The importance of traceability for public health and consumer protection

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Summary
Since the 1980s, concerns about the safety and quality of food have increased at both governmental and consumer levels. The importance of traceability of animals and animal products has grown as food production and marketing have been removed from direct consumer control. Product traceability, which requires a transparent chain of custody to maintain credibility and to complete information transfer functions, has two components, namely: a unique identification system, and a credible and verifiable mechanism for identity preservation. Traceability systems can be subdivided into the following four categories: country of origin; retail; processor; and farm-to-retail identity. Although the availability of computers and electronic data devices can enhance the speed and accuracy of data acquisition and manipulation, a common set of developmental criteria exists, irrespective of data-handling processes. As data management technologies become more powerful and less costly, product traceability requirements will multiply. Public and private sectors should seize these opportunities to improve public health and quality parameters, or risk a narrowing of their markets.

Keywords

Introduction
For the purposes of this paper, traceability is defined as the ability to maintain a credible custody of identification for animals or animal products through various steps within the food chain from the farm to the retailer. Identification may originate at any level of this food chain and may be applicable to single steps or the entire chain. As food production and marketing have been removed from direct consumer control, traceability of animals and animal products has assumed increased importance to consumers and the organisations that service the needs of consumers.

In industrialised nations, food production and marketing was largely a local function prior to the mid-20th Century; and this remains the case in many locations in the developing world. Retail outlets were locally owned and supplied, and generally traded on their personal credibility for safety, quality and honesty. The refinement of refrigeration techniques and a reduction in transport costs coupled to encourage global production and distribution activities. New multi-national companies were formed to market foods with minimal local control of production or processing. In many examples, consumers are presented with a fungible product that may originate from different continents or hemispheres depending on seasons, product availability and market demands. The flexibility of this system may provide a vast array of products, but the system also exposes consumers to global public health risks and varied production practices.

Over the past two decades, concerns about food safety and quality have increased at both governmental and consumer levels. Interest has primarily focused on control of those microbes, parasites, viruses and chemical additives and contaminants that can be dangerous to humans when introduced into the food supply, either during production or
processing (8). In some countries, these concerns have been expanded to include animal welfare and environmentally-friendly production practices. The ability to maintain differentiation of these products based on consumer desires and needs is the principal aim of systems for traceability of animals and animal products.

As public and private bodies work to alleviate food safety concerns through modifications of processing and production methods, an expanded array of information detailing the implementation of these steps needs to be transferred. A key component of this information transfer mechanism is the traceability of individuals or cohorts of animals affected by these modifications from farm to retailer. This information transfer may be used to identify products with intrinsic characteristics valued by consumers or to enhance system safety and quality through imposition of higher production standards. The complexity of these systems will be substantially heightened by the traceability requirements.

Traceability of a product requires a transparent chain of custody to achieve credibility and to complete the desired information transfer functions. Product traceability has two components, as follows:

1. Unique animal or product identification systems
2. A credible and verifiable chain of custody or identity.

This custody chain may be very short, for example the designation of country of origin or the local producer selling at a shop or farmers market, or considerably longer, as is the case for an international farm-to-retail process.

Farm-to-retail traceability systems

Within a country of origin designation or retail/producer mark, several concurrent traceability levels may operate to fulfil management requirements for identification and quality through the farm-to-retail chain (Fig. 1). A product moving from production to processing/retailing will be identified to assure payment and, in many cases, to assess and value quality attributes. At the national level, traceability of animals to production sites may be required to assure adherence to national standards through monitoring and testing programmes. Individual animal or cohort traceability does not need to be maintained after standard compliance has been assured. The ability of consumers to trace product is limited by the processor or the retailer. Therefore, farm-to-retail system traceability is not necessarily enhanced by these actions, but improved product quality may be quantifiable.

Traceability functions may be based on individuals or groups, depending on the management systems and the information transfer required. The needs of the system in terms of robustness and scope will vary widely depending on traceability requirements and desired information transfer functions. Where cohorts of similarly aged and managed animals are maintained and specific information about individuals is not required, group identification to the lot or production system may suffice. In other instances, information about health status, age or other details specific to an animal require individual identification.

The ‘cattle passport’ traceability scheme implemented in the United Kingdom (UK) (7) in compliance with the European Union requirements (Article 6.2 of Commission Regulation [EC] No. 2629/97) (3) is an example of life-long animal traceability developed in response to public concerns about bovine spongiform encephalopathy (BSE). This system gives consumers confidence in the information supplied at the point when the animal is presented to the food chain (the age of the animal and the management of the animal since birth). An age limitation of thirty months has been used to indicate enhanced public health, based on the BSE incubation period in cattle. By recording animal movement, this system provides information about the national feed and management standards under which each bovine has been maintained. These data points are important resources to allay consumer concerns about BSE and transmission of the BSE agent into the human food supply.

Programmes for food quality and safety may be developed by public (governmental) or private organisations, depending on the goals of each scheme and public perceptions. In some countries, the government has a high credibility rating and a good food safety record, and hence strong consumer acceptance. In these cases, a governmental stamp or seal of approval carries great weight with consumers. As a result,
retailers and processors will meet any standards necessary to achieve this approval. Such a governmental quality mark may be the sole requirement of consumers as a basic safety and quality designation. At the other end of the spectrum, based on prior public experiences, consumers in some countries have developed a heightened sensitivity to safety and quality issues and are more comfortable with private organisations setting and monitoring standards.

Competing private systems may be developed to meet perceived local consumer needs for setting and monitoring of standards. In many cases, because of the attribute(s) being promoted, these programmes become product marketing activities that may confuse rather than enlighten consumers. Public and private partnerships may also develop where private groups set the production and programme standards and government and/or private entities monitor compliance. Irrespective of the original construct, these schemes require certification by a third party to be credible (2). In all cases, some levels of traceability for animals and animal products are required, both for certification and for consumer acceptance. The level of detail and robustness of the system is predicated on the needs of the programme and the complexity of the system. Concurrent public and private quality and safety programmes may be enforced to meet different goals in terms of public health and competitiveness. Such varying schemes may require substantially different levels of traceability rigor, depending on the goals of the programme.

Traceability of animals and animal products can be subdivided into the following four categories:

- a) country of origin
- b) retail labelled
- c) processor origin
- d) farm-to-retail identity (Table I).

Country of origin designations may provide a substantive array of information to regulatory and commercial segments of the food chain that understand the regulatory and production standards of different countries. Governments set standards for animal or animal product imports, based on protection criteria for public health and industry. Sanitary and phytosanitary standards for products and disease or pest classification for live animals and animal products are valid concerns for governments. Preventing the entry of a foreign animal disease or a disease with public health implications is an appropriate function of government. Designation of the ‘true’ country of origin for animals and animal products, coupled with a transparent disease and public health reporting system are central to the proper dispensation of these rightful governmental activities. Consumers generally prefer domestic products, when given a choice, because of a perceived understanding of the national conditions of production and distribution, compared to the variety of international standards. Given such preferences, imported products must attempt to differentiate themselves by using higher and more targeted product standards than domestic competitors.

Retail organisations set standards to meet the needs or desires of consumers. Consumer expectations are such that the retail organisations will source products which meet consumer standards for quality and safety. These sources may be local, regional or global, depending on the retail marketing strategy and product availability. Attributes may be categorised by product characteristics (taste, appearance), production systems (organic, environmentally-friendly production, etc.), or by product availability and price. In the final analysis, consumers determine whether retailers meet their expectations through their purchasing decisions. The responsibility for discovery and fulfilment of consumer needs/desires resides with the retail organisation. The ability of the retailer to meet or exceed consumer expectations dictates commercial success. These expectations may be personal or community preferences or may be generated by the marketing stratagem of the retailer. In each case, consumers judge product adequacy based on these criteria and align themselves with retailers that meet their current needs/desires. Traceability requirements are dictated by the retail establishment and its credible pursuit of the consumer. This spectrum may be limited to offering easily-identified private label brands or may expand to more complex farm-to-retail programmes.

**Table I**

<table>
<thead>
<tr>
<th>Definitions of traceability categories</th>
<th>Definition</th>
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<tr>
<td>Traceability</td>
<td>The ability to maintain credible custody of identification for animals or animal products through various steps within the farm-to-retail chain</td>
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<tr>
<td>Producer traceable</td>
<td>The ability to trace animal products from the retailer to the initial inputs of production (genetic lines, feed inputs, production systems, etc.)</td>
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<tr>
<td>Processor traceable</td>
<td>Identification of an individual product back to the processor, but not to the producer</td>
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<tr>
<td>Retail traceable</td>
<td>Identification of an individual product back to the retailer, but not the processor</td>
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<tr>
<td>National origin traceable</td>
<td>Identification of an individual product back to the nation of origin, but not beyond the retailer/processor</td>
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Source: modified from Liddell (5)
Processor origin traceability is the next step up the chain from retail activities. Processors are free to delineate their products based on quality, safety and marketability characteristics. These actions form the bases for retail market access and consumer preferences. Failure to meet these expectations may result in a loss of the market share. Effective food safety controls against known risks are a consumer expectation. Quality expectations are shaped by tradition, consumer needs/desires and product management. Processors may access a product from a variety of sources, domestic and international, to meet their product specifications or final product attributes. The processor may purchase a raw product with specific attributes or select desired attributes from a panoply of production offerings to meet different retail/consumer market demands. Strategies to fulfi these market choices are dictated by the retail market and production sources available. Processors may blend products from a variety of production sources to meet a specific market request. Blending limits traceability to the brand or label identity of the processor, because the consumer and retailer are unable to examine the origin of source materials. Therefore, brand loyalty generated by past experiences of processor products or the availability of product, based on visible quality characteristics and price, become the principal instruments of processor sales. Without the inclusion of production-based attributes, system-wide product traceability requirements are minimised.

At the opposite end of the information spectrum is the desire or necessity to trace a product from the farm to the retailer, so-called ‘farm-to-retail identity’. This chain of custody may be short, as in a ‘local’ production programme (farmers’ market, local producer/process or speciality marketing). In these schemes, the producer is directly known or accessible by the consumer. Consumer contact may be direct or electronic, but is readily available. Two examples of electronic farm-to-retail marketing activities are the direct marketing of foods over the Internet (4) and producer identification under Swedish Farm Assured programmes (1). Farmers’ markets and Community Supported Agriculture (CSA) projects are local examples of direct market strategies. As many consumers are interested in establishing a more direct link between themselves and the production/processing of food, these systems are multiplying in a variety of permutations within industrialised nations, based on local needs and resources. The essential basis for these programmes is the development of direct interplay between consumers and producers, which generates a common bond of safety and quality credibility (Fig. 2).

The development of such direct bonds between consumers and producers must be supplemented by verifiable and traceable production systems that enable consumers to have confidence that their specifications are being met throughout the product chain, irrespective of the complexity of the chain and the number of participants. As food production activities become further removed from the consumer, these interrelations are increasingly difficult to maintain within existing market structures.

![Fig. 2 Processor facilitation of farm-to-retail traceability](image-url)
existing equipment and work activities are required, particularly in multi-source plants.

The appearance of credible and cost-efficient production and marketing systems that guarantee specific increased product safety and quality attributes may be more appealing to consumers than more generalised systems, particularly in societies or markets that place a high premium on process control. Societies that have experienced dramatic food safety problems which have undermined confidence in government regulatory activities may be similarly situated. In such environments, suppliers unable to meet these concerns may be denied access, irrespective of quality or price competitiveness.

For such specialty markets to expand, formalised, credible and verifiable production and processing standards must be devised, implemented and monitored. This information must be transferred throughout the chain and properly identified to the appropriate animal or animal products. The continued development of electronic data storage and management systems have revolutionised animal and animal product marketing by reducing the reliance on processor intervention to provide quality and safety of product and will enhance direct consumer choice and system confidence.

The effect of such activities is to uncouple production and marketing from processing of animals and animal products. Product control shifts from processors to entrepreneurs who develop consumer demand for products containing known attributes and assemble production to meet these demands. The challenge for governmental entities will be to develop appropriate surveillance and regulatory structures to monitor and encourage these interactions between various members of the food production and consumption chain.

Traceability activities may be used in response to concerns about public health or production attributes. Consumers will place differing weight on these attributes within each classification, based on local needs and experiences. Prior experiences with a significant food-borne illness on a local or national scale predictably stimulate producer/processor responses to improve product safety in those or related areas. In each case, a credible system must be developed to provide consumers with this safety information. Transparency must be maintained at various levels within the farm-to-retail marketing chain. These transparency and traceability functions are critical factors to enhance the value of these marketing activities.

Country of origin identity may provide such information at a very basic level. Sweden, after a major outbreak of human salmonellosis in the 1950s, launched a national programme to prevent Salmonella contamination in food products of animal origin. Since that time, this national programme has provided consumers in Sweden with credible assurance that local products are safe from Salmonella contamination. This programme is based on improved processing techniques and practices and on a national testing and traceback scheme. Contaminated farms are eliminated to assure product safety at the national level. Few other countries can make such claims in relation to Salmonella contamination of animal products sold in domestic and export markets.

Since the mid-1990s, pork producers and processors in Denmark have participated in an aggressive scheme to reduce Salmonella contamination of pork products, with notable success. National prevalence of Salmonella contamination in pork has fallen from over 6% to below 2% since the inception of the programme (6). Long-term national strategies for brucellosis, tuberculosis and trichinae elimination have been implemented by many developed countries to improve public and animal health. Similarly, control of animal production diseases such as foot and mouth disease, classical swine fever (hog cholera), African swine fever, scrapie, sheep scabies, rinderpest and others have been successfully undertaken, to reduce production costs and to increase export opportunities. Farm of origin testing and traceability from centralised sampling programmes have been critical to the success of these efforts. National and international registries provide sources for animal products of known health standards.

The UK has led the development and implementation of national pork production systems that encourage social interactions of the animals, as a form of animal welfare. Sweden has enacted similar production criteria. These activities have been codified in law and are a basis for marketing programmes based on the assurance that such standards are met. Since 1985, Sweden has been in the forefront of banning sub-therapeutic growth promoters. Animal health officials in Australia and New Zealand have a long and successful history of fastidious adherence to regulations designed to exclude animals or animal products that could introduce new animal disease or public health concerns to their countries. These examples demonstrate that an animal product which is traceable to a country of origin may be imbued with unique production or public health characteristics under the mantle of these national activities. Knowledgeable consumers can use these national programmes to find the desired attributes in domestic and imported products.

Traceability and information tracking by retailers and processors may be multi-faceted, depending on market demands. Product branding and specialty product development are designed to enable consumers to readily identify the product source. In cases where brand characteristics are introduced into commodity products within the processing arena (i.e. specialty cuts, packaging, or further
processing), complete traceability has minimal value. Traceability is limited to identity and reputation of the processor or retail establishment. All safety and quality controls are the responsibility of the processor or retailer. At the other end of the spectrum, these retail/processor organisations may require elevated animal production standards to meet brand characteristics which they cannot interject during processing. Farm-to-retail product tracking and transparent assurances that such standards have been fulfilled may be key to brand credibility.

As the food chain has lengthened from local production, processing and consumption to more global commercial opportunities, the need to transfer information related to production and public health and the complexity of these transfer vehicles to consumers have expanded exponentially. Some processors responded to this chain expansion by the development of commodity product lines that enabled the sorting of animals and animal products into marketable entities with minimal market differentiation. Processors and retail brands were used to convey general quality and safety standards to consumers. The raw input product (the live animal) was considered safe when it met governmental standards to consumers. The raw input product (the live animal) was considered safe when it met governmental inspection and production standards (antimicrobial withdrawal periods, rules for pesticide use, etc.). Under these systems, farm-to-processor traceability was limited to compliance with governmental regulations and quality payment schemes (in which producers are rewarded for supplying meat with certain attributes).

Since the 1980s, this commodity animal product system has experienced a range of local and international food-borne incidents (Escherichia coli O157, Salmonella, BSE, dioxins), leading to consumer illnesses and deaths that have eroded confidence in these general systems. Coupled with consumer distance (both physical and experiential) from production agriculture, these events have triggered increased demands for product information throughout the food chain. The widespread acceptance of hazard analysis and critical control point (HACCP) systems for safety management is a response to these concerns and has increased the need for product chain information interactions for animals and animal products throughout the chain. The world-wide technology revolution has enhanced capabilities to acquire, process and store large quantities of information at increased speeds and at increasingly reduced prices. The confluence of these pressures and technologies has encouraged the development of farm-to-retail information systems designed to improve public health and to increase consumer acceptance.

Differentiation of products of animal origin and the concurrent transfer of production or safety information are technically and economically feasible even in complex, high volume commercial applications. This realisation has driven development of specialty markets and products that provide consumers with information to meet an array of desires and concerns about quality and safety issues. Many of the desired attributes must be introduced at the production level and cannot be added during processing. In these systems, traceability, process transparency and third-party assurance of process integrity are central to gaining and retaining consumer confidence.

**Capturing information**

Farm-to-retail traceability may be achieved under a variety of information management systems. Computer and electronic data devices can enhance the speed and accuracy of the acquisition and manipulation of data, but a common set of concerns apply, irrespective of the data-handling processes. Certain decisions must be taken during the development of a traceability system for public health and food quality, including, but not limited to the following choices:

- **a)** animal identification at the individual or cohort level
- **b)** length of the period of product traceability
- **c)** information to be transferred
- **d)** level of processing traceability
- **e)** availability of retail information

The decision as to whether to use individual animal or cohort identification is dictated by the types of production and the public health or quality concerns to be monitored. The tracking requirements must take into consideration the goals for the process and all relevant sources of information. Under production systems in which individual animal productivity and health are important data points, the identification and recording systems must fulfill this information requirement. Individual health records, including medication and vaccination histories, age, and country and herd of origin may be important considerations for some products. Under other management schemes, animals are treated as groups for handling and marketing purposes or when the desired characteristics to be measured (production facilities and systems, group feeding or medication practices, genetics, welfare management, etc.) are found uniformly within the group. In these cases, each production cohort, not individual animal, is a data source that must be tracked. Transfer of animal handling experiences, medication and vaccination histories, quality certifications, production process reviews, and other group-related information may not require individual data capture and storage. These determinations affect the tracking and information management system to be selected.

The period during which identification monitoring is required is a second parameter in the development of credible traceability systems. Birth-to-market identification may be required to capture all relevant production and identity data.
Where genetic evaluations are a desired outcome, the tracking of the maternal, rather than the foster dam and her offspring becomes paramount. This is particularly true in production systems in which new-born animals may be transferred among dams to enhance survival. Systems to reliably identify and track individual new-born animals within a group production environment are much more challenging than cohort identification. Identification devices are easier to apply at a later age, and in many applications this later identification provides the requisite information to maintain the scheme. For maintenance of individual production parameters during the pre-market periods, visible forms of identification (ear tags) or externally readable instruments (electronic ear tags, electronic implant devices) are required. Other marking formats may be appropriate, depending on the production system. Medication and vaccination histories and other data may be added to the data stored on the individual animal where read/write electronic chips are utilised. Concurrent storage of paper and electronic data may be used as an alternative method for the collection and storage of data that is presented at transfer of the animal. Compatible reporting and identification systems must be developed and implemented within the marketing system to ensure accurate reporting and tracking. This activity becomes increasingly complex as the number of product sources and product volume increases.

Information to be transferred may have a variety of configurations, depending on the final purpose. Traceability considerations are not limited to the type of activity (e.g. safety or quality attributes), but to where in the chain traceability must be generated and to whom the information must be transmitted. Quality and safety parameters must be identified at the appropriate level for control and transferred through the farm-to-retail chain. Some production attributes (genetics, production style, nutritional programmes, pharmaceutical limitations, owner identity, physical defects and residual control practices, etc.) can only be established at the production level. Once the animals leave the production site, these attributes are fixed and cannot be changed. These attributes may have a specific value at the retail level, requiring farm-to-retail traceability.

Other attributes are captured by the system at the processor level, requiring a more limited tracking system. Some food safety concerns may have a farm or individual animal basis, for example BSE, feed-related chemical contaminants (dioxins and mycotoxins) and zoonotic parasites. Certification that production sites do not constitute a risk regarding these concerns may be transmitted to the processor or to the retail consumer level. In these cases, feed suppliers to the production units may also be critically examined as contributors to potential product contamination. Other food safety concerns have been primarily linked to processing and retail contamination, for example *Listeria monocytogenes*, *E. coli O157:H7* and *Staphylococcus aureus*. Farm-to-retail traceability is not essential in addressing these concerns. Processor and retail traceability systems may suffice to assure confidence in product safety. By categorising the desired information to be transferred, in terms of origin and target audience, the complexity of traceability systems can be determined. These considerations must be integrated into the strategy, to determine the most appropriate transmission vehicles.

Tracking and information transfer needs at the processor level depend on the intended use of the production information supplied and the product segregation capabilities within the processing environment. The desired level of process control must be determined. A hierarchy of difficulty is presented when process control levels move from sorting and maintaining identity based on multiple farm groups with the same characteristic to specific farm cohorts or to individual animals. Several technologies are currently applicable and of moderate expense for use where carcass identity is to be maintained until segregated into a lot with others of similar production or quality values or into farm cohorts prior to further processing. More difficult is the maintenance of these identities as the carcasses are disassembled during further processing in high-speed multi-source operations. Complex identification and storage systems exist that enable tracking of individuals or cohorts through further processing. Such systems are expensive to purchase and require substantive changes in many traditional processing activities. Lower-volume processing facilities will find maintenance of individual and group identity less complex. Under each scenario, the technologies to maintain identity during processing and through to retail sales are currently available.

Retail information availability must be dictated by market assessments and technology utilisation. Bar codes and other standard identification devices may be used to access electronic databases where production and other information is stored for each individual or cohort. Such information transfer requires an unbroken chain of information custody from farm to retailer. Alternatively, production systems (environmentally-friendly, improved animal welfare, organic or other limitations) may aggregate under labels or designations that require the presence or absence of certain product attributes as a prerequisite for admission. This chain of custody may be maintained unbroken from farm to retailer or by an equivalent tracking system that assures product segregation and transfer of this information through the processor to the retail chain. In each case, transparency of data collection, storage and transmission are required to maintain system credibility.

**Conclusion**

Substantial variation exists in the costs of applying these systems. However, as information acquisition, storage and management technologies become more powerful and less costly, the ability to manipulate the large data sets required by...
L’importance de la traçabilité pour la santé publique et la protection des consommateurs

J.D. McKean

Résumé
Depuis les années 1980, l’innocuité et la qualité des aliments constituent un sujet de préoccupation grandissant pour les pouvoirs publics comme pour les consommateurs. La traçabilité des animaux et des produits d’origine animale a pris d’autant plus d’importance que la production et la distribution agro-alimentaires échappent désormais au contrôle direct des consommateurs. La traçabilité des produits, qui suppose une chaîne de contrôle transparente pour garantir la crédibilité et remplir les fonctions de transfert de l’information, comporte deux composantes, à savoir : un système d’identification unique et un mécanisme crédible et vérifiable de préservation de l’identité.

Les systèmes de traçabilité peuvent être subdivisés en quatre catégories, selon leur objet : pays d’origine, distributeur, transformateur et identité du produit depuis l’élevage jusqu’au détaillant. Les ordinateurs et systèmes informatiques permettent d’accélérer la collecte et le traitement des données et d’en améliorer la précision, mais il existe aussi un ensemble commun de critères de réalisation, quels que soient les procédés de traitement des données. À mesure que les technologies de gestion des données gagneront en puissance et deviendront financièrement plus accessibles, les exigences liées à la traçabilité des produits se renforceront. Les secteurs public et privé devraient saisir cette opportunité pour améliorer les paramètres liés à la qualité et à la santé publique, sous peine de voir un déclin de leurs marchés respectifs.

Mots-clés

modern global animal production will increasingly become available. The appearance of credible and cost-efficient production and marketing systems that can guarantee specific increased product safety and quality attributes may be more appealing to consumers than more generalised safety and quality systems, particularly in societies or markets that place a premium on process or safety control. Similarly situated may be societies that have recently undergone food safety experiences that have undermined confidence in governmental regulatory activities. As consumers understand that their wants/desires can be more precisely met for a reasonable additional fee, these opportunities will expand.

Traceability of animals and animal products, coupled with transparency and assurance of process control, may become market access issues for both local and global commerce in the foreseeable future. In such environments, suppliers unable to meet these concerns may be denied access, irrespective of quality or price competitiveness. Technologies exist to maintain the identity of animals and animal products from birth to consumption. Public and private groups should avail themselves of these opportunities to improve public health and quality parameters for animals and animal products, or be prepared to have their market opportunities limited.
Importancia de la rastreabilidad para la salud pública y la protección del consumidor

J.D. McKean

Resumen
Desde los años ochenta, la cuestión de la inocuidad y la calidad de los alimentos viene suscitando creciente inquietud tanto en las administraciones como entre los consumidores. La rastreabilidad de los animales y sus derivados ha ido cobrando importancia a medida que el consumidor perdía el control directo de la producción y la venta de alimentos. Los sistemas de rastreabilidad de productos, que requieren de una cadena transparente de controles para conservar la credibilidad y ejecutar cabalmente las funciones de transferencia de información, comprenden dos grandes bloques, a saber: un sistema único de identificación; y un mecanismo creíble y verificable para preservar la identidad de los ejemplares a lo largo de la cadena alimentaria. Los sistemas de rastreabilidad pueden subdividirse en cuatro categorías, según se apliquen al país de origen, al minorista, al industrial o a la identidad del animal desde la granja hasta el punto de venta. Aunque los ordenadores y el tratamiento electrónico de los datos pueden incrementar la rapidez y exactitud de los procesos de obtención y tratamiento de información, hay una serie de criterios comunes de elaboración que deben aplicarse con independencia del sistema de tratamiento de datos de que se trate. A medida que las tecnologías de gestión de datos vayan abaratándose y ganando en potencia, se multiplicarán las exigencias en materia de rastreabilidad de productos. El sector público y el privado deberían aprovechar esa coyuntura para mejorar los parámetros de calidad y salud pública, so pena de fragilizar sus mercados.

Palabras clave

References