Australian Government
Department of Agriculture, Fisheries and Forestry

Import risk review for the inclusion of avian material in aquaculture feed: final report



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Contents

Summary ..... **iv**

Introduction **1**

1.1 Australia's biosecurity policy framework 1

1.2 Import risk review 1

1.3 Production of processed aquaculture feed 7

2 Method **10**

2.1 Assessment process and terminology 10

2.2 Focus on infectious bursal disease virus 11

2.3 Estimating unrestricted risk 11

3 Risk assessment: very virulent infectious bursal disease virus **12**

3.1 Technical information 12

3.2 Likelihood of entry 17

3.3 Likelihood of establishment or spread 19

3.4 Potential consequences 20

3.5 Unrestricted risk 20

3.6 Risk management 21

4 Conclusions **22**

References **23**

Tables

Table 1 Nomenclature for qualitative likelihoods 10

Table 2 Matrix of rules for combining descriptive likelihoods 10

Table 3 Matrix for determining the overall risk 11

Summary

This import risk review has been undertaken in response to a request from the aquaculture feeds industry to consider the level of biosecurity risk associated with the inclusion of avian materials in imported aquaculture feed. This request reflects an increasing global pressure on aquaculture industries to diversify from a reliance on ocean-caught bycatch as the primary protein substrate for farmed fish. It is strongly supported by a range of Australian aquaculture industries.

This import risk review is intended to be read as an addendum to the Assessment of a prescribed heat treatment as a risk management measure for fish and fish products for use as pet food and stockfeed (Fish and fish products review).

Australia imports a large amount of fishmeal-based aquaculture feed. Current conditions prohibit (with the exception of some highly processed and New Zealand components) the inclusion of material derived from terrestrial animals. This includes avian material, and encompasses egg products and feathers. Avian material within this prohibition is derived from the definition of risk animal material (RAM) under Australia's ruminant feed ban. RAM includes any material taken from a vertebrate animal (including fish and avians) other than tallow, gelatin, milk products or oils. It also extends to rendered products and compounded feeds made from these products. There have been concerns that imported feeds intended for non-ruminant livestock, including aquatic species, may potentially be contaminated with ruminant derived material and later diverted to ruminants for use. For this reason, current conditions for the importation of fishmeal-based aquaculture feed require the product label, or if sold in bulk, the delivery docket/invoice must state 'This product contains restricted animal material - do not feed to cattle, sheep, goats, deer or other ruminants.'

The Fish and fish products review concentrated on infectious pancreatic necrosis virus (IPNv), as the most resistant of the aquatic animal viruses to thermal treatment. This addendum to that review concentrates on very virulent infectious bursal disease virus (vv-IBDv) as the most resistant of the avian disease agents to thermal treatment. Beyond vv-IBDv, a formal hazard identification process was not undertaken.

The addendum examines 3 common categories of product with respect to the risk for vv-IBDv:

1) granulated hatchery feed
2) extruded pelletised hatchery and grow-out feed
3) soft tuna feed.

The analysis was applied to industry-standard temperatures and times at key processing steps. The analysis found that routine manufacture and processing alone does not reduce the level of biosecurity risk for vv-IBDv to achieve Australia's appropriate level of protection (ALOP).

From this analysis the department concludes that additional heat treatment is required. Avian materials must be subjected to a thermal process at least equivalent to that which was recommended within the Generic import risk analysis report for chicken meat (80°C for 125 minutes). This could be undertaken within the preconditioning or extrusion step of the manufacture of extruded pelletised feeds. Alternatively, manufacturers could apply heat treatment to avian

materials before adding them to the aquaculture feed manufacturing process. Where avian material undergoes this preliminary treatment, it may achieve sufficient risk for each of the 3 identified product categories. Manufacturers must ensure subsequent manufacturing steps meet Australia's existing import requirements for fish and fish products along with any other permit conditions.

Introduction

1.1 Australia's biosecurity policy framework

Australia's biosecurity policies protect the country from exotic pests and diseases that could enter, establish, or spread in Australia, and threaten our unique flora and fauna and agricultural industries.

Risk assessments are an important part of Australia's biosecurity policy. They enable our government to formally consider the level of biosecurity risk associated with the import of goods into Australia. If unrestricted biosecurity risks do not achieve Australia's appropriate level of protection (ALOP), risk management measures are proposed. If the risks cannot be managed to an acceptable level, the goods will not be imported into Australia until suitable measures are identified.

Successive Australian governments have maintained a conservative approach to managing biosecurity risks. This approach is considered in Australia's ALOP, which reflects community expectations through government policy and is currently described as providing a high level of protection aimed at reducing risk to a very low level, but not to zero.

The department undertakes Australia's biosecurity risk analyses using technical and scientific expertise from relevant fields and consults with stakeholders throughout the process.
These biosecurity risk analyses align with Australia's international biosecurity obligations, including those under the World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) and the World Organisation for Animal Health (WOAH). Through this approach, risk analyses support our international obligations whilst addressing the biosecurity risks that goods may pose.

Risk analyses may take the form of a regulated Biosecurity Import Risk Analysis or a non-regulated risk analysis. The latter may include a scientific review of existing policy and import conditions or scientific advice. For information about Australia's biosecurity framework, see the Biosecurity Import Risk Analysis guidelines.

The department recognises that new scientific information and technologies, or other combinations of measures, may achieve an equivalent level of biosecurity protection for disease agents that require risk management.

1.2 Import risk review

1.2.1 Background

This review is an addendum to the Assessment of a prescribed heat treatment as a risk management measure for fish and fish products for use as pet food and stockfeed (Fish and fish products review). The department commenced this review in response to a request from the aquaculture feeds industry to consider including avian materials in imported fishmeal-based aquaculture feed. The request reflects increasing pressure on global aquaculture industries to reduce reliance on ocean-caught bycatch as the primary protein source for farmed fish. Several industry groups and

commercial entities in Australia have supported the request for access to a broader range of terrestrial animal components in aquaculture feeds.

The department currently permits the importation of certain stockfeeds and stockfeed ingredients for consumption by aquatic animals, including as aquaculture feed, hatchery and nursery feed and aquarium food. This includes (with caveats) products containing ingredients derived from aquatic animals, certain highly processed terrestrial animal components and components sourced from New Zealand terrestrial animals.

Approval to import stockfeed will only be granted once it is determined that:

- all ingredients are sourced from tissues, species and countries approved by the department
- processing of biological ingredients renders any contaminating disease agents non-viable and unable to replicate
- manufacturers produce the product in facilities with adequate quality systems and effective controls to prevent cross-contamination
- effective measures apply across production, storage, transport and processing to prevent product contamination of stockfeed and stockfeed ingredients
- appropriate controls ensure that low-risk target species (such as aquatic animals) consume imported products and minimise exposure to off-target, high-risk species.

Stockfeed provides a direct pathway for the potential introduction of disease agents into Australian production animal systems or wildlife. If imported stockfeed is contaminated, Australian animals that consume the product will be exposed to any exotic disease agents. The consequences of importing contaminated stockfeed can be severe, affecting both the intended livestock species and other species that may be exposed through diversion of feed to unintended uses. In some cases, animals may also be exposed through the contamination of the feeding environment via remaining stockfeed.

Bovine spongiform encephalopathy is a key matter for imported livestock feeds and current import conditions for aquaculture feed prohibit the use of material derived from terrestrial animals. This includes avian material, egg products and feathers. The inclusion of avian materials in this prohibition is derived from the definition of risk animal material (RAM) under Australia's ruminant feed ban. RAM includes material derived from any vertebrate animal, including fish and avian species except for tallow, gelatin, milk products or oils. The definition also extends to rendered products and compounded feeds made from these products. The Australian livestock and stock feed industries first introduced the ruminant feed ban as a voluntary measure in 1996, and all states and territories enacted it through legislation in 1997. International markets require assurance that Australia applies appropriate measures to prevent the feeding of RAM to ruminant livestock species such as cattle, sheep, goats and deer. The legislation and its enforcement provide these assurances.

The department has identified a risk that imported feeds intended for non-ruminant livestock species, including aquatic species, may be diverted to ruminants. To manage this risk, current import conditions for fishmeal-based aquaculture feed require clear labelling. The product label, or for bulk consignments, the delivery docket or invoice must include the statement 'This product contains restricted animal material – do not feed to cattle, sheep, goats, deer or other ruminants'.

1.2.2 Fish and fish products review

The 2022 Fish and fish products review responded to interest from Australian pet food and stockfeed manufacturers in importing salmonid products for pet food and stockfeed to meet market demands. As part of the review, the department assessed an alternative biosecurity measure based on the European Union's processing method for category 2 and 3 fish-origin materials.

The assessment used inactivation of infectious pancreatic necrosis virus (IPNv), the most heat resistant of the aquatic animal viruses, as the minimum standard for aquatic viral inactivation to manage the biosecurity risks and achieve Australia's ALOP. Based on the evidence considered, the assessment concluded that moist heat treatment of salmonid fish products to a core temperature of 85°C for 25 minutes would inactivate IPNv. This treatment aligns with the European Union's processing method for category 2 and 3 material of fish origin (EU Regulation 2015/9 of 6 January 2015). Viral titres in non-salmonid fish are generally lower than those in salmonids. As a result, existing thermal treatment requirements to achieve a core temperature of at least 85°C for at least 15 minutes, or at least 80°C for a least 20 minutes is sufficient to achieve viral inactivation in non-salmonid fish products.

A combination of risk management measures and operational systems to reduce the biosecurity risk associated with the importation of fish products imported for use as pet food and stockfeed to achieve Australia's ALOP was therefore implemented. These measures included:

- Fish products of salmonid origin for use as pet food and stockfeed must be treated to meet one of the following conditions:
  - moist heated to a core temperature of at least 85°C for at least 25 minutes, or
  - an equivalent temperature and specified time agreed by the department.
- Fish products that contain only non-salmonid fish material for use as pet food and stockfeed (excluding non-salmonid fish products sourced from New Zealand) must meet existing conditions:
  - moist heated to a core temperature of at least 85°C for at least 15 minutes, or at least 80°C for at least 20 minutes, or
  - an equivalent core temperature and specified time agreed by the department.
- The competent authority must approve and oversee all premises where fish products are processed and packaged.
- All fish products must be manufactured from ingredients that have not been derived from terrestrial or avian animals, including egg products, dairy products and feathers.

The biosecurity measures for fish products of salmonid origin imported for use as pet food and stockfeed differ from current measures. The changes are:

- Heat treatment to a core temperature of 100°C for no less than 30 minutes for fish products containing salmonid material will be reduced to a moist heat treatment to a core temperature of at least 85°C for no less than 25 minutes; or to an equivalent core temperature and specified time agreed to by the department.

- Current restrictions on the percentage of salmonid material contained in the fish products (no more than 2%) will no longer apply.

The biosecurity measures for fish products of non-salmonid origin imported for use as pet food and stockfeed remain unchanged. This is because the department considers that existing measures continue to manage biosecurity risks and achieve Australia's ALOP. These measures will also apply to whole non-salmonid fish imported into Australia for further processing at an approved arrangement site for the manufacture of pet food and stockfeed. It should be noted that whole salmonid fish are not currently permitted import into Australia.

1.2.3 Current import conditions for aquaculture feed and aquatic meals (all countries)

This section outlines import conditions for aquaculture feed and aquatic meals from all countries of key relevance to this review.

Consignments must be accompanied by an official government certificate verifying the following:

- The ingredients used in the manufacture of the goods were not derived from terrestrial (including avian) animals. This includes egg products, dairy products and feathers.
- The goods do not contain material derived from fish from the family *Salmonidae* and genus *Plecoglossus*.

The official certificate must be issued by a body listed in the Director of Biosecurity's List of Overseas Authorities – Aquatic Animals for Import.

Conditions may allow heat treated salmon to be permitted, but salmon ingredients will be assessed on application.

Consignments must be accompanied by a manufacturer's declaration with evidence that any aquatic animal material within the goods has been heat treated to a minimum of:

- 85°C for a period of no less than 15 minutes, or
- 80°C for a period of no less than 20 minutes.

This condition also allows for the assessment of alternative heat treatments upon application.

In addition to conditions assessed as part of the import permit process, suppliers are required to provide a completed production **questionnaire** for Goods for animal consumption, animal cosmetic use or environmental purposes. This includes the question:

> Does the manufacturing facility store, handle or process material of terrestrial (including avian) or marine animal origin (e.g. dairy, oils, protein meals)?

Applicants who respond 'Yes' must provide the following information for each material:

- How is this animal material stored and handled at the site?
- Is this animal material processed on the same production line as that used to produce goods for the Australian market?
- What controls are in place to prevent cross-contamination with product for Australia.

Responses to this part of the questionnaire help the department to determine the likelihood that product destined for export to Australia will be contaminated with product that is not compliant with Australia's requirements.

1.2.4 Scope

This import risk review was limited to the inclusion of avian materials in aquaculture feed. Materials derived from other terrestrial animals such as pigs or other livestock species were not included.

The review focused on the intentional inclusion of carcase materials derived from commercially farmed poultry species. These species include domestic birds of the superorder *Galloanserae* (fowl), especially the order *Galliformes* such as chickens, quails and turkeys. The review also considered waterfowl of the family *Anatidae* (ducks and geese).

Although the review did not exclude specific avian species, it did not focus on the accidental inclusion of excreta or carcase materials derived from wild birds. However, the conclusions of the review can be extended to this pathway if such materials contaminate fishmeal prior to the commencement of commercial processing into aquaculture feed.

1.2.5 Legislation

The objects of the *Biosecurity Act 2015* under section 4 are:

a) to provide for managing the following:

   i) biosecurity risks;

   ii) the risk of contagion of a listed human disease or any other infectious human disease;

   iii) the risk of listed human diseases or any other infectious human diseases entering Australian territory or a part of Australian territory, or emerging, establishing themselves or spreading in Australian territory or a part of Australian territory;

   iv) risks related to ballast water;

v) biosecurity emergencies and human biosecurity emergencies.

b) to give effect to Australia's international rights and obligations, including under the International Health Regulations, the SPS Agreement (World Trade Organization (WTO) *Agreement on the application of sanitary and phytosanitary measures*), the Ballast Water Convention, the United Nations Convention on the Law of the Sea and the Biodiversity Convention.

Section 9 of the Act defines 'biosecurity risk' as the:

a) the likelihood of a disease or pest:

i) entering Australian territory or a part of Australian territory; or

ii) establishing itself or spreading in Australian territory or a part of Australian territory; and

b) the potential for any of the following:

i) the disease or pest to cause harm to human, animal or plant health;

ii) the disease or pest to cause harm to the environment;

iii) economic consequences associated with the entry, establishment or spread of the disease or pest.

In performing functions or exercising powers under the Act, the Director of Biosecurity must have regard to the objects of the Act. This includes giving effect to Australia's international rights and obligations under the World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement). Australia's ALOP is a high level of sanitary and phytosanitary (SPS) protection aimed at reducing biosecurity risks to a very low level, but not to zero. This is in accordance with Australia's rights and obligations under the SPS Agreement.

The SPS Agreement requires risk assessments to:

1) Take into account risk assessment techniques developed by the relevant international organisations (Art 5(1)).
2) Take into account available scientific evidence, relevant processes and production methods, relevant inspection, sampling and testing methods, prevalence of specific diseases or pests, existence of pest or disease-free areas, relevant ecological and environmental conditions, and quarantine or other treatment (Art 5(2)).
3) Take into account relevant economic factors: the potential damage in terms of loss of production or sales in the event of the entry, establishment or spread of a pest or disease; the costs of control or eradication in the territory of the importing Member; and the relative cost-effectiveness of alternative approaches to limiting risks (Art 5(3)).
4) Avoid arbitrary distinctions in the levels of risk considered appropriate in different situations, if such distinctions result in discrimination or a disguised restriction on international trade (Art 5(5)).

5) Ensure SPS measures are not more trade-restrictive than required to achieve the ALOP, taking into account technical and economic feasibility (Art 5(6)).

This document considers the standards, guidelines and recommendations set by WOAH.

1.3 Production of processed aquaculture feed

Although there is marked variation across the aquaculture industries in respect of the formulations and presentations of feed fed to farmed fish, 3 broad categories are commonly produced:

1) granulated or micro-pelletised hatchery and nursery feed
2) pelleted grow-out feed
3) soft tuna food.

1.3.1 Hatchery and nursery feed

Although the distinction is not fixed, a hatchery operation produces fertilised eggs, larvae or fingerlings, while a nursery progresses the fingerlings through to juveniles. Once sufficiently matured, juveniles are transferred to a grow-out facility. Components of the hatchery may be land-based (in ponds or tanks) or sea-based. In general, sea-based systems will require less feed but will also provide a less controlled or consistent aquatic environment. Feeding is a key component of the rearing process and one of the most significant costs. Although some species are able to grow using maternal reserves alone (yolk sac, termed lecithotrophy), most commercially produced species require feeding to optimise survival, growth, yield and juvenile quality. In species such as salmon and trout, the newly hatched fry first feed from their yolk sacs and then can be fed with starter feeds. Marine species such as sea bass, sea bream, flounders and turbot typically consume the nutrition in their yolk sacs during the first few days post hatching and then are fed for several weeks on live prey.

Nutritional requirements are species specific and also vary with larval and juvenile maturation. Carnivorous fish are commonly fed with live prey; rotifers are usually offered to early larvae due to their small size, progressing to larger *Artemia nauplii* or zooplankton. Processed feeds provide an alternative to live prey, and also a substrate for non-carnivorous species. Processed feeds can be produced on site or purchased from commercial suppliers, with the imperative in each case to maintain the level of support for young fish while minimising the cost of feeding.

Processed hatchery and nursery feeds are supplied in a granular or micro-pelletised form, with a particle size appropriate to the size of the larval or juvenile fish. Because water quality is critical to the health of larval and juvenile fish, the granulated feed should not include dust and should leach out of the water column. The protein source within this feed is typically derived from aquatic animals, including fish, krill and squid. Avian material may also be used as a protein source.

Process steps

The components of hatchery and nursery feed are first mixed, ground and sieved. These steps are mechanical only, and although they do not typically include thermal elements, some components may be supplied in rendered form. Following these preliminary steps, hatchery and nursery feed may either be granulated or may be processed using an extrusion procedure similar to pelleted feed. The choice of method will be based on the desired end size of individual feed particles, which in turn will

be dictated by the size and species of the larval or juvenile fish. Granulated hatchery and nursery feed has a lower particle size than micro-pelletised feed and marketed as feed for younger and smaller fish.

Granulated

Granulated hatchery and nursery feed will be subjected to a thermal drying process, with temperature typically 60°C for approximately 20 minutes of a 30 to 40-minute drying cycle.

Extruded (micro-pelletised)

Extruded (micro-pelletised) hatchery and nursery feed will undergo preconditioning, extrusion and drying steps, each of which has a thermal element. The extrusion component also includes increased pressure (typically 20 to 30 bar).

- Preconditioning raises the mixture to a temperature that will achieve starch gelatinisation, which may range from 80°C to 100°C (frequently about 95°C) over a retention period of approximately 5 minutes.
- Extrusion has been cited at 20 to 30 bar and a temperature in the range of 100 to 125°C for approximately 30 seconds.
- Drying is at 90 to 120°C for approximately 40 minutes.

1.3.2 Pelleted grow-out feed

A grow-out operation progresses juvenile fish through to a marketable size.

Four key grow-out systems are commonly used:

1) recirculating aquaculture systems
2) flow through systems
3) cages
4) ponds.

In a recirculating aquaculture system, water is continuously filtered and returned to the tank. This ensures relatively constant water quality, although some replacement and replenishment will be required. In a flow-through system, water is supplied constantly and drained away from the tanks. Cages are used to produce large quantities of fish in large water bodies (e.g. sea, lakes). In this system, there is little additional control of water quality. Ponds are the least managed method. In this setting, the water level is maintained, and aeration may be provided, but there is not otherwise any control over water quality and other parameters.

Grow-out feed is tailored to each species and may be further modified for stages within the grow-out period. Grow-out feed is typically supplied in coated pelletised form. The protein source within grow-out feed is in general derived from aquatic animals, including fish, krill and shrimp, squid. Avian material may also be used as a protein source.

Process steps

The components of grow-out feed are first mixed, ground and sieved. These steps are mechanical only, and although they do not typically include thermal elements, some components may be

supplied in rendered form. Following these preliminary steps, grow-out feed is generally processed using an extrusion procedure similar to micro-pelleted hatchery and nursery feed.

Extruded grow-out feed will undergo preconditioning, extrusion and drying steps, each of which has a thermal element. The extrusion component also includes increased pressure (typically 20 to 30 bar).

- Preconditioning raises the mixture to a temperature that will achieve starch gelatinisation, which may range from 80°C to 100°C (frequently about 95°C), over a retention period of approximately 5 minutes.
- Extrusion has been cited at 20 to 30 bar and a temperature in the range of 100°C to 125°C for approximately 30 seconds.
- Drying is at 90°C to 120°C for approximately 40 minutes.

Following these steps, the dried pellets are generally coated with fish oil to improve their palatability. Oil for this purpose is typically kept and applied at about 70°C. The coated pellets are then cooled and sifted to remove non-pellet debris.

1.3.3 Soft tuna food

Larger farmed tuna do not find traditional hard pelletised feeds palatable. For this reason, a range of companies have developed soft alternatives, including soft-extruded pellets and gelatine-wrapped tuna 'sausages'. The process steps for these products are proprietary and are likely to vary in respect of critical thermal components.

- Soft extruded feeds are likely to be processed using an approach that is similar to that used for extruded pelletised grow-out feed. This includes the preconditioning, extrusion and drying steps, although the latter will likely be curtailed to preserve a softer consistency.
- Gelatine-wrapped tuna sausages are not likely to be processed using extrusion.

Because the products within this category are novel, and quite varied, conclusions about temperature and pressure will not be reliable and individual products will be more appropriately evaluated on a case-by-case basis.

2 Method

2.1 Assessment process and terminology

Section 9 of the Act defines biosecurity risk as the likelihood of a disease or pest entering Australian territory, or a part of Australian territory; and establishing itself or spreading in Australian territory or a part of Australian territory; and the potential for the disease or pest to cause harm to human, animal or plant health, to the environment, and the economic consequences associated with the entry, establishment or spread of the disease or pest (section 1.2.5).

The likelihood components of biosecurity risk were evaluated qualitatively using the department's standardised descriptors (Table 1).

Table 1 Nomenclature for qualitative likelihoods

Likelihood	Descriptive definition
High	The event would be very likely to occur
Moderate	The event would occur with an even probability
Low	The event would be unlikely to occur
Very low	The event would be very unlikely to occur
Extremely low	The event would be extremely unlikely to occur
Negligible	The event would almost certainly not occur

The 2 likelihoods were then combined using the department's standardised rules (Table 2).

Table 2 Matrix of rules for combining descriptive likelihoods

Likelihood	High	Moderate	Low	Very low	Extremely low	Negligible
High	High	Moderate	Low	Very low	Extremely low	Negligible
Moderate	Moderate	Low	Low	Very low	Extremely low	Negligible
Low	Low	Low	Very low	Very low	Extremely low	Negligible
Very low	Very low	Very low	Very low	Extremely low	Extremely low	Negligible
Extremely low	Extremely low	Extremely low	Extremely low	Extremely low	Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

The consequences for vv-IBDv were taken from:

- the Generic import risk analysis report for chicken meat: final report (Chicken meat IRA)
- the Importation of cooked turkey meat from the United States: Draft review (Turkey meat draft IRA).

The likelihood and consequences components of biosecurity risk were combined and evaluated using the department's standardised matrix (Table 3). This is broadly consistent with the methodology described in Chapter 2.1 of the WOAH Code (WOAH 2024).

Table 3 Matrix for determining the overall risk

Likelihood of entry, establishment or spread	Consequences of entry, establishment or spread					
	Negligible	Very low	Low	Moderate	High	Extreme
High	Negligible risk	Very low risk	Low risk	Moderate risk	High risk	Extreme risk
Moderate	Negligible risk	Very low risk	Low risk	Moderate risk	High risk	Extreme risk
Low	Negligible risk	Negligible risk	Very low risk	Low risk	Moderate risk	High risk
Very low	Negligible risk	Negligible risk	Negligible risk	Very low risk	Low risk	Moderate risk
Extremely low	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Very low risk	Low risk
Negligible	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Very low risk

2.2 Focus on infectious bursal disease virus

This import risk review should be read as an addendum to the 2022 Fish and fish products review. The analysis for salmonid and non-salmonid fish products within the Fish and fish products review focused only on IPNv. This was considered to be the most resistant of aquatic animal viruses to thermal treatment. In a similar way, this addendum focuses on vv-IBDv as this has been shown in a range of the department's prior import risk analyses and reviews (including the Chicken meat IRA and the Turkey meat draft IRA) to be the most resistant of avian disease agents to thermal treatment. Beyond vv-IBDv, a formal hazard identification process was not undertaken.

2.3 Estimating unrestricted risk

The 2022 Fish and fish products review established the temperature and time parameters that were then implemented within the conditions for the importation of fishmeal (see section 1.2.3).

These requirements were used as a baseline when considering the impact of the processing steps set out in section 1.3.

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3 Risk assessment: very virulent infectious bursal disease virus

3.1 Technical information

3.1.1 Overview

Infectious bursal disease virus (IBDv) infects chickens, turkeys, ducks, guinea fowl and ostriches, but causes clinical disease solely in young chickens (WOAH Manual Chapter 3.3.12). Severe acute disease, usually in 3- to 6-week-old birds, is associated with high mortality, but less acute or subclinical infections are common earlier in life. IBDv causes lymphoid depletion in the bursa of Fabricius. Significant depression of the humoral antibody responses may result, thus promoting secondary infections. Two serotypes of IBDv, designated serotypes 1 and 2, are recognised. Clinical disease has been associated only with serotype 1, against which all commercial vaccines are prepared. Some antigenic variants of serotype 1 may require special vaccines for maximum protection. Very virulent strains of serotype 1 IBDv (vv-IBDv) are common worldwide and cause serious disease. Clinical IBD is commonly known as Gumboro disease.

This import risk review is concerned with IBD viruses that are exotic to Australia (including the vv-IBDv strains) and are antigenically and genetically different from Australian strains. IBDv is a WOAH listed disease and infection with IBDv (very virulent and exotic antigenic variant forms) is nationally notifiable in Australia.

3.1.2 Agent properties

IBDv is a member of the *Birnaviridae* family, *Avibirnavirus* genus (ICTV 2014). It is a single shelled, non-enveloped virion with a genome consisting of 2 segments of double-stranded RNA: segment A and segment B (Jackwood et al. 2011).

IBDv can persist for extended periods in the environment. The virus remained viable for more than 12 months in unused, dry chicken sheds; at least 6 months in dry litter; up to 122 days in the shed environment, and up to 52 days in feed, water and faeces (Benton, Cover & Rosenberger 1967; Edgar & Cho 1976).

IBDv is very resistant to heat, and certain temperature and time combinations may reduce the viral load while others will give complete inactivation. In one study, reduction of the infectivity by 1 $\log_{10}$ took 18.8 minutes at 70°C, 11.4 minutes at 75°C and 3 minutes at 80°C (Alexander & Chettle 1998). Unpublished work conducted in 1997 at the Quality Control Unit, Central Veterinary Laboratory, Alderstone, United Kingdom, showed that a mixture of bursal homogenate (23%), skin and fat (4%), muscle tissue (23%) and peptone broth (50%) contained no viable IBDv only after cooking at 80°C for at least 120 minutes.

Gamma irradiation has a limited effect on IBDv. At 3 kilograys, there was no reduction in the titre of pathogenic strains while some strains remained viable after application of 10 kilograys (Jackwood, Sommer-Wagner & Pharo 2007).

IBDv has been shown to be resistant to ether, chloroform and pH 2, but inhibited by pH 12 and iodine complex disinfectants (Benton et al. 1967). In another study only disinfectants which contained aldehyde (at 20 to 22°C) or chlorine (at 4°C and 20 to 22°C) were effective against IBDv (Meulemans & Halen 1982). Subsequent research demonstrated that invert soaps containing 0.05% sodium hydroxide with a pH of at least 12, at or above room temperature, inactivated or strongly inhibited the virus (Shirai et al. 1994). A 5 $\log_{10}$ reduction in virus was achieved at minus 20°C when Virkon and surface decontamination foam was applied to a dried suspension of IBDv and organic matter for 2 and 24 hours, respectively. In comparison, bleach produced no measurable reduction in infectivity at minus 20°C; however, there was a reduction of 5 $\log_{10}$ within 2 hours at 23°C and 4°C, while SDF and Virkon applied at 23°C and 4°C reduced IBDv by 5 $\log_{10}$ within 15 minutes (Guan et al. 2014).

3.1.3 Epidemiology

IBDv occurs in all major poultry producing areas of the world, with the exception of New Zealand where an attenuated (vaccine) strain was first detected in domestic poultry in 1993 (Chai et al. 2001). The New Zealand poultry industry has taken action to eradicate the vaccine virus from poultry flocks and the results of monitoring indicate success (Bingham, Christensen, and Stanislawek 2006; Gerber 2006). Different antigenic and pathogenic viral types exist in different geographic locations (van den Berg et al. 2000; Lukert and Saif 2003). Both classic and variant strains of IBDv have been demonstrated to be present in Australian poultry (Sapats and Ignjatovic 2000; Ignjatovic and Sapats 2002). Strains of the classic type that exist in Australia are genetically different from IBD viruses isolated overseas (Sapats and Ignjatovic 2000; Ignjatovic and Sapats 2002). Antigenic variant viruses identified in Australia are also genetically different from IBD viruses isolated overseas and are only distantly related to antigenic variants described in North America and elsewhere (Sapats and Ignjatovic 2000). The vaccines currently used in Australia do not protect against United States variant strains of IBDv strains (Ignjatovic, Sapats, and Gould 2001). Some variant-like IBD viruses recently described in Asia, Europe, and Central and South America are genetically similar to variant strains from the United States (Cao et al. 1998; Hamoud and Villegas 2006; Jackwood et al. 2006). Very virulent strains are exotic to Australia, but are found in Europe, Asia, Africa, the Middle East and South America (Chettle, Stuart, and & Wyeth 1989; Cao et al. 1998; Di Fabio et al. 1999; van den Berg, Gonze, and Meulemans 1991; Hernandez et al. 2006; Ikuta et al. 2001; Lin et al. 1993; Kasanga et al. 2007; Mardassi et al. 2004; Meir, Jackwood, and Weisman 2001; Parede et al. 2003).

IBDv serotype 1 causes clinical disease in chickens only. A serotype 1 IBDv has been isolated from the faeces of clinically healthy adult ducks, but the significance of the isolate is uncertain (McFerran et al. 1980). Guinea fowl showed clinical signs and developed antibodies to IBDv following intra-ocular inoculation with IBD bursal extract and signs of disease were observed in in-contact chickens (Adewuyi, Durojaiye, and Adene 1989). However, in a more recent study, pheasants, partridges and guinea fowl failed to excrete virus after experimental infection with IBDv, while quail shed virus via the faeces for several days after inoculation, without showing clinical signs (van den Berg et al. 2001). These authors concluded that the persistence of IBDv in wild birds is unlikely to occur and that the virus is highly host-specific for chickens. Antibodies to serotype 1 IBDv have been found in turkeys, pheasants, ostriches, guinea fowl, ducks, geese and wild birds, including gulls, crows, pigeons and penguins (Gardner et al. 1997; van den Berg et al. 2000; Gauthier-Clerc et al. 2002; Gilchrist 2005). IBDv has not been confirmed to cause disease in wild birds.

IBDv is a highly contagious virus, which is able to persist in the environment between outbreaks (see section 3.1.2). The main route of transmission is the faecal-oral route, and the virus can survive for prolonged periods in faeces and bedding (Benton, Cover, and Rosenberger 1967). Mechanical transmission of virus can occur via faecal contamination of fomites (van den Berg et al. 2000). The lesser mealworm (larva of the darkling beetle) is common in poultry houses worldwide and can serve as a reservoir for the virus (McAllister et al. 1995). Although IBDv has been isolated from mosquitos and rats, there is no evidence that these can act as vectors (Lukert and Saif 2003). Very virulent IBDv was recovered from the faeces of a dog for 2 days after it was fed on the spleen, liver, bursa of Fabricius and intestines of birds which died from acute infection with vv-IBDv (Pages-Mante et al. 2004). However, it is considered that these findings represent simple mechanical passage of the virus through the dog's digestive tract. While there is no clear evidence of wild birds acting as reservoirs or vectors of IBDv, the possibility cannot be ruled out (Gilchrist 2005; van den Berg et al. 2000).

Chickens are most susceptible to infection during active bursal development, with clinical signs being most common between 3 and 6 weeks of age. Chickens infected before 3 weeks of age, and not protected by maternal antibodies, develop immunosuppression, and this can lead to secondary viral and bacterial infections and can reduce the efficacy of vaccination. Clinical signs are occasionally seen in birds up to the age of 15 to 20 weeks (Ley et al. 1979; Okoye and Uzoukwu 1981). Age-based resistance to the development of clinical signs of IBD has been documented, and is believed to be related to changes in the bursa as chickens mature (van den Berg et al. 2000). In susceptible birds, the incubation period may be as short as 2 to 3 days.

The prevalence of IBDv infection in slaughter-age chickens is unknown (Mandeville, Cook, and Jackwood 2000). However, in a 2002 outbreak in Spain, 10 of 18 vv-IBD viruses were isolated from slaughter-aged broilers (between 35 and 49 days old), and at least some of these were from vaccinated flocks (Dolz et al. 2005). IBDv was isolated from 39- to 43-day-old layer pullets that had been vaccinated with a classic vaccine strain at 28 and 35 days of age, after having high levels of maternal antibodies at hatch (Ismail et al. 1990). These reports indicate that infection of chicks with field strains of IBDv can occur after waning of maternal antibody levels. The virus persists in the bursa and lymphoid tissues, including caecal tonsils, for 4 to 6 weeks after infection (Elankumaran, Heckert, and Moura 2002) and therefore may be present in, and shed by, slaughter-age chickens. Subclinical infection with classic strains of IBDv has been reported in over 90% of unvaccinated poultry flocks in the United Kingdom (Edwards 1981), over 80% of meat chicken flocks in Belgium (van den Berg, Gonze, and Meulemans 1991) and in 77% of layer flocks tested in Ohio (Jackwood and Saif 1983). In infected flocks, seroconversion is up to 100% with mortality rates of 1 to 2% (van den Berg et al. 2000).

Of samples obtained from 20 meat chicken farms in Victoria, New South Wales, Queensland, South Australia and Western Australia, samples from 14 farms (70%) were positive for IBDv using an antigen capture ELISA. Sequencing of the viruses from 10 farms determined their genetic similarity to Australian vaccine or classic strains, while viruses from 4 farms (from Victoria and South Australia) were determined to be Australian variant strains (Ignjatovic and Sapats 2002). An outbreak of IBD in meat chickens in New South Wales in 1999, causing 2 to 2.5% mortality in affected sheds, was found to be due to a classic IBDv of Australian origin, and was controlled by vaccination (Sergeant 1999; Ignjatovic et al. 2004). Subsequent testing of this isolate in SPF chickens revealed no mortalities. Variant strains remain largely restricted to Victoria and South Australia, with little if any genetic

change over the last 10 years (S. Sapats, Australian Animal Health Laboratory, Geelong, Victoria, Australia, personal communication, March 2007).

The prevalence of disease associated with very virulent strains of IBDv in most countries where vaccination for vv-IBDv is practiced has not been documented. This is largely for the reason that there has been no reliable way to identify the highly virulent strain of IBDv, except through experimental infection in chickens (Lin et al. 1993; Jackwood and Sommer 2005). Recently, however, the nucleotide sequence of the VP2 gene of vv-IBDv has been characterised, facilitating recognition of new incursions of vvIBDv into regions not previously affected (Ignjatovic, Sapats, and Gould 2001; Jackwood and Sommer 2005). In addition, data have been published suggesting that both RNA segments of the virus co-evolve and that vv-IBDv may be identified by analysis of both genomic segments (Le Nouen et al. 2006).

In flocks affected by vv-IBDv, mortality rates vary from 25% in meat chickens, to 60% in flocks of laying breeds, and up to 100% in SPF chickens (van den Berg, Gonze, and Meulemans 1991; van den Berg et al. 2000).

Antigenic variants are endemic in poultry in the United States (Rosales et al. 1989; Jackwood and Nielsen 1997; Jackwood and Sommer-Wagner 2005; Hamoud and Villegas 2006; Jackwood and Nielsen 1997). Antigenic variant-like strains have also been described in Canada, Central and South America, Asia and Europe, and some of these strains bear close genetic resemblance to the United States variant strains (Cao et al. 1998; Hamoud and Villegas 2006; Ikuta et al. 2001; Jackwood et al. 2006).

3.1.4 Transmission in avian meat

Contaminated meat may be produced with the slaughter of viraemic, asymptomatic chickens, or with the slaughter of convalescent chickens which continue to carry the virus in the digestive tract or other tissues (van den Berg et al. 2000). Virus has been detected at low titres in the muscle for at least 4 days after experimental inoculation of chickens (Quality Control Unit 1997a) and may persist in bone marrow and other tissues for up to 4 weeks after infection (Elankumaran, Heckert, and Moura 2002). Virus in the digestive tract can serve as a source of cross-contamination of carcases in the slaughter line (van den Berg et al. 2000). Vaccine virus was detected in the bursa of SPF chickens for 14 days after administration of a low oral dose (102.5 EID_{50} per bird) (Abdel-Alim and Saif 2001), and virus RNA was detected in the caecal tonsils and bursa of chickens for at least 22 days after inoculation (Barlic-Maganja, Zorman-Rojs, and Grom 2002).

In one trial, chicken products (drumsticks and patties) were inoculated with 5 strains of IBDv and then subjected to cooking. The meat products were cooked either by frying in hot oil or cooking in a flame grill. Following cooking to an internal temperature of 71°C and 74°C respectively, meat contained viable virus detected in cell culture. The authors concluded that temperatures and times required to totally inactivate IBDv in meat would compromise texture and palatability of the poultry products, and that poultry offal processing may not adequately neutralise IBDv (Mandeville, Cook, and Jackwood 2000). There were no appreciable differences in the heat lability of the 5 strains tested.

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Research undertaken by CSIRO, Australian Centre for Disease Preparedness (formerly the Australian Animal Health Laboratory, AAHL) (ACDP) on behalf of the department, concluded that vv-IBDv (strain CS88) can be 'transmitted with ease from both muscle and bursa of infected non-immune chickens to day-old chicks by a natural route of infection' (Australian Animal Health Laboratory 2002). This report further concluded that, while vaccination using standard European vaccination regimes was sufficient to prevent overt illness, it did not inhibit chickens from developing IBD infection when challenged with vv-IBDv. Sufficient virus was present in both bursae and muscles to infect susceptible day-old-chicks via a natural route' (Australian Animal Health Laboratory 2002). A copy of the unpublished report of this experimental work is available from the department on request.

A second experiment was conducted using variant E IBDv in place of the very virulent CS88 strain. In the first part of this experiment, unvaccinated chickens were challenged with variant E IBDv. Bursa and muscle samples harvested from these chickens 72 to 80 hours later were subsequently fed to naive 3- to 7-week-old chicks. Transmission of variant E IBDv was seen in all 50 chicks fed bursa, and in at least 32 of 50 chicks fed muscle. In another part of the experiment chickens, bred from vaccinated hens and vaccinated against variant E IBDv at either 10 or 20 days of age, were challenged with variant E IBDv. Bursa and muscle samples were again collected 72 to 80 hours post challenge and fed to groups of naive chicks. There was transmission of variant E IBDv to all 50 chicks fed bursa from chickens vaccinated at 10 days of age, and to all 50 chicks fed bursa from chickens vaccinated at 20 days of age. However, transmission of variant E IBDv was not demonstrated in any of 100 chicks fed muscle from vaccinated chickens (Australian Animal Health Laboratory 2004). A copy of the unpublished report of this experimental work is available from the department on request.

The results of this research suggest that vaccination at 10 to 20 days of age will prevent chickens developing sufficient virus in muscle to infect naïve chicks. Not all chickens are vaccinated, so it is probable that some chickens infected with variant IBDv will have sufficient virus in their muscle tissues to cause infection in naive birds. The experiments demonstrated that the bursa did become infected, and presumably there was infection of other gastrointestinal lymphoid tissues following oral exposure. Under commercial slaughter conditions, it is highly likely that there would be cross-contamination of carcases from gastrointestinal contents and from direct contact of bursa with the carcase during processing, so that meat and scraps from them would contain variant IBDv capable of infecting other poultry.

3.1.5 Vaccination against vv-IBDv

In countries where vv-IBDv is present, intermediate and intermediate-plus vaccines are used to protect meat chickens and commercial layer replacements. They are also used in young parent chickens if there is a high risk of natural infection with vv-IBDv. Second and third applications are usually administered, especially if there is high risk of exposure to virulent disease (van den Berg et al. 2000).

Recent studies have shown that none of the tested IBDv vaccines fully protect against experimental vv-IBDv challenge (Rautenschlein et al. 2005; Kabell et al. 2005). In one study, although none of the challenged birds died, vv-IBDv continued to replicate in the bursa and caecal tonsils. IBDv antigen was detected in 100% of bursae 21 days after birds were vaccinated with an intermediate-plus vaccine (Rautenschlein et al. 2005). The authors speculated that in maternal antibody-positive birds, IBDv vaccines may complex with antibodies, with the virus being released as the maternal antibody

levels wane. This is a similar mechanism of action to that described for in-ovo vaccination using combined vaccine and IBDv antibody.

In another study using vaccinated and challenged SPF chickens with no maternal antibody, vv-IBDv RNA was detected in the bone marrow of a 44-day-old chicken vaccinated at one week of age, and challenged with vv-IBDv at 28 days (Kabell et al. 2005). The challenge strain was also detected in the bursa and thymus of 31- to 44-day-old chickens vaccinated at 3 weeks of age, and challenged with vv-IBDv a week later. The authors of this study concluded that surviving field virus in a broiler house may infect, replicate and be excreted from vaccinated chickens (Kabell et al. 2005).

3.2 Likelihood of entry

The likelihood that vv-IBDv would enter Australia with the importation of fishmeal-based aquaculture feed that contained avian materials was assessed in 2 parts:

1) The likelihood that unprocessed fishmeal that contained avian materials sourced from a country in which vv-IBDv is endemic, would contain infectious vv-IBDv.

2) The likelihood that the thermal processing required for the manufacture of aquaculture feed would fail to inactivate vv-IBDv.

3.2.1 Unprocessed avian materials

The department has previously determined that, in the absence of risk management, and without considerations regarding the exporting country, there is a moderate likelihood that chicken meat imported into Australia from a country in which vv-IBDv is endemic would be infected or contaminated with vv-IBDv. This likelihood included consideration of the protective effect of ante-mortem inspection and meat inspection, and other steps relevant to sourcing and slaughter of chickens, and the processing of chicken meat intended for human consumption. When these considerations are removed, as relevant to avian material included in aquaculture feed, the likelihood will be slightly higher. Offsetting this, however, is the understanding that avian materials may be derived from a range of species (section 1.2.4), including *Galliformes* (such as quail and turkeys) and waterfowl of the family *Anatidae* (such as ducks and geese). Although vv-IBDv can infect the breadth of poultry species, clinical disease is only observed in chickens (WOAH Manual Chapter 3.3.12). This means that the overall prevalence of the disease agent and the titre of virus within affected birds will be lower than is the case for chickens and chicken meat alone. This position was reflected in the Turkey meat draft IRA, where the likelihood of entry for unprocessed turkey meat for human consumption was rated as low.

Balancing these considerations, it was concluded that, prior to the consideration of thermal processing, there remains a moderate likelihood that avian material included in fishmeal imported into Australia from a country in which vv-IBDv is endemic would contain infectious vv-IBDv.

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3.2.2 Processed aquaculture feed

The second part of this likelihood concerns the inactivation of vv-IBDv through the:

- level of thermal processing currently required for fishmeal
- level of thermal processing typically associated with the production of processed aquaculture feeds.

The Chicken meat IRA recommends that vv-IBDv can be inactivated when product is heated to a minimum core temperature of 80°C for at least 125 minutes. To compare the effect of different heat treatments on a specific microbial or viral population the lethality of a process can be calculated to establish the F-value or thermal death time. F-value is the number of minutes to accomplish a given reduction in the number of infectious microorganisms at a specific temperature and can be calculated by the following equation:

$$Fvalue_{Tref}^{Z} = time \times \left((Temporature \times Tref) \div z\right)$$

In this equation, the z-value has a significant effect on the lethality of a process. However, as the effect of a process on a single agent (vv-IBDv) is consistent across all calculations the z-value is set at the reference of 10°C. This facilitates comparisons across temperatures. The refence temperature (Tref) will be 80°C, as established experimentally, time is the treatment time in minutes, and temperature is the treatment temperature in Celsius.

In this instance the F-value of the process is required to be 125 minutes. All following F-values will be expressed in minutes at 80°C.

Current conditions

Requirements for the importation of fishmeal were summarised in section 1.2.3. Fishmeal of non-salmonid origin must be heated to at least 85°C for a period of no less than 15 minutes (F-value= 47.43 minutes), or at least 80°C for a period of no less than 20 minutes (F-value=20 minutes). Fishmeal of salmonid origin will be assessed by the department on a case-by-case basis, noting that the Fish and fish products review concluded that 85°C for at least 25 minutes (F-value= 79 minutes) would provide for adequate inactivation of IPNv. As the F-values for the time-temperature requirements for feed of either salmonid or non-salmonid origin do not achieve the requirement for vv-IBDv (125 minutes), the current conditions for both products would likely fail to inactivate vv-IBDv. The likelihood of entry with current conditions alone was therefore considered to be high.

Thermal processing of aquaculture feed

Substantive thermal inactivation will only be achieved for extruded pelletised feeds. The drying step within the manufacture of granulated hatchery feed is the only point at which substantive heat is applied. As this operates at about 60°C, it does not achieve the 74°C target required for the inactivation of vv-IBDv (due to the 'tailing-off' effect in the thermal inactivation curve of vv-IBDv, temperatures less than 74°C are not considered for poultry products). In addition to time and temperature, the effectiveness of a thermal process is also dependent on the water activity of the product. If a thermal process reduces the product's water content, the effectiveness of subsequent thermal processes is substantially reduced. Extruded pelletised aquaculture feed includes the following thermal processes:

- preconditioning at approximately 80 to 100°C for approximately 5 minutes (minimum F-value=5 minutes)
- extrusion at approximately 100 to 125°C for 30 seconds (minimum F-value=50 minutes)
- drying at approximately 90-120°C for approximately 40 minutes (F-value=400 minutes).

Although the drying step (iii) does in theory achieve the required F-value, the product at this point in the process is too dry for optimal thermal inactivation.

Based on these outcomes, the likelihood that the thermal processing entailed in the production of extruded pelletised aquaculture feed would fail to inactivate vv-IBDv was considered to be high. As the thermal process is not effective at inactivating vv-IBDv, this high likelihood for processed pelletised feed will not be materially different from that which would be associated with granulated feed or soft tuna feed.

Overall likelihood of entry

The likelihoods for unprocessed and processed aquaculture feed (moderate and high) were combined using the matrix of rules shown in Table 2. The outcome of this calculation was an overall moderate likelihood of entry.

3.3 Likelihood of establishment or spread

The likelihood that vv-IBDv would establish itself or spread within Australian territory, or a part of Australian territory, following the importation of aquaculture feed that contained infectious vv-IBDv within included avian material, was estimated in 2 parts:

1) The likelihood that susceptible species within Australia would be exposed to infectious vv-IBDv within imported aquaculture feed.
2) The likelihood that exposure would result in the establishment or spread of vv-IBDv within Australia.

3.3.1 Exposure of susceptible species

It is a condition of the importation of aquaculture feed and aquatic meals that the label for the imported product (or if sold in bulk, on the delivery docket/invoice) includes the statement, 'This product contains restricted animal material – do not feed to cattle, sheep, goats, deer or other ruminants.' This statement reflects Australia's ruminant feed ban. The ruminant feed ban provides for a ban on the feeding to all ruminants of all meals, including meat and bone meal, derived from all vertebrates, including fish and birds. The ban was introduced by the Australian livestock and stock feed industries in 1996 and was then legislated in all states and territories of Australia in 1997. All states and territories have now adopted in their respective legislation the term RAM to describe animal meals that cannot be fed to ruminants, being any meal derived from vertebrate animal origin, including fish and birds. Although the ruminant feed ban, and associated labelling, specifically targets the feeding of RAM to ruminants, it likely provides some collateral protection against the diversion of such feeds to non-ruminant livestock – including to backyard and commercial poultry. The extent to which imported aquaculture feed is currently diverted to poultry is not known, although domestically produced meat and bone meal is routinely added to poultry diets as a source of protein.

In addition to the diversion of aquaculture feed from its intended purpose, consideration was also given to contamination of the aquatic environment with imported aquaculture feed containing vv-IBDv and the likelihood that susceptible wild avian species would then feed on this material, be exposed to vv-IBDv, and the disease would subsequently spread from these wild birds to farmed poultry. This likelihood is minimised chiefly by the fact that, whilst wild birds may become transiently infected, and may develop antibodies following exposure to the virus, infection and establishment of the disease in wild birds has never been reported (section 1.2.3). Based on this, the Chicken meat IRA concluded that it would be extremely unlikely that the transient infection of wild birds would result in the spread of disease to highly susceptible poultry species.

The likelihood that susceptible species within Australia would be exposed to vv-IBDv within imported aquaculture feed was thus driven largely by the scenario in which aquaculture feed is diverted from aquaculture to poultry. In the absence of conclusive data, this likelihood was considered to be moderate.

3.3.2 Establishment or spread within Australia

The Chicken meat IRA employed a complex semiquantitative model based on exposure groups and outbreak scenarios, and from this reported a moderate likelihood for the scenario that vv-IBDv would establish in a directly exposed population, spread within a state/territory, including to other exposure groups if applicable, and become endemic in Australia. This likelihood was attached most strongly to medium biosecurity commercial poultry. The Turkey meat draft IRA reviewed this assessment and provided a simplified single estimate of low across all exposure groups and outbreak scenarios. The approach taken within the Turkey meat draft IRA was considered closer to that which was followed in this review, and for this reason the estimate of low was adopted as the likelihood that vv-IBDv would establish or spread within Australia following the exposure of poultry through imported aquaculture feed that included contaminated avian materials.

3.3.3 Overall likelihood of establishment or spread

The 2 likelihoods (moderate and low) were combined using the matrix of rules shown in Table 2. The outcome of this was a low likelihood of establishment or spread.

3.4 Potential consequences

The potential for vv-IBDv to cause harm to human, animal or plant health, to the environment, and the economic consequences associated with the entry, establishment or spread of the disease or pest, were rated as moderate in the Turkey meat draft IRA. The Chicken meat IRA employed a more complex disaggregation of likelihoods and consequences, and a less direct calculation of overall impact, and was considered for context and completeness.

3.5 Unrestricted risk

The 2 likelihoods (moderate and low) were combined using the rules set out in Table 2 to give a low likelihood of entry, establishment or spread. This was then combined with the moderate consequence rating, using the rules set out in Table 3, to give a low overall risk rating for vv-IBDv. Because this rating does not achieve Australia's ALOP, additional risk management measures will be

required. This outcome applies to granulated hatchery feed, to extruded pelletised hatchery and grow-out feed, and to soft tuna feed.

3.6 Risk management

The Chicken meat IRA advises that vv-IBDv can be inactivated when meat is heated to a minimum core temperature of 80°C for at least 125 minutes. The Chicken meat IRA also allows for the use of an alternative temperature and time, if this achieves an equivalent level of thermal inactivation.

If avian material included within aquaculture feed was subjected to this treatment in the exporting country, the likelihood that vv-IBDv would enter Australian territory, or a part of Australian territory, would be reduced to a negligible level. This result would mean that the overall level of biosecurity risk, as it relates to vv-IBDv, is also negligible. As this risk achieves Australia's ALOP, the risk for vv-IBDv in aquaculture feed that contains avian materials would be considered appropriately managed.

A higher level of thermal inactivation could potentially be achieved within the extrusion step of the manufacture of extruded pelletised feeds. Alternatively, avian materials could be heat treated (typically by rendering) prior to their inclusion in the aquaculture feed manufacturing process. Where avian material is treated prior to its inclusion in aquaculture feed, a sufficient risk reduction could potentially be achieved for each of the 3 identified forms of aquaculture feed: granulated hatchery feed, extruded pelletised hatchery and grow-out feed, and soft tuna feed – noting that subsequent steps of manufacture would then need to satisfy existing import requirements for fish and fish products, as well as any other permit conditions.

4 Conclusions

This import risk review evaluated the level of biosecurity risk associated with the inclusion of avian materials in imported aquaculture feed. The review focused on the level of biosecurity risk for IBDv (specifically vv-IBDv) as this is significantly the most heat resistant of the identified avian pathogens of biosecurity concern. The review included 3 common groups of aquaculture feed product:

1) granulated hatchery feed
2) extruded pelletised hatchery and grow-out feed
3) soft tuna feed.

The review found that the level of thermal inactivation of vv-IBDv achieved by either the current import conditions for aquaculture feed and aquatic meals, or the thermal steps relevant to the manufacture of aquaculture feed, were insufficient to achieve Australia's ALOP.

The review recommended additional heat treatment, noting that this might be applied as an enhancement of an existing thermal step within the manufacture of extruded pelletised aquaculture feed, or as a standalone preliminary step for relevant components, such as rendering. If a sufficient standalone preliminary heat treatment is used, then the treated avian material could potentially be included in any of the 3 forms of aquaculture feed product – subject to that product also meeting the existing requirements for fishmeal (and other permit conditions).

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