Review

Whole-chain traceability, is it possible to trace your hamburger to a particular steer, a U. S. perspective

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Abstract

Traceability through the entire food supply chain from conception to consumption is a pressing need for the food industry, consumers and government regulators. A robust, whole-chain traceability system is needed that will effectively address food quality, food safety and food defense issues by providing real-time, transparent and reliable information from beef production through slaughter and distribution to the consumer. Traceability is an expanding part of the food safety continuum that minimizes the risk of foodborne diseases, assures quality and cold-chain integrity. Traceability can be a positive competitive marketing edge for beef producers who can verify specific quality attributes such as humane production or grass fed or Certified Organic. In this review we address the benefits as well as the remaining issues for whole-chain traceability in the beef industry, with particular focus on ground beef for the markets in the United States.

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1. Introduction

A limited form of traceability of individual beef animals has been part of the U.S. cattle production system from its very beginnings. Marking livestock with fire-heated brands to identify ownership has its origins in ancient times, dating as far back as the early Egyptians (Stead, 1986). Ancient Romans sometimes chose the symbols used for their cattle brands as part of a magic spell aimed at protecting animals from harm (Blancou, 2001). The practice of branding came to the New World with the Spaniards, who brought the first cattle to a land known to them as New Spain. Hernán Cortés branded his cattle with three Latin crosses, possibly the first brand used in the Western Hemisphere (Lackey, 2011). This owner identification practice was carried on through the old West cattle operations that allowed herds of cattle driven to Northern rail heads to be separated prior to shipment to Northern slaughter facilities. More recent developments in individual animal identification have included tattooing, ear notching, ear tagging (metal and plastic) and electronic identification (injectable, ear tags and electronic bolus), as well as natural systems (mainly retinal imaging and molecular markers) (Caja, Ghirardi, Hernández-Jover, & Garín, 2004).

Individual animal traceability has been motivated by ownership disputes and animal health concerns; these concerns as well as beef-associated foodborne illness outbreaks and more recent hamburger adulteration have all driven the development of traceability systems to identify the ownership and health status of animals whose benefits can carry over to the safety attributes of meat and meat products. As a result of these motivations two largely distinct sets of traceability systems have developed in the livestock/meat sector: one set for live animals and a second for meat products. The current challenge for the cattle/beef industry is to integrate these systems and develop a traceability system to maintain the identity of the animal and production-level attributes of the finished meat product, in other words, to trace meat back to the farm in a true whole-chain traceability system.

Whole-chain traceability will require that individual animals and the meat products derived from those animals have their identity preserved with a robust record keeping system which guarantees traceability through all parts of the product life cycle (Smith et al., 2005). Animal health issues and food safety concerns have accentuated this demand for source identification for all food products (Golan et al., 2004; McKean, 2001). Consumers around the world are concerned about the source, production practices and safety of their food supply (Smith et al., 2005). Stakeholders, including government agencies, retailers and consumers, are asking for traceability throughout the animals’ life cycle, from conception to the final consumer (Gledhill, 2002). The spreading controversy over horsemeat contaminated hamburger continues to expand in Europe (Levs & Nyberg, 2013).

In this paper we concentrate on the situation in the United States, with limited comparison to other major beef producing countries such as Brazil, Australia, New Zealand, Canada, Argentina and Uruguay where traceability systems are likely quite different than in the U.S. It is our intention to cover the international aspects of traceability in a separate publication.

2. Stakeholder positions

2.1. Livestock industry

Formerly the United States livestock industry used only a group identification number termed an animal group identifier or AGID rather than individual animal identification (Smith et al., 2005). However, both the USDA’s Process Verified Program (USDA, 2004) and the Global Food Safety Initiative (GFSI) have requirements for traceability that have resulted in some beef producers pursuing identification and traceability down to the individual animal level. The National Animal Identification System (NAIS) was created in 2004 after the discovery in late 2003 of a cow infected with a pathogenic prion that caused bovine spongiform encephalopathy (BSE), also known as mad cow disease. The goal of the NAIS was to give every animal, or in the case of pigs and poultry, groups of animals, a unique identification number that would be entered in a national database and participation in NAIS was voluntary. Producers would be registered and the movements of animals would be tracked, and if there was a disease outbreak or a sick animal was found, officials could quickly locate other animals that had been potentially exposed. NAIS was designed to be implemented in three phases that included registration of the production facilities, animal identification and animal tracing. The system received $150 million in federal financing, but gained very little (40%) participation of the nation’s livestock producers according to a report by the Congressional Research Service (Greene, 2010). Although the poultry and pork industries had higher participation (95% and 80% of premises registered respectively) the U.S. cattle industry strongly resisted the initial phase of premises registration and only 18% of premises producing beef were ever registered. On February 5, 2010, the Secretary of Agriculture, Tom Vilsack, announced that NAIS would be abandoned in favor of an Animal Disease Traceability system that allowing individual states and tribal nations to administer their own traceability programs. USDA maintained a requirement that all animals moving in interstate commerce have some form of ID that allowed traceability back to their originating state or tribal nation (Neuman, 2010). Unfortunately, the proposed new system does not appear to be any more popular with beef producers than NAIS was (Flynn, 2011).

For the beef producer, the ability to track individual animal health issues may provide a compelling reason for adopting traceability of individual animals. When a disease investigation occurs, animal health officials need to be able to trace affected animals quickly to ensure that the spread of the disease is minimized and the impact on industry is contained. On the other side of the argument, livestock producers are justifiably concerned about their increased liability, increased trespass on their properties by regulators and the added expense associated with maintaining auditable records that will permit tracing an individual animal from birth to the point of harvest or beyond. Most of the discussions of traceability have not included tort reform which could provide additional incentives for companies to be able to identify and withdraw products, limit liabilities for producers and manufacturers, and limit fines lawyers receive in contingency law suits. A tort does not necessarily need to be an illegal act, but an action which ultimately causes loss or harm to another person. Bolte, Dhuyvetter, Schroeder, and Rickard (2007) studied the financial benefits of a traceability system that simply verified that cattle had been vaccinated; the cattle were radio-frequency identification (RFID) tagged and the source of the animals was verified prior to going to cattle auction markets in Kansas. Buyers were willing to pay a premium that year of $1.50 to $2.00 per hundred weight for calves managed under this minimal traceability system. Another objection from beef cattle producers has been that the newly proposed Animal Disease Traceability system provides most of the financial benefits to the beef packers and exporters but the burden of the
majority of the expenses falls principally on the farmers and rancher cattle producers (Flynn, 2011). Additional studies are needed to quantify the allocation of costs and expected benefits of any new traceability system that is under consideration.

2.2. Processors

Traceability in the slaughter and processing areas of beef production is strictly voluntary beyond records required by the Federal Meat Inspection Act, Wholesome Meat Act, HACCP and BSE regulations. Most U.S. beef processors express the belief that traceability which goes beyond the group, AGID level, would slow animal throughput through the slaughter facility too much (Mennecke & Townsend, 2005). However, GFSI as well as new export regulations from other countries may be changing this picture.

Processors also are reluctant to spend the extra money to implement individual tracing of cut meat from “carton to carcass” or back to the sale-barn or producer (Shackell, 2008). During much of the last few decades, the beef slaughter operations sold whole or partially carcasses to retailers and a local butcher fabricated the meat into its final retail form. Today packers prepare cuts from the primal (i.e. rib, chuck, round, loin, etc.) and sub-primal sections of the carcass to make individual retail cuts of beef. These individual, retail cuts are assembled from several carcasses in a single box for shipment to retailers or food service buyers (Robb & Ross, 2004).

2.3. Consumers

Anecdotal reports implicate consumers as the driving force pushing for individual beef animal traceability, but many published studies that have asked consumers their preference indicate that this may not be the case for certain segments of the population. One consumer survey found that 30% of respondents were unwilling to pay any premium for meat with guaranteed traceability (Latouche, Rainelli, & Vermersch, 1998). Bernués, Olazola, and Corcoran (2003) separated consumers into various demographic groups based on age, income or meat consumption patterns and found that their opinions on paying more for traceability varied widely depending on their grouping.

Loureiro and Umerberger (2004) researched the role different attributes of beef have in U.S. beef consumer choice, specifically how consumers’ attitudes toward a quality attribute translate into their willingness-to-pay (WTP) for various labeled ribeye steaks. Results indicated that USDA food safety inspection labels, labels indicating that the steak is tender, or the ability to trace back the animal to the farm were more important to consumers than country of origin labeling (COOL). These researchers calculated coefficients which demonstrated that participants were willing to pay the highest premium for food safety ($3.89 per pound) followed by tenderness ($1.13 per pound) and traceability came in at a $1.03 per pound premium.

Angulo and Gil (2007) conducted a telephone survey of 652 beef consumers and found their willingness to pay a premium for source identified beef was correlated to the individual consumer’s perceived risk of foodborne illness from beef. Almost three-quarters (73%) of these consumers were unwilling to pay any traceability premium, but those with a greater concern about food safety risks associated with beef were willing to pay a 5% premium for beef that could be traced back to the producer. Based on these published results a more critical examination needs to be undertaken to quantify the depth of support from the broad-spectrum of the beef consuming public over traceability.

3. Perceived benefits of implementing whole chain traceability

Cattle producers often are required to be able to segregate a single animal, document vaccinations or track the benefits of changes in their management practices. In the 1940s the U.S. undertook the task of eliminating bovine brucellosis; as part of this process each vaccinated animal was issued a tag and a corresponding ear tattoo (Murphy et al., 2008). Currently in the U.S. large ruminants, wild bison and elk in and around Yellowstone are the last remaining reservoir of Brucella abortus and have been reported to transmit brucellosis to cattle in those areas (Aune, Rhyman, Russell, Roffe, & Corso, 2012). Thus, animal disease tracking is another reason for implementing traceability.

3.1. Global Food Safety Initiative (GFSI) and Global Good Agricultural Practices (Global GAP) requirements

Until just recently there have been numerous conflicting and competing industry specific regulations for food safety standards including traceability, which have caused confusion, imposed trade barriers and may have unnecessarily driven-up the costs of food (Schmidt, 2007). The Global Food Safety Initiative (GFSI) that began in May 2000 is an international effort to continuously improve food safety management systems that will increase consumers’ confidence in the delivery of safe food worldwide. GFSI provides real-time information to manage food safety, minimize risks from foodborne pathogens, manage costs associated with establishing a dynamic and effective food safety culture and maintain consumer confidence in our food and retail industries (GFSI, 2011).

GFSI requires the development and maintenance of systems to ensure:

> All ingredients and services supplied to a manufacturer are identified
> Appropriate records are kept on batches in-progress, final product and packaged good
> Records of purchaser and delivery destinations are maintained for all finished product shipments.

A recent survey of the U.S. manufacturers who had adopted one of the GFSI benchmark standards found that tracking the education of employees had increased and most agreed that complying with GFSI requirements had reduced their perceived food safety risks (Crandall et al., 2012). Additionally, Good Agricultural Practices and Global Good Agricultural Practices (Global GAP) have specific directives on the maintenance of records during the livestock production phase (Global G.A.P., 2012).

The Food Safety Modernization Act (FSMA) of F.D.A. is currently evolving, and is drafting traceability rule setting requirements and soliciting comments from stakeholders and conducting limited pilot trials. When FSMA is fully implemented there may be additional traceability requirements beyond the “one-up, one-down” and FSMA may set the stage for future USDA traceability requirements (FDA, 2011). Many of these requirements have as their main focus food safety trace back, but are typically integrated into a broader based, multi-faceted, whole-chain, traceability scheme.

3.2. Animal disease tracking

Many states are now encouraging individual animal identification for the purposes of disease eradication. For instance, the Minnesota Board of Animal Health has asked beef producers in their state to consider attaching official ID ear tags to cattle and domestic bison. Minnesota successfully regained their status as being a Tuberculosis-Free State in 2011 and now their Animal Health Board is seeking more rapid ways to track animals (Johnson, 2012). The Board favors the use of newer identification tags together with radio frequency identification (RFID) capabilities to alleviate some of the potential problems with manually writing down tag numbers and test results. Farmers must keep records for a minimum of five years that include the sex of the animal, date of castration for steers, the breeder, whether or not it was born on the farm where it resides, and the names of previous
owners (Johnson, 2012). In the past, whole-herd depopulation was the method of choice whenever bovine tuberculosis was detected in a herd. However, with herds now exceeding 1000 animals and public sentiment against wide-spread slaughter of animals, individual animal identification may make increasing sense (APHIS, 2010).

3.3. Recalls

In order to improve their individual food product recalls, food companies in the U.S. have voluntarily developed their own traceability systems without government regulation (Golan et al., 2004; Thomsen, Ollinger, Crandall, & O’Bryan, 2008). Commercial traceability systems have been shown to play a critical role in limiting the expense of product recalls by limiting the scope of the recall (Buhr, 2003). Kramer, Coto, and Weidner (2005) stated that most major meat processors in the U.S. have been involved in a recall at some point in time, and are already spending considerable funds to prevent and respond quickly to future beef recalls.

Resende-Filho and Buhr (2010) published a conceptual model on the probable savings from a mock recall for Escherichia coli contaminated ground beef. Using their model, they described and calculated probability, size and cost for various simulated recall scenarios. Their recall simulation showed that a cost saving of 11 cents per pound (7% of the total ground beef sale value) could be achieved by having a traceability system in place at the time of the recall.

3.4. Increased marketing opportunities

In order to promote marketable management production practices such as “grass fed” or “organic” many beef producers already keep track of individual animals and how they are being raised since these attributes can command substantial price premiums in certain retail markets (Greene, 2010). Processors and retailers have a long-standing use of universal bar codes (Universal Product Code, UPCs) on processed food, including meat, to manage inventories, add value to products, and monitor consumer buying. There are also government-coordinated programs for these purposes such as a “Process Verified” program operated by USDA’s Agricultural Marketing Service (AMS) which confirms written manufacturing processes through independent, third party audits which have already been discussed (Greene, 2010).

4. Obstacles to whole-chain traceability

4.1. Lack of vertical integration

The retail equivalent value for U.S. beef in 2011 was 79 billion dollars based on 34.1 million head slaughtered. Of this 26.7 million head were steers or heifers and the remaining 6.8 million head were cull beef, dairy cows and some of the 2.1 million head imported into the United States (ERS, 2012). Most of these animals pass through many companies on their way from the farm where they were born, through a feedlot, to a slaughter operation to a retail outlet.

Most retail beef consumed in the U.S. comes from cattle born and raised on one of the estimated 800,000 calf-cow farms, with smaller amounts of retail meat coming from culled dairy cows or imported from Mexico and Canada (Golan et al., 2004). Small-scale calf-cow operations are defined as operations with fewer than 100 beef cows but they account for nearly half, 45%, of all U.S. retail beef productions (USDA NASS, 2007). In the U.S. and Canada, beef animals from 6 to 18 months of age are moved to feedlots where they are fed until they reach slaughter weights in the 1200–1300 lb range (Golan et al., 2004). The feedlots may be owned by the same farmer or rancher, but in most cases, the feedlots are separate commercial enterprises which feed out only company owned animals purchased from several suppliers. The custom feedlots that feed/finish animals for a fee are typically kept separate. Because of this mixed production source and ownership, individual animal identification of cattle is more important than on a single farmer-owned feedlot (Golan et al., 2004). Cattle ready for slaughter will be trucked to a slaughter facility that is owned by one of the four major meat packers; FSIS regulations require that slaughter plants keep the head and certain organs of slaughtered animals, plus all identifying tags, with the carcass until all parts of the animal pass USDA in-plant carcass inspection. Then, depending on the processing plant, the individual identity of the live animal can be transferred to the carcass through the chilling, grading and sorting of carcasses. Some plants maintain this individual identification through the fabrication process to the box ready for shipment. This is a mandatory requirement for specific risk materials from animals older than 30 months of age (FSIS, 2008).

4.2. Costs for implementation and maintenance

Much of the published research indicates that it is highly likely that there will only be minimal financial benefit to the farmers and ranchers who will incur the majority of the increased costs of implementing an individual animal identification for whole chain traceability. The cost-benefit study for the NAIS (APHIS, 2009) found that over 90% of the annual cost of NAIS would fall upon the cattle production sector, and would amount to $5.97 per animal marketed. This estimated expense is expected to increase from needing computer hardware/software, RFID recording devices or other record keeping requirements that may be so complex they might overwhelm the small operators’ capabilities (Greene, 2010).

4.3. Increased liability

Many opponents of whole chain traceability cite increased tort liability as one of their major concerns. Implementation of whole chain traceability could target the beef producer whenever there was no positive identification of an alternative route of contamination. Tort liability implies that the source of a hazard can and will be held responsible for alleged harm (Souza-Monteiro & Caswell, 2004). This scenario could, however, be construed as an incentive for the beef industry to use safer production and processing methods, which might in turn reduce beef related food safety incidents (Souza-Monteiro & Caswell, 2004).

4.4. Complexity of logistics

Logistics is the management of resources flowing in and out of an operation plus typically moving finished goods from the point of production to a customers’ warehouse. For a beef operation this covers the range of tracing incoming food additives, films, liners and trays for a value-added product to bags, boxes, labels, pallets and shrink-wrap for most retail cuts. A logistical tracking system can manage inventory and handling of packaging materials in the slaughter facility linking to transportation, scheduling, ordering, warehousing and shipping. Much of what is involved in logistic traceability is beyond the limited scope of this review, but certainly needs are to be considered as part of a whole-chain traceability system. A second and perhaps most significant consideration must be training of employee-users. The most sophisticated traceability system in the world is no better than the persons using it and responsible for its maintenance.

Firms distributing food in Europe have been required since 2005 to have whole-chain traceability from the shipping unit, typically pallets or a shipping container, down to retail level boxes. Many food companies are using the GS 1, a two dimensional bar code to exchange traceability information among suppliers and customers (GS 1, 2012a). GS 1 US is a member of the international GS 1 organization and has replaced the older Uniform Code Council. GS 1 US
manages and assigns GS1 prefixes to companies in the U.S. which allows users to create an individual retail item Universal Product Code (UPC), a 12 digit Global Trade Item Number (GS1, 2012b). In addition GS1 US is responsible for a Serial Shipping Container Code, SSCC, that is an 18 digit code, GS1-128 that is affixed to shipping containers to further facilitate tracking of goods.

Many retailers and many food manufacturers are embracing Radio Frequency Identification (RFID) tags. These tags can contain a battery and transmit radio waves containing tracking information several meters away to a reader or they may be passive, not having a battery, and be energized and read by a reader that does not have to physically “see” the tag like a bar code reader. RFID tags are more expensive than passive bar-codes but provide numerous advantages in constantly evolving technology (Information Technology Research Institute, 2011).

5. Traceability in the US beef supply chain

5.1. Traceability from birth to slaughter

Formerly in the U.S. beef production industry only show animals and breeding animals commonly had a unique identification numbers for each animal, while commercial animals intended for the market, if they were marked at all, had a group identification number, for example all the animals from a single year, from a single producer had the same brand, ear tag number or tattoo (Smith et al., 2005). The traditional method of identification for cattle in the U.S. is branding, whether hot branding, freeze branding, or hide branding, and many Western states still have branding laws in force (Golan et al., 2004). Other methods of animal identification include tattooing, retina scanning, iris imaging, or the most common method, ear tagging. Tags may have simple printed numbers on plastic stock, imbedded microchips, or may be RFID. However, RFID technology is expensive, with readers and computer software costing hundreds of dollars (Golan et al., 2004). APHIS (2011) estimated that only 40% of the smallest cow-calf operations with 1 to 49 cows use individual animal identification on at least on some calves, compared with about 60 to 70% of larger operations.

5.2. Traceability in the slaughter operation

At the time of slaughter the head, hide and intestines are removed from the carcass, which removes almost all means of physically identifying the source of the individual animal. The carcass, or the trolley carrying the carcass, may be re-tagged or attached with a RFID sticker (Shackell, 2008). However, the original animal identification and the slaughter house ID must be linked in order to allow traceability. Many beef processors have express concern about the requirement for individual animal identification slowing down the throughput in a typical, large scale beef slaughter operation.

5.3. Traceability in processing

For an idea of the scope of the whole-chain traceability issue, the Economic Research Service (ERS) reports that in 2010 the retail dollar equivalent production for the U.S. beef industry was $74 billion (ERS, 2012). Consumer consumption of beef amounted to 26.4 billion pounds, or about 3 oz/person/day. Of this amount about 60% of the beef is consumed as hamburger or almost 16 billion pounds (National Cattleman’s Beef Association, 2012). In many operations, the beef trim made into hamburger is sourced from multiple sources all being co-mingled in the initial hamburger grinder. Fig. 2 shows a simplified diagram of a beef slaughter operation, where the animal is slaughtered, cut into primals, and subsequently fabricated into retail cuts. Typically a 1200 pound animal will yield a 700 pound carcass with 400 lb of salable-retail meat. This current process allows meat from different animals to mix during production (Shackell, 2008). For whole-chain traceability a label or some means of identifying the original animal must accompany each cut of meat. Heaton et al. (2005) reported in their research that almost 10% of liver samples did not match the animal they reportedly came from. This erroneous identification of the source of retail cuts of meat creates a high margin of inaccuracies.

5.4. Traceability during grinding

During the processing of a beef carcass somewhere between 85 and 125 lb of trim is generated per carcass that is later made mostly into ground beef. Ground meat is almost always exempt from any requirements for traceability (Shackell, 2008) because so many animals are involved in the make-up of a single lot of ground beef. Ground beef is also processed from mixes of these trimmings with boneless beef imported primarily from Australia and New Zealand to attain a desired fat content (Golan et al., 2004). Beef grinding plants receive large combo bins of trim (each about 2000 lb) from multiple sources. These bins are inspected by receiving plant personnel to ensure it contains no visible bones or foreign material, and that it does not have an off odor.

Raw materials are tested by individual combo for the presence of pathogens and other bacteria, and samples are taken to estimate the lean-to-fat ratio, then the trim will be stored in the same state it was received, either refrigerated or frozen, until it is ready for grinding on a “First-In/First-Out” (FIFO) rotational basis (BeefU, 2012). In the initial grind to produce “coarse ground” product, the raw material is initially ground through steel “breaker” plates with holes typically 1/4- to 1-inch in diameter depending on whether the trim is frozen or refrigerated, while the temperature is kept as close to 28 °F as possible (BeefU, 2012). The coarse ground beef is then sent to a mixer where the fat content is carefully checked and adjusted with additional trim or other beef fat as necessary to meet the retailers’ specifications; any approved food additives are added at this point. This mixture is sent for the final grind after which it is formed into hamburger patties or packaged in bulk (BeefU, 2012). Ground beef traceability would depend on being able to identify the trimmings entering the plant in combos of raw material (Golan et al., 2004).
et al., 2004). Currently each piece of trim is not identified individually as having come from a particular animal. The use of traditional traceability methods for ground meats could prove extremely difficult and costly.

Maverick Ranch Beef (Denver, CO) has an extensive traceability system for their “Natural Beef” program. They use retinal scanning to identify calves at birth, weaning, entry to the feedlot and at slaughter; post slaughter they use trolley tracking and bar code tagging of individual cuts to trace back to a particular animal, but even then they do not manage to maintain identity for beef trimmings (Smith, Pendell, Tatum, Belk, & Sofos, 2008). DNA tracking offers an option for identifying components of compound meats such as ground beef, although many of these techniques also have limitations. Shackell, Mathias, Cave, and Dodds (2005) tested micro-satellite genotyping as a potential tool for DNA-based tracing of ground beef product. They found they could distinguish between mixtures containing equal amounts of meat from three different individuals, meat from three individuals mixed in different proportions, ground beef mixtures purchased in different cities, and different batches of ground beef patties (Shackell et al., 2005). However, when batches contained larger numbers of individuals (>10) the method was not consistently accurate. Recently, the IdentiGEN Company began working with Canadian researchers to adapt DNA traceability to ground beef products; they want to develop a batch-based identifier that will link ground beef packages to a manufactured batch, improving traceability (Meat Trade News Daily, 2012).

5.5. Retail traceability

Virtually all boxes of beef sold in the U.S. are traceable from the retail outlet back to the processor or slaughter plant. USDA inspection numbers for the processing plant must remain on the labels of meat as they pass through the logistics and distribution systems and marketing chain. Beef processors can also place the firm’s logo and lot number information on labels to identify a particular processing batch. Voluntary recalls as listed on USDA’s website refer consumers to coded information on the package specifying the lot or batch of meat items included or excluded from the recall (Golan et al., 2004). There may be some discrepancy in the traceability when larger shipments of beef are received in a distribution center then sub-divided for re-shipment to individual retail stores.
6. Achieving whole chain traceability in the beef industry

In the past once carcasses passed USDA inspection, slaughter plants kept batch Lot Tracking information on the identity or characteristics of each animal by a group/lot. Recently developments in marketing and meat-quality pricing have expanded beyond attributes that can be determined by visually examining the meat itself as is done to estimate grades of beef and marbling. Premiums are being offered for quality characteristics related to consumer preferred production processes, such as animals being certified that they were humanely raised, consumed certain types of feed (USDA Certified Organic), or been given vaccines or not given growth hormones (Golan et al., 2004). Human health concerns have also emerged due to diseases such as mad cow that link animal health to human health and have motivated many consumers to demand traceability back to the farm and assurances of humane production practices (Golan et al., 2004). The beef industry has begun to build systems that will link individual animal tracking systems that will interface with the retail meat tracking system. These systems include sequence in slaughter order, time-of-day processing, carcass tagging, trolley-tracking, and RFID sensing devices (Golan et al., 2004). These systems tend to break down into capital intensive (favoring large firms) versus highly labor intensive (favoring smaller operations) systems. For instance a very small beef processing operation could identify beef primals and all the trims being made into ground beef from a specific animal by simply processing one carcass at a time (Steinstrater & Jensen, 2001). JBS-Swift has a system in place that uses individual animal retinal scanning at feedlots and the slaughter facility to maintain the identity of individual animals, tagged trolley tracking at the processing plant, collecting and archiving muscle samples from each animal and stamping a code number on each box of retail cuts (Smith et al., 2005). However even with JBS-Swift’s advanced system, they make no attempt to maintain animal origin of beef trimmings which are ground into hamburger, only a Lot Tracking identity.

While some technological problems are being solved other barriers remain. For instance, livestock has traditionally been exempt from commercial implied-warranty laws, but many fear that traceability systems that can link meat to specific animals will shift at least some of the liability for foodborne illness back to cow-calf operators and feedlots (Golan et al., 2004).

7. Conclusions

Stakeholders in the beef industry, including government agencies, retailers and consumers, are interested in whole-chain traceability from birth of the animal to the plate of the consumer. Several good reasons exist for clearly defining the objectives of a robust traceability system including animal disease issues, food safety and premiums for marketing of specialty products. Although technology exists that would allow tracing of ground beef back to a particular animal that provided the trim, it is currently only feasible in very small operations where carcass by carcass processing takes place. It is likely that we will not be able to identify the specific animals that are in our commercially packaged ground beef, except by lot of animals being slaughtered or Lots of trim being ground to adjust fat content of a particular order during a recorded time-of-day.

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References


Crandall, P., Van Loo, E. J., O’Byran, C. A., Mauroumtakos, A., Yiannas, F., Dyenson, N., & Mauromoustakos, A. (2004). The beef industry has begun to build systems that will link individual animal tracking systems that will interface with the retail meat tracking system. These systems include sequence in slaughter order, time-of-day processing, carcass tagging, trolley-tracking, and RFID sensing devices (Golan et al., 2004). These systems tend to break down into capital intensive (favoring large firms) versus highly labor intensive (favoring smaller operations) systems. For instance a very small beef processing operation could identify beef primals and all the trims being made into ground beef from a specific animal by simply processing one carcass at a time (Steinstrater & Jensen, 2001). JBS-Swift has a system in place that uses individual animal retinal scanning at feedlots and the slaughter facility to maintain the identity of individual animals, tagged trolley tracking at the processing plant, collecting and archiving muscle samples from each animal and stamping a code number on each box of retail cuts (Smith et al., 2005). However even with JBS-Swift’s advanced system, they make no attempt to maintain animal origin of beef trimmings which are ground into hamburger, only a Lot Tracking identity.

While some technological problems are being solved other barriers remain. For instance, livestock has traditionally been exempt from commercial implied-warranty laws, but many fear that traceability systems that can link meat to specific animals will shift at least some of the liability for foodborne illness back to cow-calf operators and feedlots (Golan et al., 2004).