Imported food risk statement

Fresh and frozen ready-to-eat berries and hepatitis A virus

Scope: Ready-to-eat (RTE) fresh and frozen berries, including (but not limited to) blackberries, blueberries, raspberries, strawberries, mulberries, loganberries, cranberries, bilberries, gooseberries and currants (*Ribes* genus). Retorted and dried product is not covered by this risk statement.

Recommendation and rationale
Does hepatitis A virus (HAV) in imported fresh and frozen RTE berries present a potential medium or high risk to public health:
☑ *High* ☐ *Medium* ☐ *No*
FSANZ concludes that hepatitis A virus (HAV) in imported fresh and frozen RTE berries presents a potential high risk to public health.
Rationale: • HAV is a serious hazard as it causes incapacitating illness of moderate duration which, in rare cases, can be life threatening. It is very infectious, with small quantities likely to cause infection. • There is strong evidence that HAV has caused foodborne illness associated with fresh and frozen RTE berries. • The method of primary production and processing can introduce contamination, and there is also the potential for post-processing contamination of the food. Berries are often eaten raw, so there is no pathogen elimination step. • Although HAV cannot replicate in food, it can survive in frozen and fresh RTE berries and still be present at the time of consumption. • In Australia, hepatitis A is uncommon and, while vaccination is available, there is a low overall seroprevalence in the population. This means a significant proportion of the Australian population are susceptible to foodborne transmission of HAV.

General description
Nature of the virus:
Hepatitis A (HAV) belongs to the *Picornaviridae* family of viruses. It is a small (25–28 nm) non-enveloped icosahedral virus with a single stranded RNA genome. Like all viruses, HAV can multiply in living host cells but cannot replicate in food. However the virus can survive in food and still be present at the point of consumption. The virus can also survive in the environment and is considered to be extremely stable under a wide range of environmental conditions, including drying, freezing and heating (Codex 2012; FDA 2012; FSANZ 2013; Hollinger and Martin 2013).
The host range of HAV is limited to humans and non-human primates (Hollinger and Martin 2013). In humans, HAV is transmitted via the faecal-oral route by either person-to-person contact or consumption of contaminated food or water (FSANZ 2013).
HAV replicates in the liver before being released into the small intestine via the bile duct and subsequently shed in highest concentrations in faeces. Peak levels of HAV shedding in faeces occurs in the two weeks prior to the onset of clinical symptoms (up to 10^9 infectious HAV particles per gram of faeces) (Hollinger and Martin 2013; Wasley et al. 2010). Asymptomatic and symptomatic infected persons are generally unaware they present a hazard at the time most virus is shed in faeces (FSANZ 2013).
Resistance of HAV to heating is variable and highly dependent on the virus strain, initial level of contamination, time and temperature of heating and the type of food matrix (Bidawid et al. 2000; Codex 2012; FSANZ 2013). Also, increasing the concentration of sugar increases the resistance of HAV to heating (Deboosere et al. 2004). Cooling and freezing processes are not considered suitable for the control of viruses as they do not reduce virus infectivity to levels considered safe. In studies on enteric viruses on berries and herbs, Butot et al. (2008; 2009) showed that both freeze-drying and frozen storage for up to

General description
90 days at -20°C had negligible effect on the infectivity of HAV, with less than 1 Log reduction achieved on most products. In addition, HAV is not readily inactivated by drying or desiccation (Cliver 2009; Sanchez and Bosch 2016). Studies on blueberries have shown that HAV was still detectable after osmotic dehydration at 23°C (15 hours) followed by air drying at 100°C (1 hour), with a 2.6 Log reduction in HAV (Bai et al. 2020). Very high temperatures—e.g. dry heat treatment of freeze-dried berries at 120°C for 20 min—was required to inactivate HAV (Butot et al. 2009).
Adverse health effects: HAV is a serious hazard as it causes incapacitating illness of moderate duration which, in rare cases, can be life threatening. Symptoms associated with HAV infection include fever, nausea, anorexia, malaise, vomiting, diarrhoea, muscular pain and often jaundice. Jaundice generally occurs five to seven days after the onset of gastrointestinal symptoms. Illness typically occurs 15–50 days after infection and HAV is shed in the faeces up to two weeks before, and for several weeks after, onset of illness. The duration of illness is typically one to two weeks, although prolonged or relapsing cases may continue for up to six months in a minority of patients (FDA 2012; FSANZ 2013). People of all ages are susceptible to HAV infection unless they have immunity from a previous infection (which provides lifelong protection against reinfection) or vaccination (after which, anti-HAV antibodies persist for at least 20 years) (CDC 2019). The disease is milder in young children under six years, with many cases being asymptomatic. HAV infection in people over 40 years can have a more severe disease outcome. In rare cases, HAV infection can lead to acute liver failure which can be fatal (Codex 2012; FDA 2012; FSANZ 2013). The infectious dose of HAV is considered to be 10–100 viral particles (FDA 2012).
Consumption patterns: In the 2011–2012 Nutrition and Physical Activity Survey (part of the 2011–2013 Australian Health Survey), 14.2% of children aged 2–3 years, 11.5% of children aged 4–8 years and 7.8% of adults (aged 19 years and above) reported consumption of fresh and frozen RTE berries (ABS 2014). This excludes berries consumed as part of mixed dishes such as smoothies and pies. The reported percentages are based on a single day of consumption information from each nutrition survey and do not indicate the frequency of consumption of fresh and frozen RTE berries. It is likely that consumption of berries has increased in the years since the 2011–2013 Australian Health Survey was conducted, driven by changing food consumption trends and evidenced by the increase in Australian berry production over recent years (Hort Innovation 2018) and importation of these products into Australia[1]. Data sourced from the Australian Bureau of Statistics for 2014-2016 indicates that Australia imported around 1,200 tonnes of fresh berries and 10,500 tonnes of frozen berries annually at that time. The quantity of fresh berries imported into Australia has remained relatively constant between 2016 and 2018 (Hort Innovation 2019).
Risk factors and risk mitigation Berries can potentially be contaminated with HAV at many points in the supply chain, from primary production through to the point of consumption. To minimise contamination of berries with HAV, effective control measures are necessary during primary production and processing, e.g. through application of Good Agricultural Practices (GAP) on-farm, and Good Hygienic Practices (GHP) throughout the supply chain up to the point of consumption (Codex 2017). During the primary production of berries, risk factors include the quality of water used for irrigation and the application of water-soluble fertilisers and agricultural chemicals, potential contact with human biosolids used as fertiliser and seepage of untreated or partially treated sewage into the soil. Risks can be managed by application of GAP, including the use of clean or potable water (free of human faecal contamination); proper management of fertiliser storage and treatment facilities; and minimising the contact of berries with irrigation water and soil-borne contaminants (Codex 2012, 2017; Fiore 2004). Harvesting of berries by hand is a key risk factor as it can lead to transfer of HAV from the hands of infected workers to the surface of the fruit. In countries where HAV is endemic, workers who are asymptomatic or have unsuspected HAV infection (shedding virus), or those who are caring for an infected child, can increase the risk of contaminating fresh produce. Appropriate control measures include providing adequate sanitation and hand washing facilities for field workers (Codex 2012, 2017; Fiore 2004). Berries can also be contaminated by the use of HAV-contaminated water for rinsing after harvesting. Potable water should be used for rinsing berries and for ice used for packing (Codex 2012; Fiore 2004).

[1] Imported food data sourced from the Australian Department of Agriculture, Water and the Environment

General description
Contamination of berries can occur during processing (e.g. during hand sorting of berries) and after processing (e.g. handling of product after freezing) by transfer from the hands of an infected food handler. Possible control steps include reducing bare hand contact with the fruit and providing workers with training in food hygiene and access to sanitation and hand washing facilities (Codex 2012; Fiore 2004; Tavoschi et al. 2015). Frozen product, compared with fresh berries, may lead to wider distribution of contamination due to processing routines such as mixing batches of different origin during freezing and before packaging (Tavoschi et al. 2015). As berries are often eaten raw or with minimal heat treatment, there is no pathogen elimination step. There are currently no effective, realistic and validated risk management options to eliminate viral contamination of fresh produce prior to consumption without changing the normally desired characteristics of the food (Codex 2012). Further processing of berries, e.g. heat treatment, may result in inactivation of HAV. It is recommended to cook food to 85°C for 1 minute to inactivate HAV, recognising that the extent of virus inactivation is influenced by the food matrix. Products with higher sugar content require longer treatment times to achieve the same reduction in HAV (Bozkurt et al. 2020; Deboosere et al. 2004; FSANZ and NZ MPI 2015). Any berries destined for the fresh or frozen market suspected of being contaminated with HAV should be immediately disposed of in a manner that prevents cross-contamination. Persons suspected of, or displaying signs of, infection should be excluded from food handing premises until fully recovered and no longer shedding the virus. Vaccination of food handlers can assist in reducing the risk of viral contamination of the food. Where feasible and appropriate, checking for HAV immune status of food handlers could be useful (Codex 2012). Widespread post-exposure vaccination can also be used as a control measure in outbreaks (CDC 2016; Fiore 2004). In Australia since 2006, targeted HAV vaccination programs have effectively reduced the number of notifications and hospitalisations in specific subpopulations at increased risk of infection. HAV infection is now uncommon in Australia. The relatively low overall hepatitis A seroprevalence in the population means a large proportion of the Australian population is susceptible to foodborne transmission of the disease (AIHW 2018; Thompson et al. 2017). Testing food for HAV is challenging, requiring matrix-dependent extraction and concentration techniques (Codex 2012). HAV contamination of food is difficult to detect through cell culture techniques (Grohmann and Lee 2003). Detection of HAV RNA can also be difficult, as the virus may not be homogenously spread through the food, there may be low levels of contamination, and the food may contain materials that inhibit the amplification process (used for viral detection). Detection of viral genetic material does not discriminate between infectious and non-infectious virus particles. A negative test result does not exclude the possibility of HAV contamination (Codex 2012; EFSA 2014; Enkirch et al. 2018; Tavoschi et al. 2015).
Surveillance information: HAV is a notifiable disease in all Australian states and territories with a notification rate in 2020 of 0.3 cases per 100,000 population (85 cases). This was a substantial decrease from the previous five year mean of 1.0 case per 100,000 population per year (ranging from 0.6–1.7 cases per 100,000 population) (NNDSS 2021). The reported notification rate includes both foodborne and non-foodborne transmission. Historically, the majority of HAV cases in Australia have been acquired overseas (OzFoodNet 2015, 2018). However, due to the global pandemic in 2020 there was very limited overseas travel, which is anticipated to have led to the drop in reported Australian HAV cases. **Illness associated with consumption of fresh and frozen RTE berries contaminated with HAV** A search of the scientific literature via EBSCO, US CDC National Outbreak Reporting System and other publications from 2005 to 2020 identified that there have been at least ten HAV outbreaks associated with consumption of fresh and frozen RTE berries. Examples are listed below: • Sweden and Austria (2018) – 34 hepatitis A cases linked to consumption of frozen strawberries, often served in smoothies and ice cream, imported from a Polish producer (strawberries originated from Poland and Egypt). The outbreak HAV strain was detected in leftover frozen strawberries (Enkirch et al. 2018; Ruscher et al. 2020). • Germany (2018–2020) – 65 hepatitis A cases linked to consumption of frozen strawberry cake made from imported frozen Egyptian strawberries. A case control study showed the hepatitis A cases were epidemiologically linked to consumption of frozen strawberry cake (odds ratio of 43), and in particular linked to a certain brand (odds ratio of 32). The sequence of the German outbreak cases matched the sequence of the Swedish/Austrian HAV outbreak cases (previous outbreak described above). Also, traceback investigations identified that the same batch of frozen Egyptian strawberries were supplied to both the German frozen strawberry cake producer and to the Polish producer implicated in the Swedish/Austrian outbreak (who then distributed these to Austria) (Ruscher et al. 2020).

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- Canada (2018) – hepatitis A cases linked to consumption of imported frozen strawberries (the number of cases was not reported). The frozen strawberries were imported from Egypt (CFIA 2018). No information was provided about a potential link with the previous two outbreaks (described above) that were also associated with frozen Egyptian strawberries at a similar time.
- US (2016) – 143 hepatitis A cases linked to consumption of frozen strawberries imported from Egypt, served in smoothies by a restaurant chain. HAV was detected in multiple strawberry samples (CDC 2016).
- Australia (2015) – 35 hepatitis A cases linked to consumption of an imported frozen mixed berry product. The outbreak HAV strain was detected in 1/3 opened packets from the cases. HAV was detected in 1/15 sealed packets but the level was too low to sequence. A case control study showed the hepatitis A cases were epidemiologically linked to consumption of the implicated frozen mixed berry product (odds ratio of 440) (OzFoodNet 2017).
- Australia (2017) - four hepatitis A cases linked to consumption of an imported frozen mixed berry product. The sequence of the 2017 outbreak cases matched the sequence of the 2015 Australian HAV outbreak cases (previous outbreak described above). Environmental investigations detected HAV in one opened packet and in one sealed packet of frozen mixed berries (DHHS Victoria 2017; SA Health 2017).
- New Zealand (2015) – seven hepatitis A cases were linked to consumption of imported frozen berries. The cases were epidemiologically linked to the product using a hypothesis-generating questionnaire. All of the cases that had consumed the frozen berries had the same HAV genotype and sequence type (ESR 2016).
- Europe (2013-2014) – More than 1500 hepatitis A cases and 2 related deaths in ten countries were linked to consumption of frozen berries (361 cases had identical HAV sequence to the outbreak strain). HAV was detected in frozen berries and some frozen berry products. Case control studies in Ireland and Poland showed the hepatitis A cases were epidemiologically linked to consumption of products containing frozen berries (odds ratio of 12) and a particular cake topped with non-heat treated mixed frozen berries (odds ratio of 13), respectively. A case control study in Italy confirmed berries were the highest independent risk factor for hepatitis A infection (odds ratio of 4.99). Potential sources included blackberries from Bulgaria or red currants from Poland (EFSA 2014; Severi et al. 2015).

Data on the prevalence of HAV in fresh and frozen RTE berries

A search of the scientific literature via EBSCO and other publications from 2005 to 2020 identified that surveys of fresh and frozen RTE berries have isolated HAV in 0 to 8.3% of samples, with an overall prevalence of 0.2% (95% CI 0% - 2.0%) determined using a random effects meta-analysis of ten surveys (surveys included product collected from Australia, Brazil, Mexico, Turkey, South Korea, and several European countries such as the Czech Republic and Italy). However, it should be noted that due to the constraints of viral RNA extraction and the low levels of virus contamination, false negative test results are common. The purpose of these surveys was to collect surveillance data, and they were not associated with an outbreak. Examples of surveys are listed below:

- Czech Republic and other European countries – HAV was not detected in strawberries collected from the farm (n=156) or fresh strawberries sampled in the marketplace (n=70) (Dziedzinska et al. 2018).
- Turkey (2015) – HAV was detected in 8.3% frozen raspberries (n=240) collected from the supermarket (Incili et al. 2019).
- International (2009–2016) – HAV was detected in 0.1% of strawberries (n=918) and 2.6% of red currants (n=39), but was not detected in raspberries (n=536), blueberries (n=126), mixed berries (n=122), blackberries (n=49), black currants (n=20) or cranberries (n=16). The berries sampled in this study were mainly frozen, although some were dried, in puree, syrup or part of a finished product (i.e. cake) (Li et al. 2018).
- South Korea (2016–2017) – HAV was detected on 0.8% of strawberries (n=120) collected from the farm (Shin et al. 2019).
- Australia (2013–2014) – HAV was not detected in fresh berries (strawberries and blueberries) collected at retail (supermarkets, greengrocers and farmers markets) (n=141) (Torok et al. 2019).
- Italy - HAV was not detected in berries (blackberries, blueberries, raspberries, red currants) collected from the farm (n=75) (Macori et al. 2018).

Standards or guidelines

- Codex general principles of food hygiene *CAC/RCP 1 – 1969* follows the food chain from primary production through to final consumption, highlighting the key hygiene controls at each stage (Codex 2020).
- Codex code of hygienic practice for fresh fruit and vegetables *CXC 53-2003* addresses Good Agricultural Practices and Good Hygienic Practices that help control microbial, chemical and physical hazards associated with all stages of the production of fresh fruits and vegetables, from primary production to consumption (Codex 2017).

Standards or guidelines
• Annex V (Berries) of the code of hygienic practice for fresh fruit and vegetables *CXC 53-2003* provides specific guidance to minimise microbiological hazards during primary production until packing and distribution of fresh berries and consumer use, including fresh RTE berries and those processed without a microbiocidal step (e.g. frozen berries) (Codex 2017). • Guidelines on the application of general principles of food hygiene to the control of viruses in food *CAC/GL 79-2012* provides guidance on how to prevent or minimise the presence of human enteric viruses in foods, and more specifically norovirus and HAV in foods (Codex 2012). • In Australia, the majority of horticultural product is grown under recognised food safety schemes. The main schemes used are the Harmonised Australian Retailers Produce Scheme (HARPS), and schemes that are internationally benchmarked to the Global Food Safety Initiative (GFSI) (FSANZ 2020). Further, Chapter 3 Standards (Food Safety Standards) of the *Australia New Zealand Food Standards Code* apply to food businesses that handle or sell horticultural produce. Some requirements in these Standards can apply to activities such as transport and pack house activities (as long as they are not considered to be "primary food production"). Some elements of traceability are also provided through food receipt and recall provisions of Standard 3.2.2, along with labelling requirements under Standard 1.2.2.

Management approaches used by overseas countries
New Zealand categorise frozen berries as a food of increased regulatory interest. An importer of frozen berries must provide an assurance that food safety has been effectively managed. This may include testing to show that *E. coli* levels are <100 MPN/g or provide a declaration that the frozen berries will be or have been heat treated to 85°C for 1 minute or equivalent (NZ MPI 2020). The European Food Safety Authority (EFSA) recommends good hygiene, manufacturing and agricultural practices in berry producing countries. The *European Commission Regulation (EC) No 852/2004 – Annex 1 Part A: General hygiene provisions for primary production and associated operations* outlines general provisions for the hygienic production of food, including fresh produce. This includes requirements on water use; health and hygiene of food handlers; cleaning and sanitising of facilities, equipment and vehicles; animal and pest exclusion; storage of waste; and the use of biocides (EU 2004). Fresh fruit or vegetables imported into Canada must meet Canadian requirements as set out in the *Safe Food for Canadian Regulations* as well as the *Food and Drug Regulations*. Some products, such as Guatemalan raspberries, are associated with elevated food safety risks and have specific import requirements to minimize potential hazards (CFIA 2019a). Under Section 8 of the *Safe Food for Canadian Regulations* food that is imported, exported or inter-provincially traded must not be contaminated; must be edible; must not consist in whole or in part of any filthy, putrid, disgusting, rotten, decomposed or diseased animal or vegetable substance; and must have been manufactured, prepared, stored, packaged and labelled under sanitary conditions (CFIA 2019b). In the US the Produce Safety Rule of the *Food Safety Modernization Act* established science-based minimum standards for the safe growing, harvesting, packing, and holding of fruits and vegetables grown for human consumption. This includes requirements for water quality; biological soil amendments; sprouts; domesticated and wild animals; worker training and health and hygiene; and equipment, tools and buildings (FDA 2019b). The USDA has aligned the harmonized Good Agricultural Practices Audit Program (USDA H-GAP) with the requirements of the FDA Food Safety Modernization Act's Produce Safety Rule. While the requirements of both programs are not identical, the relevant technical components in the FDA Produce Safety Rule are covered in the USDA H-GAP Audit Program. However, the USDA audits are not regarded as a substitute for FDA or state regulatory inspections (FDA 2019a).

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References

ABS (2014) Australian health survey: Nutrition first results - Foods and nutrients, 2011-12. Australian Bureau of Statistics, Canberra. https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/4364.0.55.007main+features12011-12. Accessed 20 February 2015

AIHW (2018) Hepatitis A in Australia. Australian Institute of Health and Welfare, Canberra. https://www.aihw.gov.au/getmedia/6f006a38-4d3d-4926-b663-28f7b67e1d9f/aihw-phe-236_HepA.pdf.aspx. Accessed 2 September 2019

Bai X, Campagnoli M, Butot S, Putallaz T, Michot L, Zuber S (2020) Inactivation by osmotic dehydration and air drying of *Salmonella*, Shiga toxin-producing *Escherichia coli*, *Listeria monocytogenes*, hepatitis A virus and selected surrogates on blueberries. International Journal of Food Microbiology 320:108522. https://doi.org/10.1016/j.ijfoodmicro.2020.108522

Bidawid S, Farber JM, Sattar SA, Hayward S (2000) Heat inactivation of hepatitis A virus in dairy foods. Journal of Food Protection 63:522–528

Bozkurt H, Phan-Thien KY, van Ogtrop F, Bell T, McConchie R (2020) Outbreaks, occurrence, and control of norovirus and hepatitis A virus contamination in berries: A review. Critical Reviews in Food Science & Nutrition:1-23. https://doi.org/10.1080/10408398.2020.1719383

Butot S, Putallaz T, Sánchez G (2008) Effects of sanitation, freezing and frozen storage on enteric viruses in berries and herbs. International Journal of Food Microbiology 126:30–35. https://doi.org/10.1016/j.ijfoodmicro.2008.04.033

Butot S, Putallaz T, Amoroso R, Sanchez G (2009) Inactivation of enteric viruses in minimally processed berries and herbs. Applied and Environmental Microbiology 75:4155–4161

CDC (2016) Multistate outbreak of hepatitis A linked to frozen strawberries (final update) - 2016. Centers for Disease Control and Prevention, Atlanta. https://www.cdc.gov/hepatitis/outbreaks/2016/hav-strawberries.htm. Accessed 17 June 2019

CDC (2019) Hepatitis A questions and answers for health professionals. Centers for Disease Control and Prevention, Atlanta. https://www.cdc.gov/hepatitis/hav/havfaq.htm. Accessed 4 July 2019

CFIA (2018) Updated food recall warning - Montana brand frozen strawberries recalled due to hepatitis A. Canadian Food Inspection Agency, Ottawa. https://www.inspection.gc.ca/about-the-cfia/newsroom/food-recall-warnings/complete-listing/2018-04-20/eng/1524250838428/1524250840507. Accessed 4 July 2019

CFIA (2019a) Overview - Importing fresh fruit or vegetables. Canadian Food Inspection Agency, Ottawa. http://inspection.gc.ca/food/importing-food/food-specific-requirements/fresh-fruit-or-vegetables/eng/1541613882667/1541613882890. Accessed 21 June 2019

CFIA (2019b) Regulatory requirement: Trade: Safe Food for Canadians Regulations, Part 2. Canadian Food Inspection agency, Ottawa. http://inspection.gc.ca/food/requirements-and-guidance/food-licensing/trade/eng/1539883860127/1539883860720. Accessed 21 June 2019

Cliver DO (2009) Capsid and infectivity in virus detection. Food and Environmental Virology 1:123–128

Codex (2012) Guidelines on the application of general principles of food hygiene to the control of viruses in food (CAC/GL 79-2012). Codex Alimentarius Commission, Rome. http://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXG%2B79-2012%252FCXG_079e.pdf. Accessed 9 December 2020

Codex (2017) Code of hygienic practice for fresh fruits and vegetables (CXC 53-2003). Codex Alimentarius Commission, Rome. http://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXC%2B53-2003%252FCXC_053e.pdf. Accessed 5 March 2021

Codex (2020) General principles of food hygiene (CXC 1-1969). Codex Alimentarius Commission, Rome. http://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXC%2B1-1969%252FCXC_001e.pdf. Accessed 5 March 2021

Deboosere N, Legeay O, Caudrelier Y, Lange M (2004) Modelling effect of physical and chemical parameters on heat inactivation kinetics of hepatitis A virus in a fruit model system. International Journal of Food Microbiology 93:73–85

DHHS Victoria (2017) Hepatitis A oubreak associated with frozen berries. Department of Health and Human Services, Victoria State Government, Melbourne. https://www2.health.vic.gov.au/about/news-and-events/healthalerts/alert-hepatitis-a-berries-2-june-2017. Accessed 31 July 2019

Dziedzinska R, Vasickova P, Hrdy J, Slany M, Babak V, Moravkova M (2018) Foodborne bacterial, viral, and protozoan pathogens in field and market strawberries and environment of strawberry farms. Journal of Food Science 83:3069–3075. https://doi.org/10.1111/1750-3841.14401

EFSA (2014) Tracing of food items in connection to the multinational hepatitis A virus outbreak in Europe. EFSA Journal 12:3821. https://doi.org/10.2903/j.efsa.2014.3821

Enkirch T, Eriksson R, Persson S, Schmid D, Aberle SW, Lof E, Wittesjo B, Holmgren B, Johnzon C, Gustafsson EX, Svensson LM, Sandelin LL, Richter L, Lindblad M, Brytting M, Maritschnik S, Tallo T, Malm T, Sundqvist L, Ederth JL (2018) Hepatitis A outbreak linked to imported frozen strawberries by sequencing, Sweden and Austria, June to September 2018. Eurosurveillance 23:1800528. https://doi.org/10.2807/1560-7917.ES.2018.23.41.1800528

ESR (2016) Annual summary of outbreaks in New Zealand 2015. The Institute of Environmental Science and Research, Wallaceville. https://surv.esr.cri.nz/PDF_surveillance/AnnualRpt/AnnualOutbreak/2015/2015OutbreakRpt.pdf. Accessed 1 August 2019

EU (2004) Regulation (EC) No 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32004R0852. Accessed 21 June 2019

FDA (2012) The bad bug book: Foodborne pathogenic microorganisms and natural toxins handbook. US Food and Drug Administration, Silver Spring. https://www.fda.gov/food/foodborne-pathogens/bad-bug-book-second-edition. Accessed 17 June 2019

FDA (2019a) Frequently asked questions on FSMA . US Food and Drug Administration, Silver Spring. https://www.fda.gov/food/food-safety-modernization-act-fsma/frequently-asked-questions-fsma. Accessed 29 August 2019

FDA (2019b) FSMA final rule on produce safety. US Food and Drug Administration, Silver Spring. https://www.fda.gov/food/food-safety-modernization-act-fsma/fsma-final-rule-produce-safety. Accessed 24 June 2019

Fiore AE (2004) Hepatitis A transmitted by food. Clinical Infectious Diseases 38:705–715

FSANZ (2013) Hepatitis A virus. In: Agents of Foodborne Illness. Food Standards Australia New Zealand, Canberra. https://www.foodstandards.gov.au/publications/Pages/agents-foodborne-illness.aspx. Accessed 5 March 2021

FSANZ (2020) Proposal P1052 - PPP requirements for horticulture (berries, leafy vegetables and melons): First call for submission - Supporting document 2: Food safety measures for horticultural produce. Food Standards Australia New Zealand, Canberra. https://www.foodstandards.gov.au/code/proposals/Pages/P1052.aspx. Accessed 5 March 2021

FSANZ, NZ MPI (2015) Guidance for thermal inactivation of hepatitis A virus in berries. Food Standards Australia New Zealand and Ministry for Primary Industries. https://www.foodstandards.gov.au/publications/Documents/Guideline%20for%20heat%20inactivation%20of%20HAV%20in%20berries%20pdf.pdf. Accessed 21 May 2021

Grohmann G, Lee A (2003) Viruses, Food and Environment. In: Hocking AD (ed) Foodborne microorganisms of public health significance, 6th edn. AIFST Inc. (NSW Branch) Food Microbiology Group, Waterloo, N.S.W., pp 615–634

Hollinger FB, Martin A (2013) Hepatitis A virus. In: Knipe DM, Howley PM (eds) Fields virology, 6th edn., Ch 19. Lippincott Williams & Wilkins, Philadelphia, pp 550–581

Hort Innovation (2018) Berry export strategy 2028. Hort Innovation Australia, Sydney. https://www.horticulture.com.au/globalassets/hort-innovation/resource-assets/mt17001-export-summary_berry.pdf. Accessed 5 March 2021

Hort Innovation (2019) Australian horticulture statistics handbook: Fruit 2017/18. Horticulture Innovation Australia, Sydney

Incili GK, Koluman A, Dikici A (2019) Determination of hepatitis A virus, Enterobacteriaceae, coliform and *Escherichia coli* contamination of frozen raspberries. Journal of Faculty of Veterinary Medicine, Erciyes University 16:38–42

Li D, Butot S, Zuber S, Uyttendaele M (2018) Monitoring of foodborne viruses in berries and considerations on the use of RT-PCR methods in surveillance. Food Control 89:235–240. https://doi.org/10.1016/j.foodcont.2018.02.024

Macori G, Gilardi G, Bellio A, Bianchi DM, Gallina S, Vitale N, Gullino ML, Decastelli L (2018) Microbiological parameters in the primary production of berries: A pilot study. Foods 7:105. https://doi.org/10.3390/foods7070105

NNDSS (2021) National Notificable Disease Surveillance System, Department of Health, Canberra. http://www9.health.gov.au/cda/source/cda-index.cfm. Accessed 2 March 2021

NZ MPI (2020) Food Notice - Importing food. New Zealand Ministry for Primary Industries. Wellington. https://www.mpi.govt.nz/dmsdocument/10685-Food-Notice-Importing-Food. Accessed 5 March 2021

OzFoodNet (2015) Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: Annual report of the OzFoodNet network, 2011. Communicable Disease Intelligence 39:E236-E264

OzFoodNet (2017) Quarterly report, 1 April to 30 June 2015. Communicable Disease Intelligence 41:E497-E505

OzFoodNet (2018) Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: Annual report of the OzFoodNet network, 2012. Communicable Disease Intelligence 42:PII:S2209-6051(18)00014-3

Ruscher C, Faber M, Werber D, Stark K, Bitzegeio J, Michaelis K, Sagebiel D, Wenzel JJ, Enkelmann J (2020) Resurgence of an international hepatitis A outbreak linked to imported frozen strawberries, Germany, 2018 to 2020. Euro Surveill 25:1900670

SA Health (2017) Summary of outbreaks reported to CDCB in South Australia. Communicable Disease Control Branch, SA Health, Government of South Australia, Adelaide. https://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/resources/summary+of+outbreaks+reports+to+cdcb+south+australia+2017. Accessed 31 July 2019

Sanchez G, Bosch A (2016) Survival of enteric viruses in the environment and food. In: Goyal SM, Cannon JL (eds) Viruses in Foods: Food Microbiology and Food Safety, 2nd edn., Ch 13. Springer, pp 367–392

Severi E, Verhoef L, Thornton L, Guzman-Herrador BR, Faber M, Sundqvist L, Rimhanen-Finne R, Roque-Afonso AM, Ngui SL, Allerberger F, Baumann-Popczyk A, Muller L, Parmakova K, Alfonsi V, Tavoschi L, Vennema H, Fitzgerald M, Myrmel M, Gertler M, Ederth J, Kontio M, Vanbockstael C, Mandal S, Sadkowska-Todys M, Tosti ME, Schimmer B, O Gorman J, Stene-Johansen K, Wenzel JJ, Jones G, Balogun K, Ciccaglione AR, O Connor L, Vold L, Takkinen J, Rizzo C (2015) Large and prolonged food-borne multistate hepatitis A outbreak in Europe associated with consumption of frozen berries, 2013 to 2014. Eurosurveillance 20:21192. https://doi.org/10.2807/1560-7917.es2015.20.29.21192

Shin H, Park H, Seo DJ, Jung S, Yeo D, Wang Z, Park KH, Choi C (2019) Foodborne viruses detected sporadically in the fresh produce and its production environment in South Korea. Foodborne Pathogens and Disease 16:411–420. https://doi.org/10.1089/fpd.2018.2580

Tavoschi L, Severi E, Niskanen T, Boelaert F, Rizzi V, Liebana E, Dias JG, Nichols G, Takkinen J, Coulombier D (2015) Food-borne diseases associated with frozen berries consumption: A historical perspective, European Union, 1983 to 2013. Eurosurveillance 20:21193

Thompson C, Dey A, Fearnley E, Polkinghorne B, Beard F (2017) Impact of the national targeted Hepatitis A immunisation program in Australia: 2000–2014. Vaccine 35:170–176

Torok VA, Hodgson KR, Jolley J, Turnbull A, McLeod C (2019) Estimating risk associated with human norovirus and hepatitis A virus in fresh Australian leafy greens and berries at retail. International Journal of Food Microbiology. https://doi.org/10.1016/j.ijfoodmicro.2019.108327

Wasley A, Feinstone SM, Bell BP (2010) Hepatitis A virus. In: Mandell GL, Bennett JE, Dolin R (eds) Mandell, Douglas, and Bennett's principles and practice of infectious diseases, 7th edn., Ch 173. Churchill Livingstone, Philadelphia, pp 2367–2387