Risk analysis and international trade principles applied to the importation into Canada of caprine embryos from South Africa

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Summary
Between November 1994 and February 1995 over nine thousand Boer goat embryos were imported into Canada from the Republic of South Africa. This substantial international movement of animal genetics via embryos was achieved through the application of the risk analysis principles prescribed in Section 1.4. of the International Animal Health Code of the Office International des Epizooties (OIE). Integral to the development of the health certification procedures was the application of the fundamental principles of non-discrimination, harmonisation, equivalence and transparency defined in the World Trade Organisation Agreement on Sanitary and Phytosanitary measures. Risk mitigation interventions were founded upon full consideration of the potential for disease transmission by animal embryos as espoused by the International Embryo Transfer Society and the relevant standards contained in Appendix 4.2.3.3. of the OIE International Animal Health Code. All the embryos imported into Canada were implanted into synchronised recipients on arrival. Twenty months later there has been no evidence of disease in either the recipient animals or the resulting animals born in Canada.

Keywords
Canada - Embryos - Goats - International standards - Risk analysis - South Africa - Trade.

Background
Commercial interest in creating a nucleus of the high quality Boer goat genetics developed by South African breeders was expressed in Canada. In response to this interest, veterinary regulatory officials with Agriculture and Agri-Food Canada and the South Africa Department of Agriculture entered into discussions in October 1993 to examine the feasibility of establishing a health certification protocol to provide for the import into Canada of caprine embryos from South Africa. The decision to utilise embryos rather than live animals for the international transfer of the genetics was based on several factors.

First, the decision was influenced by the growing body of scientific evidence that the disease transmission through animal embryos collected and processed in accordance with the standards and procedures prescribed by the International Embryo Transfer Society (IETS) (12) is minimal.

Second, the international movement of more than an estimated 500,000 animal embryos which has taken place since 1973 has been achieved without any confirmed report of disease transmission attributable to embryos.

Third, a number of reviews have been published over the past decade on the disease transmission potential of embryos of
various species of animals (6, 10, 14), giving rise to a well-documented knowledge base.

An important result has been the incorporation of applicable appendices in Section 4.2. of the International Animal Health Code of the Office International des Epizooties (OIE) (9).

In the rare instances where congenitally-infected progeny derived from embryo transfer were reported, contaminated media or post-transfer infection of the recipients have been the most likely underlying cause (4, 7, 8). The potential for contamination of media therefore necessitates specific interventions in the health certification protocol to limit the sourcing of such materials to reputable suppliers and vigilance to ensure the integrity and competence of the embryo collection team.

The exporting country cannot be faulted for post-transfer infection of the recipients as it is indicative of failures in the post-entry disease mitigation practices in the country of destination.

Risk assessment

The initial information exchange focused on an evaluation of the Veterinary Services of South Africa using the guidelines recommended in Chapter 1.4.3. of the OIE International Animal Health Code (9).

Elements of this evaluation included a review of the legislative authority provided in South Africa by the Animal Diseases Act of 1984, the disease surveillance and diagnostic capability, the transparency and integrity of disease reporting and the credibility of the veterinary infrastructure in South Africa. This information was subsequently validated through on-site inspections carried out by Agriculture and Agri-Food Canada.

These determinations provided a starting-point for an objective comparison of the disease gradient between the country of origin and the country of destination. They also provided a basis for the qualitative analysis of the risk of introducing specified disease agents of concern into Canada by way of the importation of cryo-preserved goat embryos from South Africa. The results of this comparison are reflected in Table I.

It was concluded that a level of equivalence existed in terms of freedom of both countries with respect to rinderpest, peste des petits ruminants, sheep pox and goat pox, contagious caprine pleuropneumonia and Nairobi sheep disease.

For contagious agalactia, caprine arthritis/encephalitis and scrapie it was determined that South Africa had a superior health status to Canada, while for foot and mouth disease, Rift Valley fever, bluetongue, brucellosis and heartwater the situation was reversed.

With the occurrence of foot and mouth disease limited to Kruger National Park and vector considerations surrounding heartwater, the possibility of recognition of partial regionalisation factors could also be introduced.

After establishing the disease profile, determination of the potential disease agents of concern was undertaken, based on the following considerations:

- diseases foreign to the country of destination (Canada)
- those diseases defined as reportable under the Health of Animals Act in Canada
- the respective classification of the diseases according to the OIE Lists
- the categorisation of the diseases in relation to the risk of transmission by embryo transfer as defined by the IETS (1).

The draft risk assessment performed by the Animal and Plant Health Risk Assessment Network of Agriculture and Agri-Food Canada was forwarded to the Directorate of Animal Health in Pretoria for comment in May 1994.

Risk management

The risk mitigation measures to be applied were established after full consideration of both the disease transmission potential of the species involved and the pathogens of concern, as identified in the risk assessment, as well as the principles espoused in the Agreement on the Application of Sanitary and Phytosanitary Measures under the World Trade Organisation.

With regard to the former, the respective regulatory officials of Agriculture and Agri-Food Canada and the South Africa Department of Agriculture attempted to address fully the regulatory concerns regarding risk management in embryo transfer as advocated by the IETS (5).

To this end, there was mutual agreement not to extrapolate considerations regarding embryo pathogen interactions or disease categorisations from one species (i.e. cattle) for which the disease transmission potential was well characterised to another (i.e. goats). This decision was made on account of the distinct differences which exist in the properties of the zona pellucida between species.

Alternative risk management procedures were adopted for those disease agents of concern for which insufficient validated research evidence exists on the efficacy of the standard embryo processing and treatment methodologies.

The ensuing negotiation of the health certification protocol was based on the observation of these principles:

- the basic rights and obligations of both countries to establish risk mitigation measures based on science;
Table I
Comparison of disease status between South Africa and Canada
[1, 2, 3]

<table>
<thead>
<tr>
<th>Disease</th>
<th>Occurrence in South Africa(^{a,b})</th>
<th>Occurrence in Canada(^b)</th>
<th>OIE List</th>
<th>IETS(^{c,d})</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cattle near Kruger National Park (1983)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rinderpest</td>
<td>1904</td>
<td>Never</td>
<td>A</td>
<td>NC</td>
</tr>
<tr>
<td>Paste des petits ruminants</td>
<td>Never</td>
<td>Never</td>
<td>A</td>
<td>NC</td>
</tr>
<tr>
<td>Sheep pox and goat pox</td>
<td>Never</td>
<td>Never</td>
<td>A</td>
<td>NC</td>
</tr>
<tr>
<td>Rift Valley fever</td>
<td>(1991)</td>
<td>Never</td>
<td>A</td>
<td>NC</td>
</tr>
<tr>
<td>Bluettongue</td>
<td>Endemic</td>
<td>(1988)</td>
<td>B</td>
<td>4</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>Brucella abortus</td>
<td>High</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. melitensis</td>
<td>Serological</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. ovis</td>
<td>Exists</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anthrax</td>
<td>Low, sporadic</td>
<td>Low, sporadic</td>
<td>B</td>
<td>NC</td>
</tr>
<tr>
<td>Contagious caprine pleuropneumonia</td>
<td>Never</td>
<td>Never</td>
<td>B</td>
<td>4</td>
</tr>
<tr>
<td>Contagious agalactia</td>
<td>Never</td>
<td>Exists</td>
<td>B</td>
<td>NC</td>
</tr>
<tr>
<td>Caprine arthritis/encephalitis</td>
<td>Never</td>
<td>Exists</td>
<td>B</td>
<td>4</td>
</tr>
<tr>
<td>Nairobi sheep disease</td>
<td>Never</td>
<td>Never</td>
<td>B</td>
<td>NC</td>
</tr>
<tr>
<td>Scapie</td>
<td>(1972)</td>
<td>Low, sporadic</td>
<td>B</td>
<td>4</td>
</tr>
<tr>
<td>Heartwater</td>
<td>Regionalised to distribution of competent vector</td>
<td>Never</td>
<td>B</td>
<td>NC</td>
</tr>
</tbody>
</table>

\(^a\) FAO/OIE/WHO Animal Health Yearbook, 1992 and 1993 (2, 3)
\(^b\) The year the disease was last reported is given in brackets
\(^c\) International Embryo Transfer Society, 1992 (1)
\(^d\) NC: Not classified

- harmonisation of the sanitary measures with existing recognised international standards, guidelines or recommendations;
- acceptance or recognition of equivalence where sanitary measures in the country of origin achieved a level of sanitary protection equal to the country of destination, as confirmed by on-site inspections and verifications;
- transparency of the assessment of risk and determination of the appropriate level of sanitary protection provided by the health certification procedures/methods proposed;
- application of the concept of regionalisation for disease prevalence in the country of origin where geography, ecosystem, epidemiological surveillance, disease pathogenesis (as in the case of heartwater) and the effectiveness of sanitary controls allowed;
- technical assistance provided by the country of destination with respect to the inspection and approval of embryo collection teams and facilities in the country of origin to ensure the uniform and equitable confirmation of adherence to the embryo collection and processing standards adopted in the receiving country.

As described by Stringfellow et al. (13), the transmission of an infectious agent through embryo transfer requires the uninterrupted occurrence of five events:
- exposure of an embryo to the pathogen prior to, during or after collection;
- adherence of the pathogen to the zona pellucida or penetration of the zona pellucida by the pathogen;
- survival of the pathogen;
- transport of an infective dose of the pathogen; and
- infection of the susceptible embryo recipient.

In assessing the level of protection desired or appropriate to achieve the disease-free international movement of germplasm of the magnitude proposed, the regulatory officials involved undertook to consider not only the disease gradient between the two countries but also the pathogenesis of the diseases of concern and the epidemiological factors of agent, host and environment as described by Stringfellow and Wright (11).

The result of this approach led to the drafting of a health certification protocol which included the following elements:
- the history in the country, region and farm of origin of freedom from specified diseases;
- the period of residence of the donor in the flock of origin;
- the length of time that the flock of origin had been in existence;
- serological testing of donors to ensure that specified pathogens were not active;
- clinical assessments of donors and cohorts pre-collection, at the time of collection and post collection;
– the sanitary assurances associated with collection and processing of the embryos in accordance with IETS recommendations;
– restriction on the origin of animal products used in embryo processing;
– recognition of the impact of the dilution factors and freezing procedures on pathogen concentration and viability;
– the inspection/approval of embryo collection teams and facilities and official supervision of the programme;
– a quality assurance programme by analysis of flush fluids, pooled washes and degenerated embryos;
– post-entry measures to isolate and assess recipient animals for a limited period of time.

Risk communication

A concerted effort was made on the part of regulatory officials in Canada and in South Africa to inform and consult with their respective livestock sectors, major international trading partners and other regulatory agencies prior to, during and after the importation.

The Canadian Animal Health Consultative Committee, which comprises representatives of agribusiness interests and livestock sectors in Canada, provincial animal health authorities and the veterinary academic faculties, and the associated Import Advisory Committee were initially advised of the proposed trade in November 1993. This was then followed by a series of open meetings with targeted national species associations.

Dialogue was initiated with international regulatory authorities through the Import/Export Committee of the IETS in January 1994, with more focused discussions being held with the United States Department of Agriculture.

With the completion of the draft risk assessment in May 1994 and the receipt of comments on the draft from South Africa, the risk assessment was presented to the livestock industry in Canada through the Import Advisory Committee in June 1994.

To ensure transparency, the risk assessment was also shared with regulatory officials in several countries which were following the developments with considerable interest.

The health certification requirements for the importation were presented to the Import Advisory Committee in September 1994 for extended industry consultation and received endorsement.

Conclusion

Under the terms of the agreed health certification protocol, over 9,000 embryos were collected by approved embryo collection teams from female donors, originating from herds free of specified infectious diseases transmissible to sheep and goats, from different geographical locations in the Republic of South Africa.

Embryos at the morula and blastocyst stage of development were collected surgically from the reproductive tract of hormonally treated (superovulated) goats 4-6 days post insemination. The semen donors were proven to be free from infectious disease.

Collected embryos were inspected microscopically for integrity of the zona pellucida and then subjected to serial washing as recommended by the IETS. After freezing, the embryos were stored under approved sanitary conditions and transported to Canada in sealed containers with liquid nitrogen.

Upon arrival in Canada, the embryos were thawed and inspected for morphological quality prior to transplant into recipients which had given negative results when tested for specified diseases and which had synchronised oestrus cycles. The recipients were then isolated for a 45-day period. Retesting and clinical assessment of the recipients were undertaken following isolation and the recipients were then released from restrictions.

Although the time which elapsed between the commencement of the preliminary discussions on the feasibility of the importation and the actual realisation of embryos from South Africa arriving in Canada may have seemed protracted from a commercial perspective, it was an investment in transparency, collaboration and consultation which provided a mutually rewarding result.

Twenty months later there has been no evidence of disease in the recipient animals or any of the resulting progeny born in Canada.
Analyse des risques et principes du commerce international appliqués lors d’importation au Canada d’embryons caprins en provenance d’Afrique du Sud

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Résumé

Cet important transfert international de matériel génétique animal, sous forme d’embryons, s’est effectué conformément aux principes d’analyse des risques spécifiés à la Section 1.4 du Code zoosanitaire international de l’Office international des épizooties (OIE). Ont également été appliqués, lors de l’élaboration des procédures de certification zoosanitaire, les principes fondamentaux de non-discrimination, d’harmonisation, d’équivalence et de transparence définis dans l’accord sur l’application des mesures sanitaires et phytosanitaires de l’Organisation mondiale du commerce.

Quant aux mesures de réduction des risques, elles ont été adoptées après avoir considéré toutes les possibilités de transmission de maladies par les embryons d’animaux, telles qu’elles sont prises en compte par la Société internationale de transferts d’embryons et suivant les normes applicables figurant à l’Annexe 4.2.3.3 du Code zoosanitaire international de l’OIE. Tous les embryons importés au Canada ont été implantés, dès leur arrivée, chez des femelles receveuses synchronisées. Vingt mois plus tard, aucun signe de maladie n’avait été décelé chez les chèvres receveuses ni chez leur descendance née au Canada.

Mots-clés

Aplicación del análisis de riesgos y de los principios del comercio internacional a la importación a Canadá de embriones caprinos procedentes de Sudáfrica

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Resumen
Entre noviembre de 1994 y febrero de 1995, Canadá importó más de 9.000 embriones de cabra Boer procedentes de Sudáfrica.

Este importante movimiento internacional de material genético animal a través de embriones fue posible gracias a la aplicación de los principios de análisis de riesgos prescritos en la Sección 1.4 del Código zoosanitario internacional de la Oficina Internacional de Epizootias (OIE). La aplicación de los principios fundamentales de no discriminación, armonización, equivalencia y transparencia definidos en el Acuerdo de la Organización Mundial del Comercio sobre la Aplicación de Medidas Sanitarias y Fitosanitarias fue también parte esencial de los procedimientos de certificación sanitaria.
Las decisiones encaminadas a la reducción de los riesgos se fundamentaron en la consideración exhaustiva del potencial de transmisión de enfermedades que presentan los embriones animales, de acuerdo con los criterios definidos por la Sociedad Internacional de Transferencia de Embriones y las normas que al respecto figuran en el Anexo 4.2.3.3 del Código zoonotico internacional de la OIE. A su llegada a Canadá, todos los embriones fueron introducidos en hembras receptoras sincronizadas. Veinte meses más tarde no se había observado ningún signo de enfermedad ni en las hembras receptoras ni en los cabritos nacidos de aquellos embriones en Canadá.

**Palabras clave**

**References**


