Introduction

Traceability, and individual identification, the principal tool for achieving traceability, are useful for safeguarding public and animal health, as well as for implementing quality assurance systems.

Both individual identification and traceability have been in use since technology systems were first introduced into animal and food production. These systems generally supplied answers to such questions as: which animal is being considered; where does the animal come from; who is the owner?

With the passage of time, animal and human populations have grown, along with international trade, communications, the speed of transport, the need to produce more food and a greater variety of animal products. All of these changes have occurred while public and animal health have been preserved and improved.

In this context, the responsibility for safeguarding public and animal health, and in some cases the environment, falls to the Veterinary Services. Within this organisational structure, the individual identification and traceability of animals and animal products is one of the prerequisites for international trade.

The level of the supply chain that can be reached using a traceback or trace forward study of an animal or animal products will depend on many factors.
Veterinary Services must approach this challenge by adopting modern management systems (such as quality assurance systems) involving the entire production chain and using identification and traceability as tools.

World livestock populations, meat production and international trade

The following information is a synopsis of the most significant data from the references cited. For more detailed information, the reader is advised to consult the references.

World livestock populations and variation over recent years

The data in Tables I to III, and Figures 1 to 5 present livestock populations and the volumes of regional and international animal trade, as well as the variation in these figures between 1961 and 1998.

### Table I

**World livestock populations in 1998, by species and regional block according to regions defined by the Office International des Epizooties** (in millions of animals)

<table>
<thead>
<tr>
<th>Species</th>
<th>America</th>
<th>Asia</th>
<th>Europe</th>
<th>Africa</th>
<th>Middle East</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>466</td>
<td>564</td>
<td>157</td>
<td>190</td>
<td>66</td>
<td>1,463</td>
</tr>
<tr>
<td>Sheep</td>
<td>114</td>
<td>402</td>
<td>157</td>
<td>233</td>
<td>121</td>
<td>1,027</td>
</tr>
<tr>
<td>Pigs</td>
<td>137</td>
<td>510</td>
<td>200</td>
<td>27</td>
<td>875</td>
<td></td>
</tr>
<tr>
<td>Goats</td>
<td>39</td>
<td>344</td>
<td>19</td>
<td>200</td>
<td>98</td>
<td>700</td>
</tr>
<tr>
<td>Horses</td>
<td>31</td>
<td>16</td>
<td>7</td>
<td>5</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Poultry</td>
<td>3,911</td>
<td>5,651</td>
<td>1,802</td>
<td>1,052</td>
<td>877</td>
<td>13,293</td>
</tr>
<tr>
<td>Total excluding poultry</td>
<td>787</td>
<td>1,856</td>
<td>540</td>
<td>655</td>
<td>287</td>
<td>4,125</td>
</tr>
<tr>
<td>Total including poultry</td>
<td>4,698</td>
<td>7,507</td>
<td>2,342</td>
<td>1,707</td>
<td>1,164</td>
<td>17,418</td>
</tr>
</tbody>
</table>

**Sources:** Food and Agriculture Organization, Office International des Epizooties, United States Department of Agriculture

### Table II

**World meat production in 1998 by species and economic block** (in thousands of tons)

<table>
<thead>
<tr>
<th>Species</th>
<th>America</th>
<th>Asia</th>
<th>Europe</th>
<th>Africa</th>
<th>Middle East</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>28,000</td>
<td>9,200</td>
<td>13,000</td>
<td>4,000</td>
<td>2,000</td>
<td>54,200</td>
</tr>
<tr>
<td>Sheep</td>
<td>408</td>
<td>3,351</td>
<td>1,451</td>
<td>915</td>
<td>1,071</td>
<td>7,196</td>
</tr>
<tr>
<td>Pigs</td>
<td>13,900</td>
<td>47,000</td>
<td>24,600</td>
<td>982</td>
<td>0</td>
<td>86,482</td>
</tr>
<tr>
<td>Goats</td>
<td>128</td>
<td>1,907</td>
<td>120</td>
<td>767</td>
<td>798</td>
<td>3,720</td>
</tr>
<tr>
<td>Horses</td>
<td>224</td>
<td>209</td>
<td>122</td>
<td>13</td>
<td>3</td>
<td>571</td>
</tr>
<tr>
<td>Poultry</td>
<td>23,200</td>
<td>13,200</td>
<td>8,700</td>
<td>2,700</td>
<td>2,200</td>
<td>50,000</td>
</tr>
<tr>
<td>Total</td>
<td>63,860</td>
<td>74,867</td>
<td>47,993</td>
<td>9,377</td>
<td>6,072</td>
<td>202,169</td>
</tr>
</tbody>
</table>

**Fig. 1**

Variation in world livestock populations by species, 1961-1998

### Table III

**World meat trade in 1998, imports and exports by species and regional block** (in thousands of tons)

<table>
<thead>
<tr>
<th>Species</th>
<th>America</th>
<th>Asia</th>
<th>Europe</th>
<th>Africa</th>
<th>Middle East</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imported</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td>1,910</td>
<td>1,400</td>
<td>2,576</td>
<td>236</td>
<td>481</td>
<td>6,603</td>
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<tr>
<td>Sheep</td>
<td>2,200</td>
<td>2,080</td>
<td>2,500</td>
<td>70</td>
<td>15</td>
<td>6,885</td>
</tr>
<tr>
<td>Pigs</td>
<td>8</td>
<td>640</td>
<td>221</td>
<td>17</td>
<td>8</td>
<td>894</td>
</tr>
<tr>
<td>Goats</td>
<td>647</td>
<td>180</td>
<td>4,400</td>
<td>37</td>
<td>0</td>
<td>5,294</td>
</tr>
<tr>
<td>Horses</td>
<td>1,065</td>
<td>367</td>
<td>5,000</td>
<td>318</td>
<td>0</td>
<td>6,750</td>
</tr>
<tr>
<td>Poultry</td>
<td>6</td>
<td>7</td>
<td>4</td>
<td>0</td>
<td>14</td>
<td>31</td>
</tr>
<tr>
<td>Exported</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td>2,000</td>
<td>2,080</td>
<td>2,500</td>
<td>70</td>
<td>15</td>
<td>6,885</td>
</tr>
<tr>
<td>Sheep</td>
<td>104</td>
<td>161</td>
<td>428</td>
<td>38</td>
<td>106</td>
<td>837</td>
</tr>
<tr>
<td>Pigs</td>
<td>8</td>
<td>640</td>
<td>221</td>
<td>17</td>
<td>8</td>
<td>894</td>
</tr>
<tr>
<td>Goats</td>
<td>647</td>
<td>180</td>
<td>4,400</td>
<td>37</td>
<td>0</td>
<td>5,294</td>
</tr>
<tr>
<td>Horses</td>
<td>1,065</td>
<td>367</td>
<td>5,000</td>
<td>318</td>
<td>0</td>
<td>6,750</td>
</tr>
<tr>
<td>Poultry</td>
<td>6</td>
<td>7</td>
<td>4</td>
<td>0</td>
<td>14</td>
<td>31</td>
</tr>
<tr>
<td>Exported</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td>632</td>
<td>2,000</td>
<td>2,902</td>
<td>134</td>
<td>500</td>
<td>6,168</td>
</tr>
<tr>
<td>Sheep</td>
<td>3,328</td>
<td>1,160</td>
<td>2,773</td>
<td>16</td>
<td>25</td>
<td>7,300</td>
</tr>
<tr>
<td>Pigs</td>
<td>3,302</td>
<td>3,761</td>
<td>10,422</td>
<td>445</td>
<td>1,101</td>
<td>19,031</td>
</tr>
<tr>
<td>Goats</td>
<td>3,326</td>
<td>1,160</td>
<td>2,773</td>
<td>16</td>
<td>25</td>
<td>7,300</td>
</tr>
<tr>
<td>Horses</td>
<td>632</td>
<td>2,000</td>
<td>2,902</td>
<td>134</td>
<td>500</td>
<td>6,168</td>
</tr>
<tr>
<td>Poultry</td>
<td>632</td>
<td>2,000</td>
<td>2,902</td>
<td>134</td>
<td>500</td>
<td>6,168</td>
</tr>
<tr>
<td>Total</td>
<td>6,674</td>
<td>4,267</td>
<td>10,545</td>
<td>422</td>
<td>48</td>
<td>21,956</td>
</tr>
</tbody>
</table>

**Source:** Food and Agriculture Organization

**Fig. 2**

World animal trade in 1998
Although the data may contain a margin of error, this will not alter the overall analysis of the global or regional situation, where the same sample for different species shows distinct levels of variation over the years; world animal movements show a similar variation.

World animal trade, totalling more than four million animals a year, represents 1% of the world animal population, whilst the world meat trade, totalling more than twenty-one million tons a year, represents 10% of world production; both are forecasted to grow.

**World meat production and variation in recent years**

The Tables and Figures show world meat production by species and economic block, indicating the rising trend for trade in chickens, pigs and cattle and the sustained trade in horse and sheep meat. This increase in trade, to which must be added the enormous volume of animal products, points to the need to ascertain the origin and destination of products, not only to safeguard public and animal health, but also for other diverse reasons.

**Links in the chain**

To trace or track animals and animal products, the various links in the chain from producer to consumer must be defined, as must the individual identification tools for each link in the chain.

**Veterinary Services**

Veterinary Services intervene in various ways at every stage in the production, transportation, processing, distribution and marketing of animals and animal products, and in some countries such intervention extends over the entire process, from the field to the plate.

Within the organisational structure of any Veterinary Service, identification and traceability are tools for monitoring animals and animal products, as well as documents and processes.

The Veterinary Services must operate efficiently in relation to their objectives and responsibilities, including the following aspects:

- legislation
- financing
- technical structure
- administrative structure
- training
- sanitary programmes
- international certification
- vigilance system
- prevention and emergency disease outbreak management systems
- quality assurance system.
Risk analysis is one of the factors that determines the conditions under which animals and animal products can be certified to guarantee safe trade, and one of the components of risk analysis is an identification and traceability system.

The operation of an identification and traceability system depends to a great degree on the general operation of the production chain as a whole, and of the Veterinary Services. By achieving the quality objectives established at each phase of the process, consumer confidence and satisfaction are guaranteed (15).

**Primary production establishments**

Despite being fixed elements, registration systems are complex, and in many cases, conflicting. Changes in ownership and the size of establishments are very frequent for certain species, production systems and countries. In some countries, herds move from one place to another (e.g. transhumance). This variability in registration systems depends on a series of factors, such as the species, type of production, national legislation and livestock production customs. Only in a few countries are geographical co-ordinates used to precisely locate farms, even though the technology involved is inexpensive and widely available (19). The dynamism of this link in the chain varies, for various reasons, in line with changes that occur in the size of the establishments.

The primary production establishment should be considered an essential link for the proper functioning of any surveillance, prevention and emergency system in the field of animal or public health, and provides the basis for any type of individual identification and traceability system.

**Primary producer**

The primary producer is a very important link in the chain; he/she implements the production process, and is chiefly responsible for delivering a healthy and disease-free animal or product to the next link in the chain.

The extent of participation of the primary producer in the various sanitary or health programmes, at either the decision-making, planning, financing or implementation stage, differs from one country to another. However, certain aspects are common to all countries, as follows:

- **a)** The primary producer is the person who is in permanent contact with the animals and is therefore the trigger of any system of prevention or epidemiological vigilance.

- **b)** The primary producer, who is familiar with the characteristics of the animals, for example, origin, feed and behaviour, is also responsible for the production process.

- **c)** Independently of the system or relationship that exists between the veterinary administrations and primary producers, the latter must be involved in sanitary and health programmes because all actions relate directly to their property (the animals).

**Transportation**

Transportation is another dynamic factor with enormous influence over the sanitary aspect of the production chain, and as for the above-mentioned links in the system, vehicles should be individually identified and registered in line with the legislation in force in each country.

Vehicles used to transport animals or animal products by air, sea or road are currently identified and registered under the different national and international transport regulations. This is another of the critical phases within the system, and as with the other phases, standards, procedures and a registration system must be in place.

**Manufacturing**

Veterinary Services require places of processing to be identified, whether this be the place in which the animals are slaughtered or that in which animal products are manufactured or processed. A product label must identify the manufacturer that produced the product. For the purposes of individual identification and traceability, records must be maintained of the components of manufactured products, raw materials and anything directly or indirectly related to the final product.

Manufacturers aim to produce an innocuous and high quality product, for both public and animal health, but must be able to undertake a traceback or trace forward study of each of the stages and components directly or indirectly involved in the manufacturing process. To do this, the components must be individually identified and the process must include registration systems.

**Products**

An animal can be divided into many different parts, each of which have a number of different uses. Figure 6 indicates the array of possible products that can be obtained from one animal. Although this is not an exhaustive list, it gives an indication of the necessary complexity of any traceability system for animal products.

Through a number of different processes and combinations of components, a wide variety of products can be obtained from a single animal, ranging from something as simple as a carcass or a cut of meat to complex products, such as delicatessen or potted meat, stocks or biscuits produced using a mixture of meat, fat, gelatine and other components made from different species of diverse origins.

With the use of modern technologies, an animal can be bred from an ovum or semen originating in different countries, or from an ovum produced the year previously and semen produced forty years earlier.

Technological developments have led to a greater variety of animal products and by-products, ranging from basic food...
made with, for example, rice, chickpeas, fruit, meat or salt, to sophisticated combinations of products and by-products; no doubt, further products will emerge as a result of continuing technological change.

As illustrated in Figure 6, using the example of a cow, animal products are extremely diverse. The possibilities of linking the animal to the product, by means of a label on the final product, are variable, and limited in practice to carcasses and cuts of meat, which present less of a health risk than other manufactured products. In all the following cases, traceback is possible as far as the manufacturing stage:

- cosmetics
- human medicines
- animal medicines
- animal feed
- hormones for human and animal use
- cells for transplants
- vaccines
- confectionery
- cakes
- biscuits
- prepared foods
- meat stock for human food (soups).

Trade

Many pointers indicate that world trade in animals and food products will continue to grow (13). Such trade not only includes products for consumption, but also a large volume of raw materials for manufacturing food, therefore consumption of food containing components of diverse origin will become increasingly common.

New forms of trade, with cheaper and faster transportation and electronic systems of commerce, compounded by longer periods and diverse types of conservation and warehousing, pose an enormous challenge to traceability.

It should be considered that, as a result of long storage periods, when a product is eaten, the producer and the manufacturer may no longer exist. This would render traceback useless, leaving only the 'product' and the guarantee originally granted on the basis of 'the process' that resulted in an 'innocuous product'.

In trade, a key player has re-emerged, namely: Veterinary Services, which certify products to guarantee public and animal health safety standards in trade.

Individual identification of animals

Individual identification of animals has been used for many years to indicate the ownership of animals. Owners of animals also use this tool for other purposes, such as genetic improvement, improving meat and milk production and general improvements to production efficiency (20).

Different elements are used to identify animals. These have changed in line with technological developments, and their use depends on a series of factors, such as the type of animal and the purpose of identification.
To describe the different elements currently available and those that may emerge in the future, a number of different aspects must be considered.

**Characteristics of identification elements**

An assessment of the different animal identification methods available is presented in Table IV (20).

**Convenience and ease of use**

Even though producers and veterinarians throughout the world are skilled professionals, the elements of identification must be easy and rapid to use because of the quantity of animals in some livestock production establishments (e.g. 100,000 head per farm), as well as the diverse production systems and installations and the variety of work facilities.

**Easy to read**

Readability is of paramount importance and two aspects must be considered; the first is that the identification should be easy to read for every link in the production chain. This varies enormously, depending on the production system and the ability to adopt and access technology. The second factor is the accuracy of reading and transmitting the data contained in the identification element. Technological advances allow systems of alphanumeric characters and bar codes to be combined into a single element, which considerably reduces errors in reading, registering and transmitting data (2, 3).

**Durability**

The durability of the legibility of the data must be considered (whether the data are printed using alphanumeric characters, bar codes or electronic systems), as well as the materials from which the identification elements are constructed (7).

**Animal health and welfare**

The identification element should be well tolerated by the animal, without producing an adverse effect on health (7).

**Harmless in food**

The identification element should not pose a risk to public health (through contact, contamination or for any other reason), as this would have a negative impact on consumer confidence in the traceability system.

**Tamper-proof**

The specific factors in each identification element that help to avert forgery and fraud are very important for the purposes of sanitary campaigns, animal transfers, sale of animals, guaranteed credit operations involving animals, subsidies, and in the interests of livestock farmers themselves (10, 11, 12, 19).

**Cost**

The implementation of technology is determined by a cost-benefit equation, in which the person who must bear the cost of investment will consider the benefits of some of the aspects mentioned earlier before taking the final decision (4, 5).

**Specific elements of individual identification**

The plastic tag is a very common method of identifying animals, and the bar code system and microchip can be incorporated into the tag, which facilitates reading, transmission and registration of data. The tag is easy to remove, but cannot easily be used again.

The tail tag is a temporary method of identification used when transferring animals. In addition to an alphanumeric printed code, a bar code system can be incorporated into the tag. The device is cheap and data are easy to read, register and transmit. The tag is easy to remove, but cannot be re-used.

**Table IV**

**Characteristics of identification methods** (20)

<table>
<thead>
<tr>
<th>Identification element</th>
<th>Application</th>
<th>Easy to read</th>
<th>Durability</th>
<th>Animal health</th>
<th>Harmless in food</th>
<th>Tamper-proof</th>
<th>Acceptance by industry</th>
<th>Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic tag</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>Metal tag</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>Tail tag</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>4</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>Plastic tag with chip</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>4/5</td>
<td>1</td>
<td>27/28</td>
</tr>
<tr>
<td>Plastic tag with bar code</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>4/5</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>Tattoo</td>
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<td>1</td>
<td>4</td>
<td>2</td>
<td>4</td>
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<td>3</td>
<td>23</td>
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<td>5</td>
<td>5</td>
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<td>2</td>
<td>28</td>
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<td>3</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>Branding of the hide</td>
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<td>3</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>27</td>
</tr>
<tr>
<td>Paint marking</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>4</td>
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<td>3</td>
<td>5</td>
<td>27</td>
</tr>
<tr>
<td>Subcutaneous implants</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>Ruminal bolus</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>27</td>
</tr>
</tbody>
</table>
Bar code systems are useful, easy and rapid to read. These systems are inexpensive, but their use must be standardised to ensure a correct reading at every point in the chain.

Microchip implants are currently used for pets and horses. In animals for human consumption, implants can pose a problem due to the risk of migration. As with a ruminal bolus, the device must be recovered at the meat processing plant. Both microchip implants and ruminal boluses require the animals to carry some additional form of visible identification (3, 8, 9, 20).

Hot and cold branding, applied either to the horns or hide, are inexpensive methods of identification. The marks are simple to read if properly applied, but the registration and transmission of data is prone to error (19, 20).

Blood typing is used in pedigree registers for various species, but also requires an additional visible method of identification (18).

Typing of deoxyribonucleic acid (DNA) is a precise, tamper-proof method that also needs additional visible identification. The development and future dissemination of this technique will have to consider the emergence of cloned animals that will have the same genetic composition.

The iris scan, the retina scan or retina imaging are methods of identification in which significant investment has been made in research and development of systems for use on humans, with some research currently in progress on racehorses. Both the iris and the retina differ from one individual to another and have hundreds of characteristics, such as striations, rings and filaments, by which one animal can be distinguished from another (18). The technique consists of taking a photographic or film image that is digitally codified and analysed using special software.

Quality assurance

Industrial, commercial and governmental organisations supply products to satisfy the needs and/or demands of customers. Greater global competition continues to raise customer expectations concerning quality (16).

To remain competitive and maintain good economic performance, a large portion of the industrial, food, pharmaceutical, service and other sectors has developed systems to continually improve quality and increase the satisfaction of customers and the other players involved (employees, owners, subcontractors and the community) (16). Quality assurance is an organisational system introduced by businesses. This system is designed to gain customer confidence and is applied to the different organisational structures of enterprises (14).

Veterinary Services are closely involved with globalisation, and with the new processes and demands that this brings, such as quality systems. Some Veterinary Services are working to develop quality management systems in line with their quality policies, which will enable adaptation to the demands of globalisation (14).

In accordance with the definition of the International Organization for Standardization (ISO), traceability is the ability to reconstruct the history, use or location of an activity, process, product, organisation, person, system, or any combination of these, by means of registered identifications (16). Individual identification and traceability play an important role in quality assurance.

For a traceability system to be used efficiently, a quality system needs to be implemented that must provide inter alia for certain procedures at each phase, as follows:

– individual identification of animals and of each element in the composition of animal products, in terms of raw materials, inputs, ingredients, packaging, machinery, the persons involved and distribution
– registers of the data for each phase in the process
– procedures and instructions defining how to handle the necessary registers and the type of data required
– procedures and instructions defining and guaranteeing the inter-relationship between all of the registers to ensure traceability.

Individual identification and traceability

Trade between countries and economic blocks requires the relevant data to be provided about the provenance of animals and animal products (20).

International trade in animals and animal products will continue to grow, and technological advances in the speed of transportation are increasing the risk of diseases emerging around the world.

Public and animal health decisions are becoming ever more complex and inter-related, with aspects such as the environment, animal welfare, consumer interests, technological developments in genetic modification and the emergence of new diseases, all requiring accurate information to be made available rapidly (20).
Systems of individual identification, registration and traceability are the correct tools for epidemiological surveillance and prevention systems (15, 17, 19, 20, 22).

The differences between the systems of individual identification and traceability implemented by the various countries and economic blocks are a response, inter alia, to the differing sanitary status and production systems in these countries.

In many countries, this is an issue of debate among the different sectors with a view to meeting local and international requirements. The key is to satisfy the needs of the various links in the chain, creating confidence without increasing costs or erecting trade barriers.

**National programmes for individual identification**

The following is a brief description of some of the most important aspects of individual identification programmes implemented by various countries, illustrating differences in the most important phases of the individual identification process (1, 4, 5, 6, 7, 10, 11, 12, 15, 19, 20, 21, 22, 23).

**Primary production establishments**

In Argentina, Australia, Canada, Cyprus, Egypt and the European Union (EU), primary production establishments are identified individually, allowing each establishment to be located by geographical position.

**Population of cattle, pigs, sheep, horses and poultry**

In all cases, the existing number of animals of different species is known. Information about the variation in the total number of animals in each country depends on the level of technology in the country. In the case of Argentina, an annual record of the number of animals is obtained through a compulsory census undertaken by the Veterinary Service.

In Argentina, Australia and Canada, the regional or local Veterinary Services have information regarding the number of animals and animal movements as a result of epidemiological surveillance.

In the case of the database used by the authorities in Ireland, the total number of animals is known at any time.

**Animal movements**

Animal movements are covered by transit documents. With the exception of a few countries in the EU, data about animal movements are not centralised in electronic databases.

**Individual identification of animals within, or when leaving, primary production establishments**

In the EU, compulsory identification of animals is performed within primary production establishments and animals may not be transferred without this compulsory identification. In Argentina, Australia, Canada, Egypt and Cyprus, individual identification of animals within establishments is not compulsory, except in the case of sanitary or waste programmes that are covered by specific regulations concerning individual identification.

In Australia, the individual identification of cattle with temporary tail tags is compulsory when animals leave the establishments of origin, to identify the consignees. Australia also has a voluntary programme of individually identifying cattle with tags, to comply with approved standards. The tags are applied before the animals leave the holding of birth. The tags remain on the animal until it is inspected at the meat processing plant. The tag allows the carcass to be traced back to the establishment of origin. This voluntary programme began in Victoria in 1999.

Computerised databases are being developed by the private sector.

In Canada, the individual identification programme is a simple traceability system that consists of identifying cattle by applying tags when the animal leaves the establishment of origin. The tags remain on the animal until the carcass is inspected at the meat processing plant. If any problem is detected, the tag allows an efficient search to be made to identify the cause of the problem, from the moment it was detected back to the establishment of origin. The programme has been compulsory since 31 December 2000 and includes a centralised database run by a private agency. The Veterinary Service is allowed access to the database for health matters.

In Argentina, animals are individually identified by means of a brand on the hide, indicating the owner of the livestock. Each livestock producer has an individual brand and the animals must be identified before being transferred. Branding enables the animal or herd to be linked with the establishment of origin. In both Cyprus and Egypt, the identification of animals by herd allows traceback to the establishment of origin.

**Manufacturing**

In all cases, meat processing plants identify the carcasses or cuts of meat by production date, allowing traceback to the suppliers of livestock on that date. Some manufacturers are involved in special programmes in which the cuts of meat can be labelled with a herd number that can be linked to the primary producer or to the animal from which the cut originated.

**Examples of individual identification and traceability systems in operation**

Table V presents examples of identification systems that are applied in different countries or regions of the world.
The factors influencing the decision regarding an individual identification and traceability system include the following:

- objectives: what are the objectives of the implementation of the system and what is the expected outcome?
- policy: each country has a different situation and different decision-making levels, as well as international commitments, that must be taken into account
- cost: undoubtedly an important aspect of decision-making, regardless of whether the public or private sector finances the programme
- financing: for countries which, for different reasons, do not use subsidies (developing countries), financing is a limiting factor for implementing identification and traceability systems
- production systems: this is one of the variables influencing decision-making, even within a single country
- health: the health status of the country and the risk associated with the product are factors to be considered.

Lastly, the traceability of animals and animal products is both a demand and a requirement of globalisation, for which the provision of different solutions will be necessary, depending on whether animal health, public health and consumer protection; genetic improvement or marketing aspects are involved. The requirements of international trade and biotechnology (cloning, genetic engineering, etc.), the varying health status and production systems of countries, and guarantees of the quality of each of the different phases, must be taken into account to allow the construction of a safe process along the entire food chain.

**Table V**

Identification systems applied in different countries or regions of the world

<table>
<thead>
<tr>
<th>Characteristics of the system</th>
<th>Argentina</th>
<th>Canada</th>
<th>Australia</th>
<th>European Union</th>
<th>Egypt</th>
<th>Cyprus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification of primary production establishments</td>
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<tr>
<td>Individual identification of animals within each establishment</td>
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<tr>
<td>Individual identification of animals when leaving establishment</td>
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</tr>
<tr>
<td>Identification of herds of animals within or when leaving establishment</td>
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<td>◊</td>
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</tr>
<tr>
<td>Carcass with identification of the animal of origin</td>
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<tr>
<td>Carcass with identification of establishment of origin</td>
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<td>•</td>
</tr>
<tr>
<td>Carcass with identification of herd/manufacturer</td>
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<td>◊</td>
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<tr>
<td>Cut of meat with identification of origin</td>
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</tr>
<tr>
<td>Cut of meat with identification of establishment of origin</td>
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<tr>
<td>Cut of meat with identification of herd/manufacturer</td>
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</tbody>
</table>

• Feasible to implement
◊ Total implementation

**Conclusions**

The health status of countries, regions, areas, production establishments, animal species and individual animals is diverse and this determines the requirement to ascertain the origin of animals and animal products.

Animal products allow varying levels of traceability, based on factors such as the origin of raw materials and the processes to which the products have been subjected. Carcasses and cuts of meat are products that present a lower health risk and are simpler to label and link to the animal(s) or establishment of origin. Animal products such as ground meat, sausages, potted meat, biologics and animal feed present a greater health risk than carcasses or cuts of meat. Furthermore, in some cases, labelling of these products in such a way as to link them back to the animal(s) or establishment of origin is impossible or very difficult.

The animal and public health aspects of animals and animal products should not be based solely on individual identification and traceability, but rather on a system that provides guarantees. The steady growth that is occurring in world trade of animals and animal products, needs to be accompanied by guarantees that trade is safe for public and animal health.

Consumers are showing a growing interest in public health matters. The demand for, and global interest in quality assurance, from both businesses and consumers, is clear.

The technology required to satisfy the different needs for individual identification and traceability is available.

Analysis of the possibility of harmonising and standardising aspects relating to individual identification and traceability is advisable (e.g. national definitions, terms and codes, etc.).

The factors influencing the decision regarding an individual identification and traceability system include the following:

- objectives: what are the objectives of the implementation of the system and what is the expected outcome?
- policy: each country has a different situation and different decision-making levels, as well as international commitments, that must be taken into account
- cost: undoubtedly an important aspect of decision-making, regardless of whether the public or private sector finances the programme
- financing: for countries which, for different reasons, do not use subsidies (developing countries), financing is a limiting factor for implementing identification and traceability systems
- production systems: this is one of the variables influencing decision-making, even within a single country
- health: the health status of the country and the risk associated with the product are factors to be considered.

Lastly, the traceability of animals and animal products is both a demand and a requirement of globalisation, for which the provision of different solutions will be necessary, depending on whether animal health, public health and consumer protection, genetic improvement or marketing aspects are involved. The requirements of international trade and biotechnology (cloning, genetic engineering, etc.), the varying health status and production systems of countries, and guarantees of the quality of each of the different phases, must be taken into account to allow the construction of a safe process along the entire food chain.
Évolution récente de l’identification des animaux et de la traçabilité des produits d’origine animale dans le cadre du commerce international

L.O. Barcos

Résumé

En conclusion, l’auteur explique les facteurs qui, de par leur influence sur les différents processus d’identification et de traçabilité, doivent être analysés lors de la sélection d’un système en particulier. Il fait également observer que les situations varient considérablement d’un pays à l’autre, pour des raisons aussi bien sanitaires qu’économiques et socio-culturelles. Aussi recommande-t-il d’engager une harmonisation internationale de ces systèmes.

Mots-clés

Recientes desarrollos de la identificación de animales y la rastreabilidad de productos pecuarios en relación con el comercio internacional

L.O. Barcos

Resumen
El autor describe la composición y variaciones del stock mundial de animales domésticos entre los años 1961 y 1998, observando el marcado incremento de la población porcina comparativamente a las demás especies domésticas. Analiza también la evolución de los intercambios internacionales de animales vivos durante el mismo periodo, que representan el 1% del stock mundial, así como la del mercado internacional de carne, que implica un 10% de la producción mundial total.

Luego analiza las diferentes pautas que integran la cadena alimentaria, desde el campo hasta el plato, explicando los elementos que son objeto del proceso de rastreabilidad, es decir, desde la composición de un bovino hasta la faena, y luego
since the different products and subproducts reach the final product that reaches the consumer. These clarifications permit describing the characteristics of the systems of individual identification of animals and products of livestock, and their applications to the investigations retroactive and prospective with the aim of traceability.

In the conclusion of the analysis, the author explains the factors that by their influence on the different processes of identification and traceability, must be investigated in the moment of selecting a system determined, and observes that the situations at a level worldwide present a great variability, due to aspects specifically sanitary as economic and sociocultural. For this reason, it is recommended to initiate a process of harmonization international of these systems.

**Palabras clave**


### Appendix I

**Products of animal origin**

The list below presents examples of animal products and their uses, to serve as a guide to the type of information that the final product could contain.

**Milk.** Human and animal food, food substrate, a large number of different products (liquid milk, powdered milk, yoghurts, cheeses, cakes, biscuits, butter, desserts and cream).

**Hormones.** For animal and human use.

**Blood.** Human and animal food, food substrate, serum as a vaccine substrate, culture media.

**Marrow.** Human and animal food, component of delicatessen meats, human medicine.

**Fat.** Human food, substrate or component of foods such as delicatessen meats, cakes, biscuits, manufacturing, animal feed.

**Semen and ova.** Animal breeding.

**Bone, hide and hair.** Industry, animal feed, human food, gelatine as a by-product for human food and manufacturing.

**Cells and calculi.** Human and animal medicine.

**Horns.** Gelatine for industrial and human use and for human medicine (aphrodisiacs).

**Feathers.** Industrial, meal for animal feed, e.g. for pets or fish (which could, in turn, be consumed by humans).

**Liver, heart, brains, pancreas.** Human and animal food, substrate or component of delicatessen meats, human medicine.

**Chitterlings, large intestine, kidney, sweetbreads, lungs, tripe, tongue.** Human and animal food, component of other foods for human consumption.

**Rennet and third stomach.** Human food, industry for manufacturing ferments for use in human food.

### References


