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Import Risk Analysis:
Milk and milk products derived from pasteurised camel milk for human consumption

Draft approved for IHS development

Prepared for Ministry for Primary Industries

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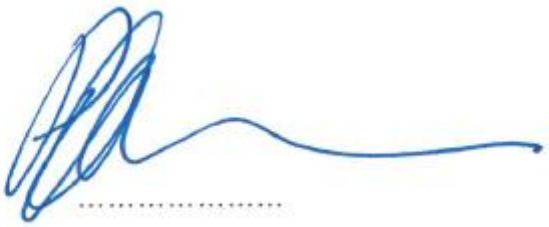

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New Zealand is a member of the World Trade Organisation and a signatory to the Agreement on the Application of Sanitary and Phytosanitary Measures ("The Agreement"). Under the Agreement, countries must base their measures on an International Standard or an assessment of the biological risks to plant, animal or human health.

This document provides a scientific analysis of the biosecurity risks associated with Milk and milk products derived from pasteurised camel milk for human consumption. It assesses the likelihood of entry, exposure and consequences of organisms should they establish in New Zealand. The document has been internally and externally peer reviewed and is now released publically. Any significant new science information received that may alter the level of assessed risk will be included in a review, and an updated version released.

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Executive summary

The Import Risk Analysis 2019, Milk and milk products derived from pasteurised camel milk for human consumption (IRA 2019) is an extension to the Import Risk Analysis for milk and milk products derived from pasteurised milk for human consumption, 2015 (IRA 2015).IRA 2019 is conducted because milk derived from camels was not included in the IRA 2015. A detailed description of the pasteurisation, additional manufacturing processes for milk products and relevant legislation in New Zealand has been included in the IRA 2015.

In this risk analysis four hazards were identified that may be associated with camel milk;

- Camelpox virus
- Coronavirus (specifically Middle East respiratory coronavirus)
- *Burkholderia mallei*
- *Yersinia pestis*

All hazards were assessed as presenting negligible risk in the commodity.

1. Introduction

Camel milk is widely consumed in countries of the Middle East and North Africa. There are also camel farms producing camel milk in the United States of America (USA).

Camel milk is promoted as a health food. Reflecting increased public interest in 'health and superfoods', there is likely to be an increase in international trade in this commodity. An increase in the international movement of people through tourism and migration may also increase the demand for trade in commodities from their country of origin.

This import risk analysis identifies potential hazards associated with camel milk and assesses whether these represent a risk to New Zealand following pasteurisation (as defined in the scope and commodity definition of this risk analysis) of camel milk.

2. Scope

This import risk analysis assesses the biosecurity risks associated with pasteurised camel milk and milk products sourced from camels of the genus *Camelus* [domesticated dromedary (*Camelus dromedaries*) and Bactrian camels (*Camelus bactrianus*)], also collectively referred to as Old World camels (OWC).

Milk from these animals is produced in a well-managed commercial hygienic dairy situation and is subjected to pasteurisation, where pasteurisation standards are defined according to the Codex standards.

Organisms that were identified as hazards in the milk from cattle, sheep, goats and buffaloes (MPI 2015), and that were subjected to a risk assessment, are not further evaluated in this risk analysis. This risk analysis assesses only organisms of concern in camels, not assessed in the import risk analysis for milk and milk products for human consumption derived from pasteurised milk (MPI 2015).

3. Commodity definition

The commodities assessed include camel milk for human consumption or used in the manufacture of other products for human consumption. The camel milk used in these commodities has been subjected to the Holder (batch) method of pasteurisation, high-temperature short-time (HTST) or ultra-high temperature (UHT) pasteurisation.

Camel milk is defined as milk derived from lactating domesticated dromedary (*Camelus dromedaries*) and Bactrian camels (*Camelus bactrianus*), where milk means 'the normal mammary secretion of milking animals obtained from one or more milkings without either addition to it or extraction from it'. Milk product means 'the product obtained by any processing of milk' (OIE 2016).

'Pasteurisation' is defined as the treatment of milk according to one of the following methods:

(a) The Holder method, by which the milk or milk product is

(i) rapidly heated to a temperature of not less than 63°C; and

(ii) retained at that temperature for not less than 30 minutes:

(b) The high-temperature short-time (HTST) method, by which the milk or milk product is:

(i) rapidly heated to a temperature of not less than 72°C; and

(ii) retained at that temperature for not less than 15 seconds:

(c) Any other heat treatment method that is as effective in terms of bacterial reduction as the methods referred to in (a) and (b).

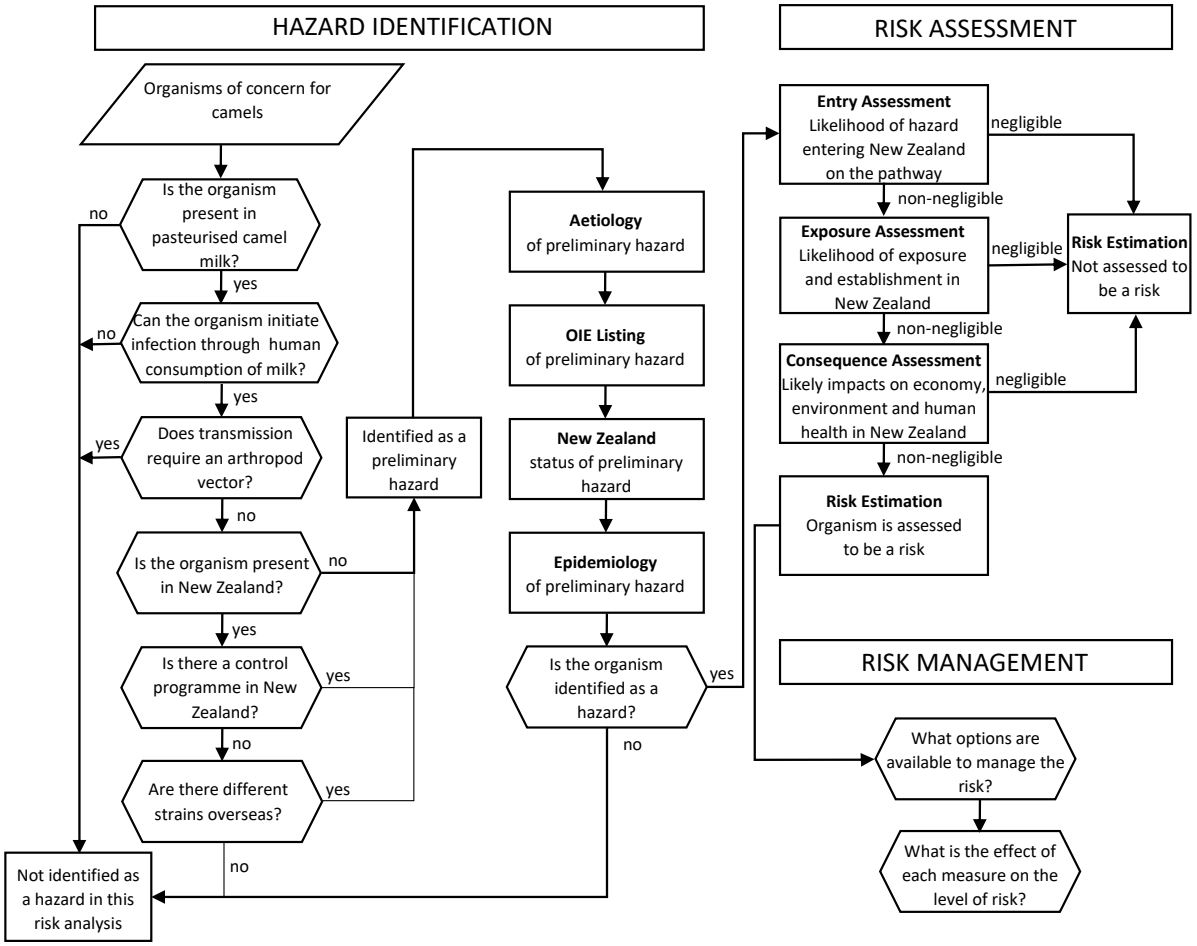
or

'Ultra-high temperature' (UHT) treatment for milk or liquid dairy material means the application of heat to a continuously flowing milk or liquid dairy material using such high temperatures for such time that renders the product commercially sterile at the time of processing, this process involves heating of milk to not less than 132°C for no less than one second.

4. Methodology

The methodology used in this risk analysis follows the guidelines as described in *Biosecurity New Zealand Risk Analysis Procedures – Version 1* (Biosecurity New Zealand 2006) and in Section 2 of the *Terrestrial Animal Health Code* of the World Organisation for Animal Health (OIE 2019). The process followed is shown in Figure 1.

Figure 1.



4.1. Preliminary list of hazards

From consulting authoritative texts, electronic databases, and previous MPI risk analyses a list of organisms known to infect old world camelids has been collated. By applying specific criteria to each organism listed, those that do not constitute any risk may be eliminated (section 6 outlines the process and specific criteria that have been applied). The remaining organisms are collated into a preliminary list of hazards.

4.2. Hazard identification

Organisms in the preliminary list of hazards are subjected to a more detailed hazard identification step. This step includes formal identification of the organism, whether it is OIE listed, its New Zealand status, and a discussion of the relevant aspects of the epidemiology of the organism. The hazard identification section is concluded by an assessment of whether the organism is identified as a hazard or not. All hazards are subjected to risk assessment

4.3. Risk assessment

Risk assessment consists of:

Entry assessment: The likelihood of a hazard (pathogenic organism) being imported with the commodity.

Exposure assessment: Describes the biological pathway(s) necessary for exposure of susceptible animals or humans in New Zealand to the hazard. Further, a qualitative estimation of the probability of the exposure occurring is made.

Consequence assessment: Describes the likely consequences of entry, exposure and establishment or spread of an imported hazard.

Risk estimation: An estimation of the risk posed by the hazard associated with importing milk and milk products. This is based on the entry, exposure and consequence assessments. If the risk estimate is assessed to be non-negligible, then the hazard is assessed to be a risk and risk management measures may be justified to effectively manage the risk.

Not all of the above steps may be necessary in all risk assessments. The OIE methodology makes it clear that if the likelihood of entry is negligible[1], then the risk estimate is automatically negligible and the remaining steps of the risk assessment need not be carried out. The same situation arises when the likelihood of entry is non-negligible but the exposure assessment concludes that the likelihood of susceptible species being exposed is negligible, or when both entry and exposure are non-negligible but the consequences of introduction are assessed to be negligible.

[1] Negligible and non-negligible are terms used as adjectives to qualify risk estimates. Negligible is defined as not worth considering; insignificant. Non-negligible is defined as worth considering; significant (Biosecurity New Zealand 2006a).

4.4. Risk management

For each organism assessed to be a risk, options are identified for managing that risk. Where the OIE Terrestrial Animal Health *Code* (the *Code*) lists recommendations for the management of a risk, these are described alongside options of similar, lesser or greater stringency, where available. In addition to the options presented, unrestricted entry or prohibition may also be considered. Recommendations for the appropriate sanitary measures to achieve the effective management of risks are not made in this document. These will be determined when the IHS and risk management proposal documents are drafted.

As obliged under Article 3.1 of the WTO SPS Agreement the measures adopted in IHSs will be based on international standards, guidelines and recommendations where they exist, except as otherwise provided for under Article 3.3. That is, measures providing a higher level of protection than international standards can be applied if there is scientific justification, or if there is a level of protection that the member country considers is more appropriate and is based on a scientific risk assessment.

4.5. Risk communication

After an import risk analysis has been completed, MPI assesses the options available and proposes draft measures for the effective management of identified risks. These are then presented in a draft IHS that is released together with a risk management proposal (RMP) that summarises the options analysis, the rationale for the identified measures and a link to the draft risk analysis.

5. Organisms of potential concern and the preliminary hazard list

Organisms of potential concern are identified from the following sources:

- Infectious diseases in camelids. 2nd revised edition. Eds: Wernery U, Kaaden OR. Blackwell Science, Berlin-Vienna, 2002.
- Significant diseases of *Camelidae.* Report of the second meeting of the OIE *ad hoc* group on diseases of camelids, Paris, 3-5 May 2010.
- Review of infectious diseases of the camel. (2005). Abbas B, Omer OH. Veterinary Bulletin. 75:8, 1-16.
- Import risk analysis: Llamas (*Lama ghlama*) and alpacas (*Vicugna pacos*) from specified countries (MPI 2010).
- Import risk analysis: Milk and milk products for human consumption derived from pasteurised milk (MPI 2015).

Table 1: Exotic organisms of concern that may be present in milk from camels

Disease agent	OIE listed	Disease or potential carrier	Present in NZ	Present in milk	Preliminary hazard
Viruses					
Akabane virus (Simbu viruses)	No	Yes (Wernery and Kaaden 2002)	No (*Peacock et al.* 2014)	No (CFSPH 2009)	No
Adenovirus	No	Yes (Intisar *et al.* 2009)	Present (Vermunt and Parkinson 2000)	No	No
African horse sickness	Yes	Yes (Mellor and Hamblin 2004)	No	No (Mellor and Hamblin 2004)	No
Aujeszky's disease virus	Yes	Yes (rarely)(CFSPH 2006a)	No	No (CFSPH2006a)	No
Bluetongue virus	Yes	Yes (Yousef *et al.* 2012)	No	No (Yousef *et al.* 2012)	No
Borna disease virus	No	Unknown	No	No (Wensman 2012)	No
Bovine ephemeral fever virus	No	Yes (Walker and Klement 2015)	No	No (Walker and Klement 2015)	No
Bovine herpes viruses	Yes	Yes (Intisar *et al.* 2009)	BHV-1.2b (Wang *et al.* 2006) BHV-4 (de Boer *et al.* 2014)	No (Muylkens *et al.* 2007)	No
Bovine immunodeficiency virus	No	Unknown	Present (Horner 1991)	Yes	No
Bovine parainfluenza 3 virus	No	Yes	Present (Vermunt and Parkinson 2000)	No	No
Bovine respiratory syncytial virus	No	Yes (Wernery and Kaaden 2002)	Present (Horner 1991)	No	No

Disease agent	OIE listed	Disease or potential carrier	Present in NZ	Present in milk	Preliminary hazard
Bovine viral diarrhoea virus	Yes	Yes (Yousif *et al*. 2004)	BVDV type 1 Present (Thobokwe and Heuer 2004) BVDV type 2 Exotic	Yes	Yes
Camelpox virus	Yes	Yes (Wernery and Kaaden 2002	No	Yes	Yes
Contagious ecthyma virus	No	Yes (Wernery and Kaaden 2002)	Yes (McFadden and Rawdon 2012)	No	No
Coronaviruses	No	Yes (OWC only) (Reusken *et al*. 2013)	Yes (dependant on strains)	Unknown	Yes
Crimean Congo haemorrhagic fever virus	Yes	Yes (Wernery and Kaaden 2002)	No	Yes	Yes
Ephemeral fever virus	No	Yes (Walker and Klement 2015)	No	No	No
Epizootic haemorrhagic disease virus	Yes	Unknown	No (Peacock *et al.* 2014)	No (CFSPH 2006b)	No
Equine herpes virus - 1	Yes	Yes, Bactrian camel (Bildfell *et al*. 1996)	Yes	No	No
Foot and mouth disease virus	Yes	Yes, Bactrian camel (Wernery and Kinne 2012)	No	Yes	Yes
Influenza viruses (A, B and equine influenza virus)	Yes	Yes (Wernery and Kaaden 2002)	Yes (Human strains)	No (CFSPH 2014)	No
Papilloma virus	No	Yes (Munz *et al*. 1990)	Yes (Vermunt and Parkinson 2000)	No	No
Parainfluenza virus	No	Yes (Wernery and Kaaden 2002)	Yes (Vermunt and Parkinson 2000)	No	No
Peste des petits ruminants virus	Yes	Yes (Khalafalla *et al*. 2010)	No	Yes	Yes
Rabies virus	Yes	Yes (Wernery and Kaaden 2002)	No	No	No
Rift valley fever virus	Yes	Yes (Wernery and Kaaden 2002)	No	Yes	Yes
*Rinderpest virus	Yes	Yes (OIE 2013)	No	Yes	N/A
Rotaviruses	No	Yes (Ali *et al.* 2005)	Yes (Howe 2008)	No	No
West Nile fever virus	Yes	Yes (El-Harrak *et al*. 2011)	No	No (CFSPH 2013)	No

Disease agent	OIE listed	Disease or potential carrier	Present in NZ	Present in milk	Preliminary hazard
Bacteria					
Bacillus anthracis	Yes	Yes (Wernery and Kaaden 2002)	No	Yes	Yes
Borrelia burgdorferi	No	Unknown but possible	No	Yes	Yes
Brucella abortus, B. melitensis, B. ovis	Yes	Yes (Wernery and Kaaden 2002)	Only *B. ovis* (Reichel *et al.* 2008)	Yes	Yes
Burkholderia mallei	Yes	Yes (Wernery *et al*. 2011)	No	Unknown	Yes
Burkholderia pseudomallei	No	Yes (Choy *et al*. 2000)	No	Yes	Yes
Chlamydophila abortus	Yes	Yes (Mansour *et al*. 2008)	No	Yes	Yes
Coxiella burrnetii	No	Yes (Mohammed *et al*. 2014)	No	Yes	Yes
Francisella tularensis	Yes	Yes (Awol *et al.* 2011)	No	No (Feldman 2003)	No
Mycobacterium avium subsp. *paratuberculosis*	Yes	Yes (Alharbi *et al*. 2012)	Yes	Yes	No
Mycobacterium bovis	Yes	Yes (Wernery and Kaaden 2002)	Yes	Yes	No
Mycoplasma agalactiae	Yes	Yes (Ur-Rahman *et al.* 2006)	No	Yes	Yes
Mycoplasma argini and other *Mollicutes* spp.	No	Yes (Elfaki *et al*. 2002)	No	Yes (some species)	Yes
Mycoplasma capricolum subps. *Capripneumoniae*	Yes	Unknown	No	No (Thiaucourt and Bolske 1996)	No
Mycoplasma mycoides mycoides SC	Yes	Yes (Egwu and Aliyu 1997)	No	Yes (sheep) Camels (unknown)	Yes
Pasteurella multocida 6:B and 6:E	Yes	Yes (Wernery and Kaaden 2002)	No	Yes	Yes
Rhodococcus equi	No	Yes (Kinne *et al*. 2011)	Yes	No	No
Staphylococcus spp.	No	Yes (Wernery and Kaaden 2002)	Yes	Yes	No
Streptococcus spp.	No	Yes (Wernery and Kaaden 2002)	Yes	Yes	No
Yersinia pestis	No	Yes (Wernery and Kaaden 2002)	No	Unknown	Yes

*Rinderpest virus: In 2011 the OIE declared world freedom from Rinderpest virus, therefore rinderpest virus is not assessed as a hazard.

Organisms that are potential hazards in camel milk and are non-endemic to New Zealand include;

Viruses

Bovine viral diarrhoea virus

Camelpox virus

Coronaviruses

Crimean Congo haemorrhagic fever virus

Foot and mouth disease virus

Peste des petits ruminants virus

Rift valley fever virus

Bacteria

Bacillus anthracis

Borrellia spp.

Brucella spp.

Burkholderia mallei

Burkholderia pseudomallei

Chlamydophila abortus

Coxiella burnetii

Mycoplasma spp.

Pasteurella multocida 6:B and 6:E

Yersinia pestis

Transmissible spongiform encephalopathies

There is not much evidence in the literature to suggest that Old World camels are susceptible to the transmissible spongiform encephalopathies, although there is ongoing research in this area (Tahmoorespur and Niaraki 2014). Babelhadj et al. detected a prion disease in dromedary camels in Algeria, designated as camel prion disease (CPD) (Babelhadj et al., 2018). Even though prions were detected from the brain and lymph node samples, the origin of the disease, epidemiology and similarity with other prion diseases in other species of animals are not yet fully known. This literature concluded warranting further studies on this new prion disease, so any advancement in this area needs to be re-assessed, and a review of this IRA must be conducted accordingly.

The majority of the organisms identified in the above list were assessed in the import risk analysis for milk and milk products derived from pasteurised milk (MPI 2016). Organisms that were not assessed and require further evaluation as hazards in camel milk are;

Viruses

Camelpox virus

Coronavirus (specifically Middle East respiratory coronavirus)

Bacteria

Burkholderia mallei

Yersinia pestis

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6. Camelpox virus

6.1. HAZARD IDENTIFICATION

6.1.1. Aetiological agent

Family: *Poxviridae*. Subfamily: *Chordopoxvirinae*.

Under the *chordopoxvirinae* are the genera *orthopoxviruses* and *capripoxviruses*. The genus *orthopoxvirus* contains the species cowpox, camelpox and buffalopox viruses.

6.1.2. OIE listed

Camelpox is listed under other diseases and infections. There is no *Code* chapter.

6.1.3. New Zealand status

Camelpox virus is a notifiable organism.

6.1.4. Epidemiology

Camelpox virus (CMLV) is closely related to variola virus the causative agent of smallpox in humans. CMLV is host specific and causes disease in camels of the genus *Camelus (Camelus dromedarius* and *Camelus bactrianus)* (Kitching 2004). CMLV does not cause disease in sheep, goats, cattle or New World camelids (Fassi-Fehri 1987, OIE 2014).

CMLV is endemic in all countries where OWC are kept, apart from Australia (OIE 2015) and the US (WAHIS, 2018). The disease has a pattern of sporadic outbreaks and a seasonal increase in occurrence associated with the rainy season (OIE 2014). The economic impact of the disease is associated with reduction in milk, weight loss and mortality in younger stock (Bhanuprakash *et al.* 2010).

CMLV causes disease primarily in young camels when colostral immunity starts to wane (Kitching 2004). Transmission is through direct contact between susceptible and infected camels, where small abrasions in the skin, respiratory tract aerosol infection and biting arthropods (*Hyalomma dromedarii*) are described as routes of infection (Wernery and Kaaden 2002).

The disease has an incubation period of 9 - 13 days (Wernery and Kaaden 2002). Primary viral replication occurs at the site of inoculation, the disease can then either become localised or systemic where there is viral replication in lymph nodes and organs and development of viraemia with extension to the skin (Wernery and Kaaden 2002). The disease is characterised by fever, lymphadenopathy and skin lesions. Mortality can be up to 28% or higher in younger animals (Kitching 2004).

Secretion of the virus in milk, saliva and oculo-nasal discharge has been reported and the virus can survive in scabs for several months (Bhanuprakash *et al.* 2010). Fomites can cause environmental contamination and serve as a source of infection (Bhanuprakash *et al.* 2010).

Recovered animals develop long lasting immunity and vaccination with live attenuated vaccines can provide protection for up to 6 years (Bhanuprakash *et al.* 2010).

6.1.5. Hazard identification conclusion

Camelpox virus can be present in the milk of infected camels therefore camelpox virus is identified as a hazard.

6.2. RISK ASSESSMENT

6.2.1. Entry assessment

Milk fat and protein in milk act as protectants for pathogens, and increase the time and temperature required to destroy pathogens in milk (Juffs & Deeth, 2007). Homogenisation, filtration, decreasing milk fat content and flow turbulence in pasteurisation decrease this protective effect, but milk products with higher fat or protein content (i.e. curd, whey, cream) may contain residual viral particles (Bidawid et al., 2000; EFSA, 2006; Hirneisen et al., 2010).

Camelpox virus can be excreted in milk or contaminate milk from lesions on teats. Although pasteurisation may be effective in removing the virus from milk, clear evidence for this is not available in the literature.

Studies on vaccinia virus (an orthopox virus closely related to variola virus, cowpox, camelpox and buffalopox viruses) showed a 94.85% (milk with 10^3 plaque forming units (PFU)/ml) and 99.99% (milk with 10^5 PFU/ml) reduction in viral titres at 65°C for 30 minutes (equivalent to batch pasteurisation) but infective viral particles could still be isolated (de Oliveira *et al.* 2010).

As vaccinia virus and orthopoxviruses share similar physical properties there may be residual pox viruses in milk following batch pasteurisation. There is no data available on the efficiency of HTST pasteurisation in destroying pox viruses, so there may be recoverable pox viruses following HTST pasteurisation. Consequently, the level of residual viral particles for camelpox following pasteurisation is deduced to be very low.

The likelihood of entry is assessed to be very low.

6.2.2. Exposure assessment

Camelpox virus causes disease only in OWC's. Cattle, sheep, goats, New World camelids, dogs, cats or pigs are not susceptible to infection. There is a very small scattered population of OWC's in New Zealand. The concentration of surviving virus in camel milk products following pasteurisation is likely to be very low and a pathway for exposure is not apparent.

The likelihood of exposure is assessed to be negligible.

6.2.3. Risk estimation

The likelihood of entry for camelpox virus is very low and the likelihood of exposure is assessed to be negligible, therefore camelpox virus is not assessed not to be a risk in the commodity.

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7. Coronaviruses

7.1. HAZARD IDENTIFICATION

7.1.1. Aetiological agent

Family: *Coronaviridae.* Subfamily: *Coronavirinae* Genus: *Betacoronavirus*, clade c, the causative agent of Middle East respiratory syndrome coronavirus (MERSCoV)

7.1.2. OIE listed

Not listed.

7.1.3. New Zealand status

Bovine coronaviruses are present (Vermunt 2000). There are no reports regarding *Betacoronaviruses* in OWC's in New Zealand.

7.1.4. Epidemiology

Intestinal coronaviruses have been reported to cause neonatal diarrhoea in camel calves and it is likely that OWC's are susceptible to bovine coronaviruses (Wernery and Kaaden 2002). Recently a novel coronavirus (clade c betacoronavirus) has been identified in OWC's with upper respiratory infection which is very similar to the coronavirus identified in humans with Middle East respiratory syndrome coronavirus (MERSCoV) (Azhar 2014). Surveys of camels have found large numbers of antibody positive animals (Reusken *et al.* 2013). It is now assumed that camels can be infected and carry the MERSCoV and potentially act as reservoirs of infection for humans (Reusken *et al.* 2013, Chu *et al.* 2014).

Seropositive dromedary camels have been found in the Middle East countries of Oman, the Kingdom of Saudi Arabia (KSA), Qatar, Jordan, the United Arab Emirates (UAE), Kuwait as well as Sudan, Somalia, Egypt, Tunisia, Nigeria, Kenya and Ethiopia in Africa, and the Canary Islands (MacKay and Arden 2015)

Sheep, cows, pigs, horses, donkeys, mules, birds, water buffalo, goats, Bactrian camels, llamas and guanaco (South American camelids) have been tested but none had detectable neutralising antibody against MERSCoV (MacKay and Arden 2015).

The disease in dromedary camels appears mild to subclinical. There may be coughing, sneezing and a nasal discharge with low grade fever and reduced appetite (Hemida *et al.* 2014).

MERSCoV-RNA has been detected in the nasal secretions, faeces and milk of camels shedding the virus (Reusken *et al.* 2014). However the titre of viral RNA in milk was very low and viral culture could not be undertaken. Furthermore it is uncertain if the virus was truly secreted from mammary gland or if there had been contamination, as milk sampling was performed using traditional methods of milking where the udder and teats were not cleaned, so there may have been salivary contamination from suckling calves. Juvenile dromedary camels are more frequently associated with active infection showing nasal discharge (Reusken *et al.* 2014).

The epidemiology of MERSCoV in camels is still under investigation. It is suspected that direct contact and aerosol transmission occurs between camels and possibly to humans but pathways of transmission are still to be elucidated (Nowotny and Kolodziejek 2014, MacKay and Arden 2015).

7.1.5. Hazard identification conclusion

The epidemiology of camel associated MERSCoV is poorly understood and there are poorly defined findings of MERSCoV-RNA in camel milk which may be associated with contamination. In the absence of further studies MERSCoV is identified as a hazard in milk.

7.2. RISK ASSESSMENT

7.2.1. Entry assessment

It is uncertain if MERSCoV is truly secreted in milk and in the publication available the titre of viral RNA found was very low and virus isolation could not be done (Reusken *et al.* 2014).

The study by van Dormalen *et al.,* 2014, experimentally inoculated milk and found that heating milk to 63°C for 30 minutes completely destroyed virus. The effect of HTST pasteurisation on MERSCoV was not evaluated, however, a study by Leclerq *et al.* (2014) reports; 'At 56°C, almost 25 minutes were necessary to reduce the initial titre by 4 $\log_{10}$. Increasing temperature to 65°C had a strong negative effect on viral infectivity as virucidy dropped significantly to 1 minute'.

Extrapolating from the above comment it is assumed that at a temperature of 72°C for 15sec (HTST pasteurisation) or greater, the virus should be significantly reduced if not eliminated.

The likelihood of entry of MERSCoV is assessed to be negligible.

7.2.2. Risk estimation

The likelihood of entry of MERSCoV is assessed to be negligible, therefore MERSCoV is not assessed to be a risk in the commodity.

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8. *Burkholderia mallei*

8.1. HAZARD IDENTIFICATION

8.1.1. Aetiological agent

Family: *Burkholderiaceae*. Genus: *Burkholderia*. Species: *B. mallei*, the causative agent of Glanders. *B mallei* is a Gram-negative, non-motile, non-sporulating, obligate intracellular bacterium.

8.1.2. OIE status

Glanders is listed under diseases and infections of equines.

8.1.3. New Zealand status

B. mallei is a notifiable organism and there is declared freedom from this disease.

8.1.4. Epidemiology

Glanders is primarily a disease of equids but is zoonotic and can cause disease in camels, bears, wolves, felids and dogs (Wernery *et al*. 2011, CFSPH 2015, OIE 2015). Cattle and pigs are resistant although small ruminants can become infected (OIE 2015).

B. mallei is thought to be endemic in the Middle East, Asia, Africa, and Central and South America (OIE, 2013). Equids are infected by the oral route when ingesting contaminated food and water (CFSPH 2015). Carnivores can be infected when ingesting contaminated meat. Transmission between infected equids or other animals (camels, small ruminants) can occur through direct contact, respiratory secretions and exudates from skin lesions and contaminated fomites and water troughs (CFSPH 2015).

The average incubation period in equids is 2-6 weeks and it is assumed this may be similar for other infected species (CFSPH 2015). The disease in camels is similar to the disease in horses and is characterised by fever, lethargy, emaciation, severe mucopurulent nasal discharge and the development of nodules and ulcers in the skin, nasal passages and lungs (Wernery *et al.* 2011, CFSPH 2015).

Infected equids can become carriers and may undergo recurrence of the disease (CFSPH 2015). The epidemiology in camels is uncertain but it can be assumed that recovered animals may become chronically infected and develop a carrier status. *B. mallei* was isolated from the blood of an infected camel that died so there is a possibility of secretion of *B. mallei* in milk or contamination from skin lesions or nasal secretions (Wernery *et al.* 2011).

B. mallei is reported to be destroyed by heating to 55°C for 10 minutes (CFSPH 2015).

8.1.5. Hazard identification conclusion

There is no evidence to suggest that *B. mallei* is excreted in milk but as septicaemia has been detected in a dromedary camel there is a possibility that the organism may be excreted in milk. Contamination of milk at milking is also possible. Therefore *B. mallei* is identified as a hazard in milk.

8.2. RISK ASSESSMENT

8.2.1. Entry assessment

B. mallei can infect camels especially where there is an outbreak in horses closely associated with camels. There is no information to confirm the excretion of the bacterium into milk but it could occur in septicaemic animals. Camels appear to be more susceptible to the acute form of the disease, therefore it is likely that animals will show clinical signs of infection, precluding them from milking. If there is excretion of *B. mallei* or contamination of milk then batch pasteurisation will be sufficient to destroy the organism, as *B. mallei* is reported to be destroyed at temperatures of 55°C for 10 minutes.

The effect of HTST pasteurisation on *B. mallei* is uncertain, however the organism is susceptible to heat and drying (CFSPH 2015) so it can be expected that HTST and further processing will either destroy the organism or cause a significant reduction in the number of bacteria present.

There is also likely to be a dilution effect on the concentration of organisms in milk with pooling of milk from multiple animals and herds.

The likelihood of entry is assessed to be negligible.

8.2.2. Risk estimation

The likelihood of entry is assessed to be negligible therefore *B. mallei* is not assessed to be a risk in the commodity.

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9. *Yersinia pestis*

9.1. HAZARD IDENTIFICATION

9.1.1. Aetiological agent

Family: *Enterobacteriaceae*. Genus: *Yersinia*. Species: *Y. pestis*

Y. pestis is the causative agent of bubonic, pneumonic or septicaemic plague in humans. *Y.pestis* is a gram-negative, facultative anaerobic, rod shaped coccobacillus.

9.1.2. OIE status

Y. pestis is not listed

9.1.3. New Zealand status

Y. pestis has not been reported in New Zealand since 1911 (Ministry of Health 2012).

9.1.4. Epidemiology

Y. pestis is found in parts of Africa, Asia, the Middle East, North and South America. It is not endemic in Europe or Oceania (CFSPH 2016).

Y. pestis is maintained in nature in a cycle between fleas and rodents or lagomorphs, which are observed to be 'maintenance hosts' (CFSPH 2016). Fleas transmit the organism to other hosts ie. humans and camels, causing disease outbreaks in these susceptible species (Wernery and Kaaden 2002, CFSPH 2016). Ticks of the genus *Hyalomma* and *Ornithodoras* have also been found to transmit disease (Werney and Kaaden 2002).

Transmission of the disease can occur through direct contact, especially in the pneumonic form where the organism can be shed and transmitted through respiratory droplets (CFSPH 2016). Organisms in body fluids and tissues can penetrate through mucous membranes and skin lesions to cause infection and outbreaks of plague in humans have been associated with the ingestion of meat from infected camels (Christie *et al.* 1980, Wernery and Kaaden 2002, Bin Saeed *et al.* 2005).

There is an incubation period of 1-6 days in camels (Wernery and Kaaden 2002) and death within 20 days. Septicaemic, pneumonic and cutaneous forms of the disease have been reported in camels (Werney and Kaaden 2016).

It is unknown if *Y. pestis* is secreted in the milk of infected animals, however as septicaemia can occur there may be secretion of bacteria into the milk. *Y pestis* can be a contaminant in milk from infected animals.

9.1.5. Hazard identification conclusion

Y. pestis can cause septicaemia therefore it is theoretically possible that bacteria can be excreted into the milk. Furthermore, there can be contamination of milk through discharges from lesions or respiratory tract secretions. *Y. pestis* is identified to be a hazard in milk.

9.2. RISK ASSESSMENT

9.2.1. Entry assessment

There is no evidence that *Y. pestis* is secreted in the milk of infected animals but as there can be a bacteraemia and septicaemia it is possible that bacteria can be secreted into milk. Contamination of milk can also occur through fomites from sick animals.

Y. eneterocolitica and *Y. pseudotuberculosis* are common food contaminants. Studies on the thermal destruction of these organisms found that HTST and batch pasteurisation is effective at destroying these organisms in whole and skim milk (Juffs and Deeth 2007). It is therefore postulated that commercial pasteurisation will have the same effect on *Y. pestis* as the organisms are microbiologically similar.

The likelihood of entry is assessed to be negligible for *Y. pestis*.

9.2.2. Risk estimation

The likelihood of entry is assessed to be negligible, therefore *Y. pestis* in is not assessed to be a risk in the commodity.

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