



# Food Safety Survey Report

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**Government  
of South Australia**

SA Health

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# Food Safety Survey Report

## **Cook Chill - Ready to heat and eat meals with extended shelf life June 2017**

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An investigation survey to measure microbiological integrity of extended life cook chill ready to heat and eat meals manufactured and sold in South Australia

### **Aims & Scope of the Investigation**

The purpose of this survey was to assess the microbiological integrity of extended shelf life (> 10 days) packaged cook chill meals (commonly known as ready meals or convenience meals).

Cook chill process refers to the food manufacturing process where food items are prepared and chilled in advance. They are then stored under refrigeration and may require reheating before consumption by the consumer. It includes packaged convenience meals (e.g. meals with pasta, rice, vegetables, meat etc.), curries, soups, pizzas, lasagne and similar products. It does not include shelf stable ready to eat meals or frozen meals or ready to eat foods (e.g. salad items, cheese etc.).

Samples were collected from various supermarkets and retail stores within Adelaide and surrounding suburbs. The intent of the survey was to identify that meals available for sale are safe and suitable and ensure that the process undertaken to produce these meals is suitable. SA Health worked in collaboration with the manufacturing businesses where unsatisfactory microbiological results were identified, to educate businesses and improve their skills and knowledge. Initially only South Australian (SA) produced products were sampled as part of this survey. Interstate products were also sampled later to compare the test results with SA products.

### **Background of the Survey**

Increasingly busy lifestyles have contributed to a higher demand for convenience meals in Australia. They are now a common item on the supermarket shelves. The high demand has generated a new market segment and increase in the number of facilities like restaurants and caterers expanding their product range to include cook chill meals with extended shelf life. These products are generally exposed to anaerobic conditions by vacuum or modified atmosphere pack (map) packaging which reduces the growth of spoilage microorganisms by reducing the availability of oxygen. However the risk of pathogens like *Clostridium botulinum* and *Listeria monocytogenes* is increased because anaerobic conditions favour the growth of these bacteria.

In general, cook chill products have a good safety record. Historically, food businesses with larger production facilities and appropriate infrastructure have been involved in cook chill production. Most recently though, there has been a shift in small food service businesses entering this arena.

In the last financial year SA Health was involved in the investigation of some food service businesses that were manufacturing extended shelf life cook chill meals. Investigation of their manufacturing processes identified that the operators did not have adequate technical skills and knowledge to understand the food safety risks associated with the cook chill process and lacked the required infrastructure. Sampling of the products also confirmed the food safety risk was not managed effectively. This led to the decision to conduct a state-

wide survey to assess the microbiological integrity of these products to determine if a potential risk to public health exists and evaluate skills and knowledge of food handlers. Appropriate actions could then be taken to ensure only safe and suitable food are being provided by this sector.

## **Extended Shelf life Cook Chill Meals and Microbiological Safety**

Cook chill meals can be categorised into short shelf life or extended shelf life products. Extended shelf life cook chill meals have a shelf life longer than 10 days while short shelf life products have a maximum shelf life of 10 days. A typical extended shelf life cook chill process involves cooking, aseptic packaging, chilling, storage and distribution under refrigeration. Aseptic packaging for these products involves a cooked product packaged in clean hygienic packaging in a clean and hygienic environment followed by immediate sealing to prevent any post process contamination. Generally hot filling or MAP (modified atmosphere packaging)/ vacuum packaging techniques are used for aseptic packaging and to create anaerobic environment in order to extend shelf life.

Cooking reduces most of the vegetative cells but spores such as *Bacillus cereus* and *Clostridium botulinum* can still survive the cooking process. Therefore temperature is very important to prevent multiplication of these microorganisms. *B. cereus* needs oxygen to grow therefore growth of these bacteria is limited in anaerobic environment. *Cl. botulinum* is considered the main target organism to control for extended shelf life product because it can grow in anaerobic environment and produces a potent toxin. The toxin is very heat resistant and not destroyed by pasteurization or cooking temperatures below 100°C.

*Cl. botulinum* does not grow at or below 3°C. Where storage and distribution temperature cannot be guaranteed to remain below this temperature, products should have the following controls in place to extend the shelf life. These controls should also be combined with aseptic packaging for shelf life extension.

- Minimum heat treatment of 90°C for 10 minutes or equivalent time temperature combination
- pH of 5 or less throughout the food
- A minimum salt level of 5%(aqueous) throughout the food
- A water activity of 0.97 from salt or 0.94 from glycerol or lower throughout the food

## **What was done?**

A total of 98 samples of cook chill meals were purchased from different retail outlets including supermarkets and display sections of manufacturing businesses in Adelaide and surrounding suburbs. Samples were collected from November 2016 to June 2017 and include 15 SA based and 5 interstate manufacturers of cook chill meals. Out of 98 samples 12 samples were manufactured interstate and the remaining 86 were from SA based producers.

All samples were analysed within their stated shelf life by SA Pathology, Food and Environmental Laboratory for the following parameters:

1. pH Value
2. Water Activity

### **Hygiene indicators**

1. *Escherichia coli* (*E. coli*)
2. Standard plate count (SPC)

## Pathogens

1. *Salmonella*
2. *Listeria monocytogenes* (*L.monocytogenes*)
3. *Bacillus cereus* (*B.cereus*)
4. Coagulase-positive *Staphylococci*
5. *Clostridium perfringens*

All cook chill meals tested in this survey are ready-to-eat (RTE) foods, for which there are no specific microbiological standards in the Australian New Zealand Food Standards Code (the Code) except for *L.monocytogenes* . Since July 2014, Standard 1.6.1 Microbiological Limits in foods has included the criteria for *L. monocytogenes* when assessing RTE foods and is based on whether the food can support its growth or not.

Criteria	Specification
RTE foods in which growth of <i>L. monocytogenes</i> will not occur	less than 100cfu/g
RTE foods in which growth of <i>L. monocytogenes</i> will occur	not detected in 25g.

Where insufficient, inadequate or no information exists to demonstrate that growth of *L.monocytogenes* will not occur, a ready meal is considered to support the growth and therefore limit of 'Not Detected' will apply

The FSANZ 'Compendium of Microbiological Criteria for Foods' (Compendium) has been used to assess the microbiological results in this survey. (Table A.)

There are four categories of microbiological quality specified in the guidelines

- **Satisfactory** – Results indicate good microbiological quality
- **Marginal** – Results are within limits of acceptable microbiological quality but may indicate possible hygiene problems in the preparation of the food.
- **Unsatisfactory** – Results are out of acceptable microbiological quality and are indicative of poor hygiene or food handling practices
- **Potentially Hazardous** – The levels in this range may cause food borne illness and immediate remedial action should be initiated.

**Table A. Evaluation Criteria as per FSANZ Compendium**

Microbiological Quality- Colony Forming Unit (CFU) per gram

Test	Microbiological results			
	Satisfactory	Marginal	Unsatisfactory	Potentially Hazardous
<b>Indicators</b>				
<i>Escherichia coli</i>	<3	3-100	Greater than or equal to 100	**
Standard Plate Count	<10 <sup>3</sup>	10 <sup>3</sup> - <10 <sup>5</sup>	≥ 10 <sup>5</sup>	NA
<b>Pathogens</b>				
<i>Bacillus cereus</i>	<10 <sup>2</sup>	10 <sup>2</sup> –10 <sup>3</sup>	10 <sup>3</sup> –10 <sup>5</sup>	Greater than or equal to 10 <sup>5</sup>
<i>Salmonella spp</i>	Not detected in 25g	-	-	detected
Coagulase +ve <i>Staphylococci</i>	<10 <sup>2</sup>	10 <sup>2</sup> –10 <sup>3</sup>	10 <sup>3</sup> –10 <sup>4</sup>	Greater than or equal to 10 <sup>4</sup>
<i>Clostridium perfringens</i>	<10 <sup>2</sup>	10 <sup>2</sup> –10 <sup>3</sup>	10 <sup>3</sup> –10 <sup>5</sup>	Greater than or equal to 10 <sup>5</sup>

\*\* Pathogenic strains of *E.coli* should be absent

**Testing Methods:**

pH	:	PRC-MBI-626
Water Activity	:	PRC-MBI-625
<i>Listeria monocytogenes</i>	:	TECRA AOAC 995.22
<i>E. coli</i>	:	AS 5013.15-2006
Standard Plate Count	:	AS 5013.5-2004
<i>Clostridium perfringens</i>	:	AS 5013.16-2006
<i>Bacillus cereus</i>	:	CCFRA Method 3.7.1-2007
<i>Salmonella spp.</i>	:	TECRA AOAC 995.22
Coagulase +ve <i>Staphylococci</i>	:	AOAC 2003.07, 2003.08, 2003.11

**Summary of Results and Actions:**

During 2016-17, a survey was undertaken to determine the microbiological integrity of cook chill meals with extended shelf life. A total of 98 samples were collected from 15 different food retail premises.

Results Summary: Table B. & Table C.

98 samples tested, 56 samples were deemed satisfactory for all microbiological testing including SPC, pathogens and *E.coli* whereas 42 samples had either marginal or unsatisfactory for these microorganisms. 26 samples were unsatisfactory and 16 samples were marginal for SPC level. Samples which were marginal or unsatisfactory for pathogens or hygiene indicator *E.coli* were also high in SPC. 3 samples had marginal results for *E.coli*; however, no pathogenic strain of *E.coli* was identified. 3 samples had marginal levels of *Bacillus cereus* while 1 sample had unsatisfactory levels (31,000cfu/g) of this spore forming pathogen. 1 sample was detected with marginal levels of *Clostridium perfringens*

*Salmonella* was not detected in any of the survey samples and levels of coagulase positive *Staphylococci* were within satisfactory limits in all samples tested. No pathogen was detected in the potentially hazardous range. Pathogen results of all other noncompliant samples were marginal.

**Table B. Assessment using FSANZ Compendium of Microbiological Criteria for Food**

Microbiological Test	No. of Samples	Microbiological Quality (%)			
		Satisfactory	Marginal	Unsatisfactory	Potentially Hazardous
<i>Standard Plate Count</i>	98	56 (57.14%)	16 (16.33%)	26 (26.53%)	-
<i>Escherichia coli</i>	98	95 (96.93%)	3(3.06%)	-	-
<i>Bacillus cereus</i>	98	94 (95.9%)	3 (3.06%)	1 (1.02%)	-
<i>Salmonella</i>	98	98 (100%)	-	-	-
<i>Coagulase-positive Staphylococci</i>	98	98 (100%)	-	-	-

<i>Clostridium perfringens</i>	98	97(98.97%)	1(1.02%)	-	-
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All samples were compliant with regulatory limits for *L.monocytogenes*.

**Table C. Assessment based on the specification provided in Standard 1.6.1 of the Code**

Microbiological Test	Specification	Total samples tested	No. of samples compliant	No. of samples non-compliant
<i>Listeria monocytogenes</i>	Not Detected in 25g	98	98(100%)	0
<i>Listeria monocytogenes</i>	< 100 *cfu/g	98	98 (100%)	0

\*cfu = colony forming unit

Out of 15 SA based manufacturers whose samples were tested during the survey, two businesses were investigated for high SPC and pathogen detection in their products and resulted in enforcement actions. Another 4 were investigated for reoccurring high SPC counts. Risk was managed by appropriate corrective actions by the business and follow up inspection by local council and SA Health where required.

### **Detailed Discussion of Individual Test**

#### **pH and Water Activity of ready meals:**

pH is a measure of acidity or alkalinity of the food. A pH value is the number from 1 to 14, with 7 as the neutral point; values below 7 indicate acidity and value above 7 indicate alkalinity.

Water activity ( $a_w$ ) refers to unbound or available water i.e. water in food which is not bound to food molecules and can support the growth of bacteria, yeasts and moulds (fungi). The water activity scale extends from 0 (no available water) to 1.0 (pure water).

pH values and  $a_w$  can be used to predict the growth of pathogens in foods. Food can be made safe, and the shelf life extended by lowering the water activity, lowering the pH value, or a suitable combination of the two can be used.

As per Standard 1.6.1 the growth of *Listeria monocytogenes* will not occur in a ready-to-eat food if :

- (a) the food has a pH less than 4.4 regardless of water activity; or
- (b) the food has a water activity less than 0.92 regardless of pH; or
- (c) the food has a pH less than 5.0 in combination with a water activity of less than 0.94

Out of 98 cook chill meal samples analysed, only 6 had pH below 4.4, the remaining 92 samples had pH ranging from 4.4 to 6.5. Similarly, 97 out of 98 samples have  $a_w$  above 0.94. Water activity at this level cannot control the growth of *L.monocytogenes* irrespective of pH values. These results indicate that the majority of cook chill meals support the growth of *L.monocytogenes* therefore the cooking time temperature combination is critical to kill this pathogen and prevent post process contamination.

#### **Table D.**

pH range of cook chill ready meals						
<b>pH Range</b>	4-4.4	4.4-5	5-5.5	5.5-6	6-6.5	Total
<b>No. of Samples</b>	6	21	28	20	23	98

**Table E.**

Water Activity range of cook chill ready meals						
<b>Water Activity</b>	0.92	0.97	0.98	0.99	1.00	Total
<b>No. of Samples</b>	1	5	25	53	14	98

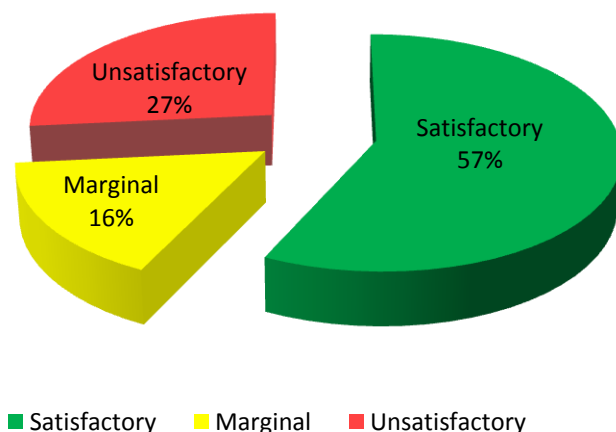
### Standard Plate Count

Standard Plate Count, is an indicator of quality, and cannot directly contribute towards a safety assessment of ready-to-eat food. The significance of SPCs, however, varies markedly according to the type of food product and the processing it has received. High counts in ready to eat meals may suggest under processing, poor temperature control and possible post process contamination. These parameters also affect the growth of pathogens in cook chill products. Therefore if high counts are observed in cook chill products within their stated shelf life, it should be investigated.

Out of 98 samples tested, 56 (57.14%) samples results were satisfactory, 16 (16.33%) were marginal and 26 (26.53%) were unsatisfactory. All the samples high in *E.coli*, *Clostridium perfringens* and *Bacillus cereus*, were also found high in SPC counts. Generally SPC counts increase during storage and reach the peak at the end of shelf life.

22 samples had over 10 day's shelf life remaining. The analysis identified that for all 22 samples, SPC counts were already above satisfactory limits. This indicated that either there was inadequate processing, post process contamination or there was poor temperature controls during processing and storage.

Figure1. Cook chill meal compliance status



### ***Escherichia coli (E.coli)***

*E. coli* is an indicator organism and its presence in ready meals indicates post process contamination due to unhygienic processing and poor handling and storage or using contaminated water at the site.

As per the compendium, the satisfactory counts of *E.coli* for ready to eat foods are “<3cfu/g” and count levels between 3cfu/g to 100cfu/g are considered marginal. Generally a level exceeding 100cfu/g indicates unacceptable level of contamination. If high levels are detected, further typing should be done to identify if the *E.coli* strains are pathogenic or not. Out of 98 samples tested for *E.coli*, the following 3 (3.06%) samples were above the satisfactory limits of *E.coli*.

**Table F.**

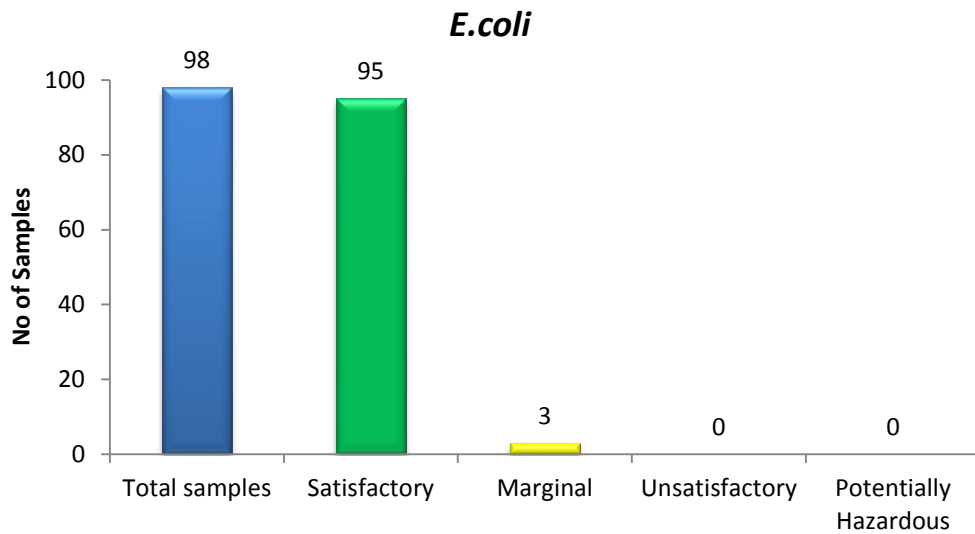
Product Name	pH	aw	<i>E.coli</i> Levels	SPC (cfu/g)	<i>Clostridium Perfringens</i> (cfu/g)
Cannelloni	5.42	0.99	3.6 MPN	12,000	<10
Baramundi and Veg	6.44	1	21 MPN	6,900,000	<10
Yellow chicken curry	6.21	1	38 MPN	2,400,000	120

\*MPN = Most Probable number

All three samples had marginal levels of 3.6cfu/g & 21cfu/g and 38cfu/g. These three samples were further tested to determine the species type. Testing identified that all 3 samples had non-pathogenic forms of *E.coli*.



Figure 2: Cook chill meals compliance for *E.coli*



***Bacillus cereus (B.cereus)***

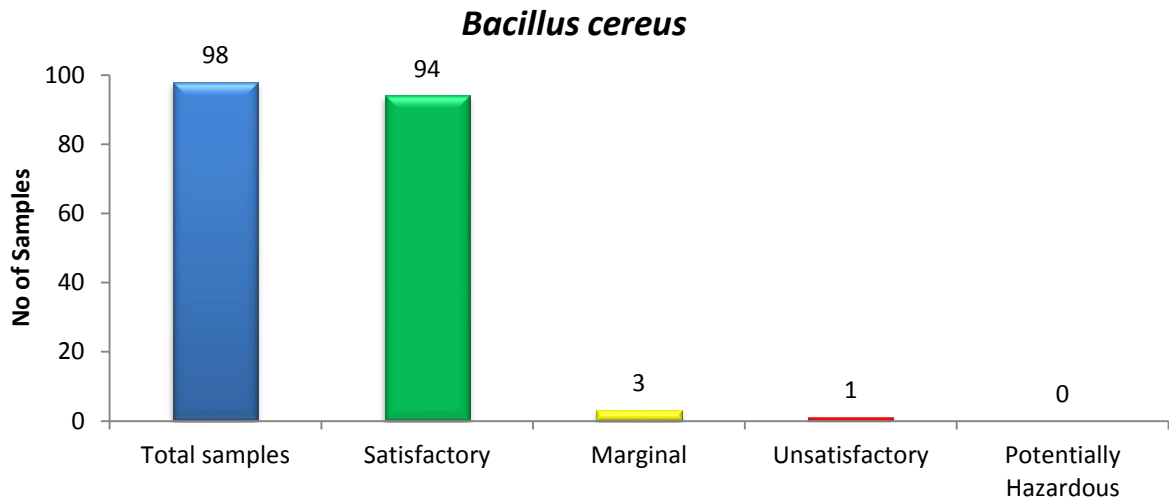
*Bacillus cereus* is a spore forming bacteria that causes food poisoning when cooked food dishes are not cooled correctly. It is typically associated with rice dishes, cereal based products like pasta and noodles or vegetable dishes.

Out of 98 samples tested, results of 3 (3.06%) samples were marginal and 1 (1.06%) sample was unsatisfactory with maximum levels of 31000 cfu/g. Levels in this range indicate possible temperature abuse during cooling and/or storage of the cooked products.

**Table G.**

Product Name	pH	aw	<i>B.cereus</i>	SPC (cfu/g)
Bolognaise Ravioli	5.24	0.99	600	2,000
Scotch Fillet and veg	5.1	1	500	>300,000,000
Alla Pana Sauce	6.3	0.99	31,000	4,200,000
Chargrilled Chicken	6.14	0.99	600	2,200

Figure 3: Ready meal compliance for *Bacillus cereus*



### ***Salmonella***

*Salmonella* is one of the principal causes of foodborne illness worldwide. It is found in eggs, raw milk, meat or poultry. Fruit and vegetables may also be contaminated, from manure based fertilizer, irrigation water, pest in field, dirty harvest equipment, unclean transport containers, dust and people. Cooked ready-to-eat foods can become cross contaminated by transfer of bacteria from raw foods, either by direct contact, or via food preparation surfaces and equipment used for both raw and cooked foods.

*Salmonella* was not detected in any of the 98 samples tested.

### **Coagulase positive *Staphylococci***

*Staphylococcus* is commonly found on the body of healthy humans, including nasal passages, but also on the hands (especially in infected cuts and sores), scalp and ears. The contamination of cooked food by the *Staphylococcus toxin* is usually a sign that food has been contaminated post processing due to poor hygienic handling and has further been temperature abused to give the organism an opportunity to grow and produce its toxin.

All 98 samples tested were within satisfactory limits of Coagulase positive *Staphylococci*.

### ***Clostridium perfringens***

*Clostridium perfringens* is widely distributed in the environment. Spores of the organism persist in soil, sediments and areas subject to human or animal faecal contamination. It is commonly found in ready to eat foods with plant origin because spores of *Clostridium perfringens* are normally present in the soil where plants are grown. *Clostridium perfringens* toxins are most commonly associated with food poisoning, which can happen when —

- People swallow a large amount of the bacteria, which then multiply and produce toxin in the intestine; or
- People eat contaminated food with the toxin already in it.

1 out of 98 samples had marginal levels of *Clostridium perfringens*. The same sample also had high levels of *E.coli* and SPC (See Table F.)

## ***Listeria monocytogenes (L.monocytogenes)***

*Listeria* is an environmental microorganism found in soils and processing environment. Horticultural products can become contaminated at the time of harvest or contaminated during preparation, processing or packaging. Its incubation period can be up to 70 days making it hard to identify the source later.

*L.monocytogenes* is the only recognised pathogenic form of *Listeria*. Its infection can affect people differently. Healthy people may develop few or no symptoms. However for immune compromised people it can be life threatening. People who are at particular risk of infection include; immune compromised, pregnant women, the elderly and newborns.

All the samples were analysed for

- presence /absence of *L.monocytogenes* in 25g – Detection method
- the number of *Listeria* cfu per g - Enumeration method

Out of 98 samples tested, all were found to be compliant with the regulatory specifications.

### **Follow-up activities**

Six out of 15 SA based manufacturer were further investigated due to poor microbiological quality. Two had high SPC and pathogens identified, while remaining 4 had high SPC levels detected in their products. In relation to the businesses where pathogens were detected, investigations were carried out jointly by SA Health and local council.

#### 1. Follow up – A business high levels of *E.coli*, *Cl. perfringens* and SPC

The inspection of this business revealed several issues including poor infrastructure, difficult to clean and sanitise contact surfaces, lack of skills and knowledge of food handlers and poor cooling practices. This manufacturing facility was deemed unfit for safe production of cook chill products and Improvement notice was served on the business by the council. This business is currently moving its production facility to another purpose built manufacturing site and consider producing frozen meals only until the process for cook chill production is validated at their new facility therefore the risk has been mitigated by changing the process as part of corrective actions. SA Health is providing technical support to ensure safe production of meals by the business.

#### 2. Follow-up– A business with high levels of *B.cereus* and SPC

Another business where high levels of *B.cereus* and SPC were detected in its food was also inspected jointly with local council. Investigation revealed that the process for making cook chill products was inadequate to meet the requirements for producing extended shelf life products. Inspection also identified cooling and storage temperature control issues. The business reduced the shelf life to less than 10 days as part of the corrective actions and food handlers were retrained on correct temperature controls for cooling and storage.

#### 3. Follow-up – Businesses with high SPC levels

Another 4 businesses where very high standard plate counts were detected in their samples were also inspected. Review of the preparation practices identified process issues such as inadequate cooking time- temperature combination, potential of post process contamination due incorrect process flow, lack of process validation, inadequate food handler skills and knowledge. All the businesses were advised of appropriate corrective actions based on the inspection findings and products were resampled to determine if the actions had improved the outcomes.

## Other observations and follow-up

- A home based business was found to be selling unrefrigerated ready meals in a pop up market. This business had not been notified to the local council. All products out of temperature control were disposed of and council carried out a further investigation to determine if the home environment was suitable for this manufacturing process.
- In some supermarkets, storage temperatures were found to be above the recommended temperature on the package. The issue was raised with the supermarket and the local council who conducted further investigation to resolve the temperature control issues.
- Some businesses were identified producing extended shelf life convenience meals without any shelf life validation. These businesses reduced the shelf life below 10 days in line with council instructions, and were allowed to continue their operation until the shelf life validation was completed, provided other process parameters were identified to be sufficiently controlled.

## Conclusion:

The manufacturing of extended shelf life convenience meals is a high risk and technically complex activity and any business that wants to enter this processing sector should have necessary infrastructure, appropriate knowledge, technical skills and suitable equipment. It is evident from the test results that nearly 43% of the cook chill meal samples within their stated shelf life had low microbiological quality.

Skills and knowledge of the operators were found to be the key issue among most of the producers in SA. While the majority of the samples were noncompliant with the hygiene indicator SPC, pathogens were also identified in the samples of two SA producers. The businesses that were noncompliant were investigated with site visits, resampling and education. Where the business failed to take necessary corrective actions, enforcement actions by councils were also taken to ensure the food safety.

The survey results indicates that there exists a potential future public health risk if businesses do not have appropriate skills and knowledge to identify and mitigate food safety risks associated with extended shelf life convenience meals. The trend of convenience meals is expected to grow more rapidly and therefore the potential risk is also high. It is intended to continue to monitor the businesses producing extended shelf life meals by continuing the survey for the next year and where required educate the businesses.

## References:

- AIFST Cook Chill for Foodservice and manufacturing: Guidelines by Brigette Cox & Marcel Bauler 2008
- South Australian *Food Act 2001*
- CSIRO MAKE IT SAFE – A guide to Food Safety 2010
- The Australia New Zealand Food Standards Code (the Code), Standard 1.6.1- Microbiological criteria for *Listeria monocytogenes* in ready-to-eat (RTE) Foods
- Food Standard Australia New Zealand (FSANZ) “Compendium of Microbiological Criteria for Food” October 2016
- FSANZ document -Guidance on the application of microbiological criteria for *Listeria monocytogenes* in RTE food