Waterloo: Australian Institute of Food Science and Technology.

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