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## **An outbreak of *Salmonella* Muenchen gastroenteritis after consuming wild hunted kangaroo, Northern Territory, Australia, 2024**

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# Communicable Diseases Intelligence

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# An outbreak of *Salmonella* Muenchen gastroenteritis after consuming wild hunted kangaroo, Northern Territory, Australia, 2024

Anthony DK Draper, Joanne Gerrell, Stacey McKay, Janet Forrester, Ana Ordonez, Ella Meumann, Rob Baird, Dimitrious Menouhos, Manoj Basnet, Tinus Creeper, Max Cummins, Vicki Krause

## Abstract

An outbreak of salmonellosis occurred in August 2024 after consuming wild hunted kangaroo in a remote area of the Northern Territory (NT), Australia.

We conducted an outbreak investigation via telephone and face-to-face interviews, using a standardised questionnaire that recorded symptoms and exposures to foods and activities prior to onset of symptoms. A confirmed outbreak case was defined as anyone with laboratory confirmed *Salmonella* Muenchen infection who was part of a group of people who shared meals on 25–26 August 2024. A probable outbreak case was defined as anyone who was part of a group of people who shared meals on 25–26 August 2024 and subsequently experienced diarrhoea, in the absence of a laboratory test.

Of the seven members of the group who shared meals, all became ill (attack rate 100%); three were confirmed cases and four were probable cases. The median age was 32 years (range 23–65 years); six (86%) were male. The median incubation period was 24 hours (range 6–30 hours). The most commonly reported symptoms were diarrhoea (100%, 7/7) and abdominal pain (86%, 6/7). Two cases were admitted to hospital, both for an overnight stay; all recovered.

All seven cases consumed the same meal – a single, locally hunted and butchered kangaroo. Contamination likely occurred due to unsafe butchering, storage, transportation and insufficient cooking of the meat. This outbreak highlights the risks of contamination of game meat (in this case kangaroo) with *Salmonella*. Those preparing hunted meat should wash hands and knives regularly while butchering an animal to avoid contamination; should store butchered meat below 5 °C to avoid bacterial growth and cook foods thoroughly to kill microbes. We estimate that the cost to society of this outbreak was 9,810 Australian dollars.

Keywords: outbreak; *Salmonella* Muenchen; gastroenteritis; salmonellosis; foodborne disease; kangaroo; hunting

## Introduction

Salmonellosis is an illness, caused by the *Salmonella* bacterium, which commonly manifests as diarrhoea (which may be bloody), abdominal pain, fever, nausea and sometimes vomiting.<sup>1</sup> *Salmonella* bacteria are carried in the gastrointestinal tracts of many animals including birds, reptiles, amphibians and mammals.<sup>1</sup>

A person with salmonellosis typically becomes ill 6–72 hours after ingesting the bacterium, which can be through direct or indirect contact with a contaminated environment, or more frequently through the ingestion of contaminated food which is typically raw or undercooked meat or eggs, or contaminated

raw fruits or vegetables.<sup>1</sup> *Salmonella enterica* subsp. *enterica* ser. Muenchen (*S. Muenchen*) is not uncommon in the Northern Territory (NT) of Australia. Between 2014 and 2023, eighty-seven notifications were received in the NT, with 30/87 (34%) occurring in the vast Central Australian region (Barkly and Alice Springs regions) despite only approximately 20% of the NT population living in this area of the outback.<sup>2</sup> About 34% of all *S. Muenchen* notifications in the NT occurred in children under 5 years of age, with the majority of these assumed to be environmentally acquired.<sup>3</sup> Known reservoirs of *S. Muenchen* include kangaroos,<sup>4</sup> wallabies,<sup>5</sup> snakes,<sup>5</sup> and geckos.<sup>6</sup>

There have been previous foodborne outbreaks of *S. Muenchen* associated with pork products in Germany,<sup>7</sup> alfalfa sprouts in the United States of America (USA),<sup>8</sup> of unknown aetiology in a paediatric hospital in the United Kingdom,<sup>9</sup> and with hunted turtle meat in the NT.<sup>10</sup>

Kangaroo meat has long been a staple food of Australia's First Nations people and has become a popular meat amongst non-Indigenous Australians in recent decades. Kangaroos are known to harbour *Salmonella*.<sup>4,11,12</sup> Foodborne disease outbreaks epidemiologically linked to consumption of kangaroo meat have occurred in Australia, with an outbreak of toxoplasmosis in Queensland;<sup>13</sup> an outbreak of Shiga-toxin producing *Escherichia coli* in the NT;<sup>14</sup> and an outbreak of salmonellosis (*S. Saintpaul*) in Western Australia.<sup>15</sup>

On 30 August 2024, the NT Centre for Disease Control (NT CDC) was alerted to a possible outbreak of salmonellosis (at that stage untyped) among people who had consumed wild hunted kangaroo on 25 and 26 August 2024. This was detected while investigating routine salmonellosis notifications; three cases separately attended the Alice Springs Hospital Emergency Department (ED) and treating clinicians reported that they were from a larger group who had consumed hunted kangaroo. We initiated an outbreak investigation in order to ascertain the cause of illness and to prevent further cases.

## Methods

### Epidemiological and environmental investigation

We confirmed the existence of the outbreak by administering a standardised salmonellosis case investigation questionnaire to the first two notified salmonellosis cases; the form recorded details on symptoms, health-seeking behaviour, food and activity exposures and to identify further cases. Once the existence of an outbreak was confirmed, we undertook an outbreak investigation in order to determine which food was associated with illness, and to find and prevent further cases. We administered the same standardised salmonellosis case questionnaire to all cases as they were identified.

A confirmed outbreak case was defined as anyone with laboratory-confirmed *S. Muenchen* infection who was part of a group of people who shared meals on 25–26 August 2024. A probable outbreak case was defined as anyone who was part of a group of people who shared meals on 25–26 August 2024 and subsequently experienced diarrhoea, in the absence of a laboratory test.

Data were collected and analysed in Microsoft Excel 2016 (Microsoft, USA). We conducted descriptive analysis by calculating frequencies, proportions, medians and ranges.

The preparation, storage and cooking processes of the wild hunted kangaroo were investigated. There was no environmental inspection undertaken of the site where the meat was butchered due to its remoteness; no leftover kangaroo meat was available for microbiological sampling.

We estimated the cost of this outbreak in Australian Dollars (AUD) using the Food Standards Australia New Zealand – Australian National University Foodborne Illness Costing Tool.<sup>16,17</sup>

Ethics approval was not sought for this investigation as it was conducted under the auspices of public health legislation.<sup>18,19</sup>

## Laboratory investigation

Human faeces sampled were cultured using standard techniques (microscopy, culture and sensitivity). Additionally, rotavirus, adenovirus, norovirus, sapovirus and astrovirus were tested by polymerase chain reaction (PCR) and *Cryptosporidium* was tested for using an antigen detection test. When *Salmonella* was cultured, isolates were typed using whole genome sequencing (WGS) on the Illumina NextSeq2000 platform at Territory Pathology, Darwin. Sequence reads were filtered and trimmed with fastp (version 0.23.4)<sup>20</sup> before genome assembly with Shovill (version 1.1.0).<sup>21</sup> *In silico* serotyping was conducted on draft genome assemblies using the *Salmonella In Silico* Typing Resource (SISTR) tool (version 1.1.1).<sup>22</sup> Pairwise single nucleotide polymorphism (SNP) distances were calculated using split k-mer analysis (version 1.0)<sup>23</sup> and Snippy (version 4.6.0).<sup>24</sup>

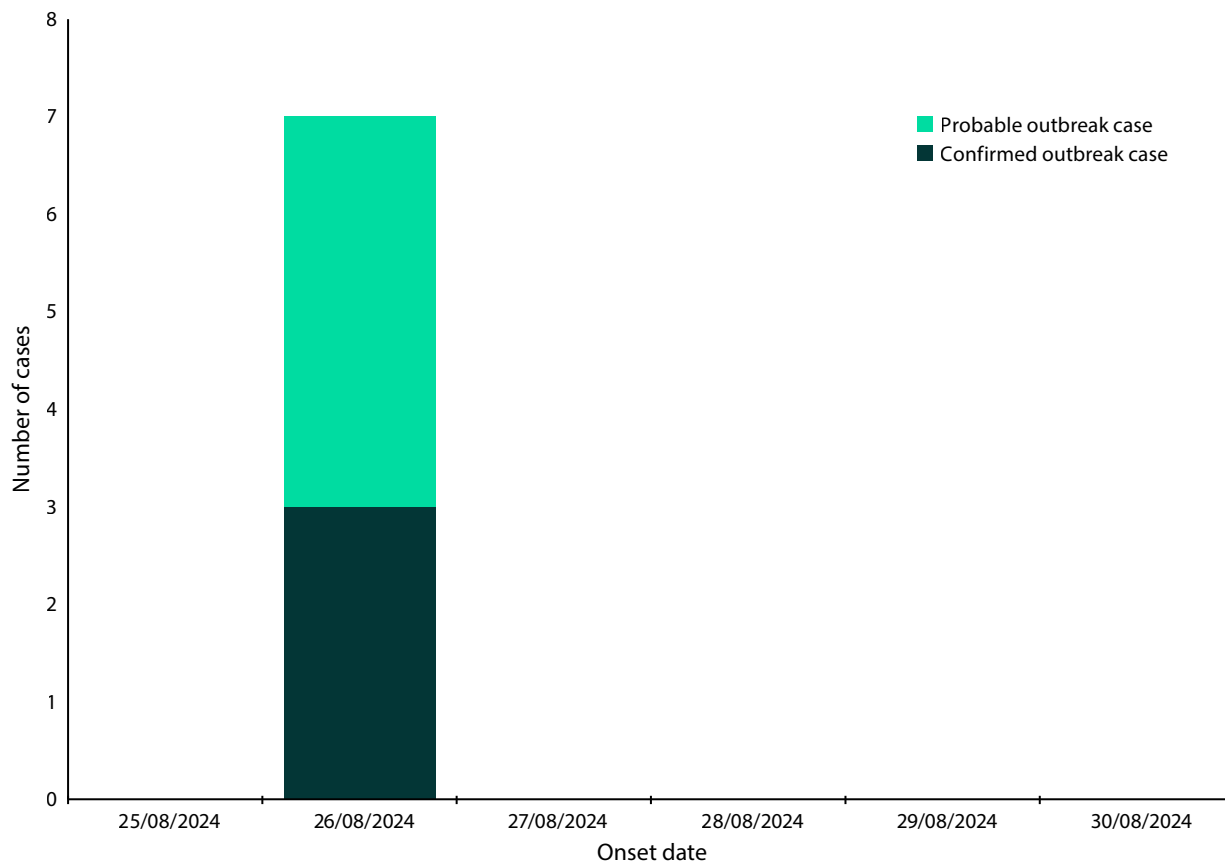
## Results

### Epidemiological and environmental investigation

We contacted 6/7 members (response rate 86%) of the group who shared meals; all became ill (attack rate 100%). One case was uncontactable but family members were able to provide details of their symptoms and exposures. Three people submitted faeces samples and had laboratory confirmed *S. Muenchen* infection; another four people met the probable case definition. The median age was 32 years (range 23–65 years); six cases (86%) were male. Three cases presented to the ED, of whom two were admitted to hospital for an overnight stay.

The most commonly reported symptoms were diarrhoea (100%, 7/7) and abdominal pain (86%, 6/7). All seven cases were known to each other and consumed the same meal: a single, locally hunted and butchered kangaroo. There was no other common food or drink consumed apart from the kangaroo. The median incubation period was 24 hours (range 6–30 hours). The epidemic curve was typical of a point source salmonellosis outbreak (Figure 1).

**Figure 1: Epidemiological curve of outbreak cases by onset day after consuming wild hunted kangaroo in the Northern Territory, Australia, August 2024 (n = 7)**



A large red kangaroo (*Macropus rufus*) was killed and disembowelled late on the evening of 24 August 2024 by three hunters, in the bush approximately 35 km outside Alice Springs. The carcass was left in the back of a ute (utility vehicle; i.e., a pick-up truck) at that location until it was cooked rare in an earth oven<sup>25</sup> late on the following morning of 25 August 2024. The three hunters first ate the meat at this point. The rare cooked meat was then transported into Alice Springs at ambient temperature and two further cases ate the meat on the afternoon of 25 August 2024. The uncooked organs of the kangaroo were washed and together with the remaining rare meat were refrigerated on the afternoon of 25 August 2024. On the morning of 26 August 2024, the internal organs were boiled and together with the rare meat were distributed to a second household where two more people ate the rare meat and all became unwell. The first four cases began experiencing symptoms at approximately 6 pm on 26 August 2024. The group recognised the kangaroo meat was likely the cause of their illness. The first household immediately discarded the remaining kangaroo meat. Members in the second house also discarded the kangaroo meat but only after nine members of that household ate a stir-fry meal that contained the kangaroo meat, but cooked thoroughly. None of the nine people who ate this meal with the thoroughly cooked meat became unwell.

On 25 August 2024, Alice Springs observed an unseasonably high minimum overnight minimum temperature of 18 °C (mean August minimum temperature 5.9 °C),<sup>26</sup> with temperatures reaching 28.5 °C by 9 am and 32.9 °C at 3 pm.<sup>27</sup>

We estimated the cost of this outbreak to be 9,810 AUD, consisting of: pain and suffering (1,140 AUD), non-fatal productivity losses (3,840 AUD), and direct losses (e.g. healthcare costs, medications, diagnostic testing, pharmaceutical costs, etc.) of 4,820 AUD.

## Laboratory investigation

The three isolates of *S. Muenchen* all clustered closely (< 5 SNPs), which was highly suggestive of a point source outbreak. No kangaroo meat was available for microbiological testing.

## Discussion

Kangaroo meat was epidemiologically implicated as the likely source of this salmonellosis outbreak and was eaten by all cases. The epidemic curve, timing of the outbreak, and environmental investigation supported this. Kangaroos are known carriers of *Salmonella* bacteria. Contamination of hunted kangaroo meat can occur when the same knife is used to clean and eviscerate the animal and then is re-used for butchering. To reduce the risk of contamination of hunted meat, it is important to clean hands and knives with soap and water; wash hands and knives regularly while butchering an animal; avoid contaminating the carcass with dirt, plant-life, and bacteria from the gut; and protect the carcass from other wildlife. Soap and water was not available at the remote site where this kangaroo was cleaned/eviscerated and left overnight.

After the likely contamination of the meat with *Salmonella* during cleaning, the environmental investigation observed that the remote site where the kangaroo carcass was left overnight experienced temperatures far above 5 °C which is recommended for safely storing and transporting raw meat.<sup>28</sup> This likely promoted *Salmonella* growing to hazardous levels in the meat. The following day the meat was only cooked 'rare', which was insufficient to kill all bacteria<sup>29</sup> which existed in the meat and could have possibly expedited the contamination of the meat through further heating. The meat was then transported later that day at temperatures approaching 35–37 °C, which is the optimal growth temperature of *Salmonella*.<sup>30,31,32</sup> Those who ate the rare meat last on 26 August, had the shortest incubation periods which may indicate higher levels of contamination. The nine people in the second household who ate meat cooked thoroughly in a stir-fry and who didn't become unwell are evidence that cooking the meat thoroughly killed the *Salmonella* and made the meat safe to consume. This investigation identified factors that contributed to the outbreak which were consistent with a previous outbreak of *S. Muenchen* in the NT in 2017 which was associated with consumption of sea turtle,<sup>10</sup> i.e. incomplete evisceration, lack of refrigeration of meat and insufficient cooking.

A major limitation of the investigation was that there was no leftover kangaroo meat available for sampling. In any case, microbiological testing of food in Central Australia is difficult due to the absence of a local food testing laboratory and the prohibitive cost of sending samples interstate for testing.

Information was obtained about 7/7 of the people who ate the kangaroo, and there were no reports of illness in other family or household members who did not eat the undercooked kangaroo.

## Conclusion

We conclude that this outbreak of *S. Muenchen* was epidemiologically associated with eating contaminated kangaroo meat. Contamination likely occurred during evisceration/butchering and was exacerbated by temperature abuses during storage and transport. Inadequate cooking failed to kill microbes and may have in fact contributed to further growth. To prevent contamination of hunted kangaroo meat, hands and knives should be cleaned with soap and water. Hands and knives should be washed regularly while butchering an animal, to avoid contaminating the carcass. Butchered meat should be stored and transported in a clean environment below 5 °C in order to reduce the risk of contamination. It is advisable to cook kangaroo meat completely through (e.g. to 72 °C) to ensure killing of all microbes. These preventative measures should be adhered to and planned for, regardless of remoteness.

It is important to investigate outbreaks of *Salmonella* in order to identify risks, to undertake appropriate public health action and to promote public safety.

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## References

1. Parry CM. Salmonellosis. In: Heymann DL, ed. *Control of Communicable Diseases Manual*. 21st ed. Washington DC: APHA Press, 2022.
2. Draper ADK, McMahon KE. OzFoodNet in the Northern Territory in 2023; a post-pandemic increase in viral gastroenteritis outbreaks and a record year overall for gastrointestinal outbreak investigations and for typhoid fever notifications. *NT Dis Control Bull*. 2024;31(1):3–13. Available from: <https://health.nt.gov.au/professionals/centre-for-disease-control/northern-territory-disease-control-bulletin>.
3. Northern Territory Government Department of Health, Centre for Disease Control (NT CDC). Northern Territory Notifiable Diseases System (NTNDS). [NT intranet.] Darwin: NT CDC; 2024.
4. Potter AS, Reid SA, Fenwick SG. Prevalence of *Salmonella* in fecal samples of western grey kangaroos (*Macropus fuliginosus*). *J Wildl Dis*. 2011;47(4):880–7. doi: <https://doi.org/10.7589/0090-3558-47.4.880>.
5. Thomas AD, Forbes-Faulkner JC, Speare R, Murray C. Salmonellosis in wildlife from Queensland. *J Wildl Dis*. 2001;37(2):229–38. doi: <https://doi.org/10.7589/0090-3558-37.2.229>.
6. United States Centers for Disease Control and Prevention (US CDC). 2015 multistate outbreak of human *Salmonella* Muenchen infections linked to contact with pet crested geckos (final update). [Internet.] Atlanta: United States Government Department of Health and Human Services, CDC; 18 June 2015. [Accessed on 6 September 2024.] Available from: <https://www.cdc.gov/salmonella/muenchen-05-15/mobile-desktop-index.html>.
7. Schielke A, Rabsch W, Prager R, Simon S, Fruth A, Helling R et al. Two consecutive large outbreaks of *Salmonella* Muenchen linked to pig farming in Germany, 2013 to 2014: is something missing in our regulatory framework? *Euro Surveill*. 2017;22(18). doi: <https://doi.org/10.2807/1560-7917.ES.2017.22.18.30528>.
8. US CDC. 2016 *Salmonella* outbreak linked to alfalfa sprouts from one contaminated seed Lot. [Internet.] Atlanta: United States Government Department of Health and Human Services, CDC; 23 February 2016. [Accessed on 3 September 2024.] Available from: [https://archive.cdc.gov/www\\_cdc\\_gov/salmonella/muenchen-02-16/advice.html](https://archive.cdc.gov/www_cdc_gov/salmonella/muenchen-02-16/advice.html).
9. Kumarasinghe G, Hamilton WJ, Gould JDM, Palmer SR, Dudgeon JA, Marshall WC. An outbreak of *Salmonella* Muenchen infection in a specialist paediatric hospital. *J Hosp Infect*. 1982;3(4):341–4. doi: [https://doi.org/10.1016/0195-6701\(82\)90065-2](https://doi.org/10.1016/0195-6701(82)90065-2).
10. Draper ADK, James CL, Pascall JE, Shield KJ, Langrell J, Hogg A. An outbreak of *Salmonella* Muenchen after consuming sea turtle, Northern Territory, Australia, 2017. *Commun Dis Intell Q Rep*. 2017;41(4):E290–4.
11. Bensink JC, Ekaputra I, Taliotis C. The isolation of *Salmonella* from kangaroos and feral pigs processed for human consumption. *Aust Vet J*. 1991;68(3):106–7. doi: <https://doi.org/10.1111/j.1751-0813.1991.tb00766.x>.
12. Speare R, Thomas AD. Orphaned kangaroo and wallaby joeys as a potential zoonotic source of *Salmonella* spp. *Med J Aust*. 1988;148(12):619,622–3.
13. Robson JMB, Wood RN, Sullivan JJ, Nicolaidis NJ, Lewis BR. A probable foodborne outbreak of toxoplasmosis. *Commun Dis Intell*. 1995;19:516–522.
14. Draper ADK, Yip TW. An outbreak of Shiga toxin-producing *E. coli* (STEC) gastroenteritis associated with eating kangaroo – a case study from the Northern Territory. *NT Dis Control Bull*. 2013;20(1):14–15. Available from: <https://health.nt.gov.au/professionals/centre-for-disease-control/northern-territory-disease-control-bulletin>.



15. Government of Western Australia Department of Health (WA Health). *Enteric disease surveillance and outbreak investigations in Western Australia 2021 annual report*. Perth: WA Health Communicable Disease Control Directorate; 2022. [Accessed on 6 September 2024.] Available from: <https://www.health.wa.gov.au/~media/Corp/Documents/Health-for/Infectious-disease/OZfoodnet/Word/OzFoodnet-annual-report-2021.docx>.
16. McClure A. FSANZ-ANU Foodborne Illness Costing Tool. [Application.] San Francisco; GitHub. [Accessed on 6 September 2024.] Available from: <https://github.com/AngusMcLure/FSANZ-ANU-Foodborne-Illness-Costing>.
17. Glass K, McLure A, Bourke S, Cribb DM, Kirk MD, March J et al. The cost of foodborne illness and its sequelae in Australia circa 2019. *Foodborne Pathog Dis*. 2023;20(10):419–26. doi: <https://doi.org/10.1089/fpd.2023.0015>.
18. Northern Territory Government: Northern Territory Legislation (NT Legislation). *Notifiable Diseases Act 1981*. [Legislation.] Darwin: NT Legislation; 27 November 2023. [Accessed on 3 September 2024.] Available from: <https://legislation.nt.gov.au/en/Legislation/NOTIFIABLE-DISEASES-ACT-1981>.
19. NT Legislation. *Public and Environmental Health Act 2011*. [Legislation.] Darwin: NT Legislation; 22 May 2022. [Accessed on 3 September 2024.] Available from: <https://legislation.nt.gov.au/en/Legislation/PUBLIC-AND-ENVIRONMENTAL-HEALTH-ACT-2011>.
20. Chen S, Zhou Y, Chen Y, Gu J. fastp: an ultra-fast all-in-one FASTQ preprocessor. *Bioinformatics*. 2018;34(17): i884–90. doi: <https://doi.org/10.1093/bioinformatics/bty560>.
21. Seemann T. *Shovill. Assemble bacterial isolate genomes from Illumina paired-end reads*. San Francisco: Github; 13 March 2020. [Accessed on 13 November 2024.] Available from: <https://github.com/tseemann/shovill>.
22. Yoshida CE, Kruczkiewicz P, Laing CR, Lingohr EJ, Gannon VPJ, Nash JHE et al. The Salmonella In Silico Typing Resource (SISTR): an open web-accessible tool for rapidly typing and subtyping draft *Salmonella* genome assemblies. *PLoS One*. 2016;11(1):e0147101. doi: <https://doi.org/10.1371/journal.pone.0147101>.
23. Derelle R, von Wachsmann J, Mäklin T, Hellewell J, Russell T, Lalvani A et al. Seamless, rapid, and accurate analyses of outbreak genomic data using split k-mer analysis. *Genome Res*. 2024;34(10):1661–73. doi: <https://doi.org/10.1101/gr.279449.124>.
24. Seemann T. *Snippy. Rapid haploid variant calling and core genome alignment*. San Francisco: Github; 9 March 2020. [Accessed on 13 November 2024.] Available from: <https://github.com/tseemann/snippy>.
25. Best Ever Food Review Show. Rare Kangaroo Cooked Underground!! Aboriginal Earth Oven in Australia!! [YouTube video clip.] Ho Chi Minh City: Best Ever Food Review Show; 11 June 2023. [Accessed on 2 September 2023.] Available from: <https://youtu.be/H-wSfcitRPI?si=Wpv52IyqzzOe3rR6&t=611s>.
26. Australian Government Bureau of Meteorology. Monthly mean minimum temperature: Alice Springs airport. [Internet.] Canberra: Australian Government Bureau of Meteorology; 2024. [Accessed on 3 September 2024.] Available from: [http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p\\_nccObsCode=38&p\\_display\\_type=dataFile&p\\_startYear=&p\\_c=&p\\_stn\\_num=015590](http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=38&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=015590).
27. Australian Government Bureau of Meteorology. Alice Springs, Northern Territory, August 2024 daily weather observations. [Internet.] Canberra: Australian Government Bureau of Meteorology; 2 September 2024. [Accessed on 3 September 2024.] Available from: <http://www.bom.gov.au/climate/dwo/202408/html/IDCJDW8002.202408.shtml>.

28. Food Standards Australia New Zealand (FSANZ). Food temperature and thermometers. [Internet.] Canberra: FSANZ; 25 January 2024. [Accessed on 3 September 2024.] Available from: <https://www.foodstandards.gov.au/business/safety/factsheets/charitiesandcommunityorganisationsfactsheets/temperaturecontrol#:~:text=Safe%20temperatures%20are%205%C2%B0,from%20multiplying%20to%20dangerous%20levels>.
29. FSANZ. Preparing and cooking food. [internet] Canberra: FSANZ; 6 December 2023. [Accessed on 3 September 2024.] Available from: <https://www.foodstandards.gov.au/business/safety/factsheets/charitiesandcommunityorganisationsfactsheets/preparingandcookingfood>.
30. Jay S, Davos D, Dundas M, Frankish E, Lightfoot D. Salmonella. In: Hocking AD, ed. *Foodborne Microorganisms of Public Health Significance*. 6th ed. Waterloo: Australian Institute of Food Science and Technology Incorporated; 2003.
31. Dominguez SA, Schaffner DW. Modeling the growth of *Salmonella* in raw poultry stored under aerobic conditions. *J Food Prot*. 2008;71(12):2429–35. doi: <https://doi.org/10.4315/0362-028x-71.12.2429>.
32. Pan W, Schaffner DW. Modeling the growth of *Salmonella* in cut red round tomatoes as a function of temperature. *J Food Prot*. 2010;73(8):1502–5. doi: <https://doi.org/10.4315/0362-028x-73.8.1502>.