The risks and prevention of contamination of beef feedlot cattle: the perspective of the United States of America

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Summary
There are currently no scientifically defined critical management points or critical control points to manage foodborne pathogens at the pre-harvest level. Research is ongoing: much of the pre-harvest research is funded by producer organisations. The beef industry has Beef Quality Assurance (BOA) programmes in place and these are dynamic. Groups of cattlemen have made a very strong commitment to reducing foodborne pathogens in beef.

Fewer *Escherichia coli* 0157:H7 organisms are shed by feedlot cattle near the end of the feeding period than by newly arrived cattle. Moreover, there is less shedding of the organisms in cattle of slaughter age than in younger cattle. The prevalence of *E. coli* 0157:H7 in feedlot cattle is similar to that in range cattle. This suggests that concentrating cattle in feedlot dirt pens does not increase the risk of shedding *E. coli* organisms. Pen maintenance, considered a good management practice, appears to be an adequate means of keeping pathogen levels in pens low.

It is not likely that pre-harvest food safety programmes will eliminate the threat of pathogens such as *E. coli* 0157:H7 or *Salmonella*. The management of foodborne pathogens will become part of an integrated programme to enhance food safety which includes the producer, the packer, the distributors, retailers and the consumer.

The feedlot industry initiated a residue avoidance programme several years ago. As a result, the risk of chemical residues in beef from feedlots in the United States of America is near zero. Hazard analysis and critical control point-type prevention programmes, using scientifically based critical management points, will help ensure that the risk remains negligible.

Keywords

Introduction
In the United States of America (USA), cow-calf production practices differ from region to region based on climate and feed resources. Grazing pasture and range land is the backbone of most USA beef cattle production systems.

Supplemental protein and hay are fed to pastured cattle when forage is dormant. Both the herd size and management intensity of cow-calf operations vary widely across the nation.

According to United States Department of Agriculture (USDA) statistics (9), 80% of the beef herds in the USA have 50 cows or less; 92% of the herds have fewer than 100 cows.
There are over 900,000 beef operations in the USA. These figures illustrate why marketing strategies and post-weaning management of calves can vary significantly.

Beef calves are usually weaned at six to eight months of age. At weaning, calves are either sold or ownership is retained. Retained ownership may extend only up to the backgrounding/stocker phase or may extend until the weaning. Calves are either sold or ownership is retained. Beef calves are usually weaned at six to eight months of age. At weaning, calves are either sold or ownership is retained. Retained ownership may extend only up to the backgrounding/stocker phase or may extend until the weaning. Calves are either sold or ownership is retained. Beef calves are usually weaned at six to eight months of age. At weaning, calves are either sold or ownership is retained. Retained ownership may extend only up to the backgrounding/stocker phase or may extend until the weaning. Calves are either sold or ownership is retained. Beef calves are usually weaned at six to eight months of age. At weaning, calves are either sold or ownership is retained. Retained ownership may extend only up to the backgrounding/stocker phase or may extend until the weaning. Calves are either sold or ownership is retained. Beef calves are usually weaned at six to eight months of age. At weaning, calves are either sold or ownership is retained. Retained ownership may extend only up to the backgrounding/stocker phase or may extend until the weaning. Calves are either sold or ownership is retained. Beef calves are usually weaned at six to eight months of age. At weaning, calves are either sold or ownership is retained. Retained ownership may extend only up to the backgrounding/stocker phase or may extend until the weaning. Calves are either sold or ownership is retained. Beef calves are usually weaned at six to eight months of age. At weaning, calves are either sold or ownership is retained. Retained ownership may extend only up to the backgrounding/stocker phase or may extend until the weaning. Calves are either sold or ownership is retained. Beef calves are usually weaned at six to eight months of age. At weaning, calves are either sold or ownership is retained. Retained ownership may extend only up to the backgrounding/stocker phase or may extend until the weaning. Calves are either sold or ownership is retained.

Beef cattle are finished for slaughter in feedlots where high energy (starch) diets are fed. Most finishing periods last over 100 days, and heifers and steers obtain weights of 500 kg to 600 kg, respectively.

Beef safety and quality are important to the consumer. The beef industry has an obligation to address these issues. To this end, the National Cattlemen's Beef Association (NCBA) has operated beef safety and quality assurance programmes since the mid-1980s. These programmes are dynamic and responsive to the needs of the consumer, the industry and scientific developments. The programmes are filtered down to the producer level through state affiliates.

Governmental agencies are part of the beef safety and quality process. The Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM), the Environmental Protection Agency (EPA) and the United States Department of Agriculture (USDA) are vital links in assuring food safety through approval of drugs and biologicals, the establishment of safe withdrawal periods and tolerances, and monitoring the effectiveness of established programmes.

The purpose of this paper is to review the food safety risks associated with beef production in intensively managed beef feedlots in the USA. Strategies to minimise chemical and physical risks are detailed. Control points for microbiological risks are lacking, however, good feedlot management practices which theoretically reduce contamination of products are discussed.

The history of beef quality assurance in the United States of America

In 1982, the United States Department of Agriculture-Food Safety Inspection Service (USDA-FSIS) began working with the beef industry in the USA to develop the Pre-harvest Beef Safety Production Programme. To avoid additional governmental regulation, the beef industry developed an industry-driven programme later termed Beef Quality Assurance (BQA). The BQA programme first evaluated production practices of three large feedlots (greater than 50,000 head capacity each). The assessment of chemical residue risk was the principal goal during the developmental stage of the BQA programme. In 1985, after careful analysis and adjustment of some production practices, these three feedlots were certified by the USDA-FSIS as 'verified production control' feedlots. Lessons learned during those early years now serve as the backbone for the BQA programme of the NCBA.

While the BQA programme was under development, a quality control programme which used many of the same principles was also being developed by a commercial company. This programme, termed 'hazard analysis and critical control point' (HACCP), gained USDA and FDA acceptance and is presently the dominant outline for quality assurance programmes in processed foods. All meat-packing plants have developed HACCP programmes.

The concepts of the HACCP programme are not different from those of the BQA. The analysis, planning and verification concepts of HACCP have long been a part of all successful business operations. Simply stated, producers are asked to think about what could go wrong, to plan to avoid it, to document adherence to their plan, and to verify that production problems were avoided. Risk assessment is a necessary part of the process. As part of good management practice, the cattle industry in the USA has documented (and validated) the production steps for years. Consumers demand a quality product at a competitive price and only producers who meet these requirements will grow and prosper in the long term. Even though BQA embraces the same concepts as HACCP, the term 'hazard' has not been well accepted by the USA beef production industry.

Until 1994, the USDA-FSIS had no regulatory authority outside the food processing facilities. In 1994, the USDA-FSIS formed the Animal Production-Food Safety (AP-FS) section. The AP-FS provides a mechanism for the development of food safety programmes at the pre-harvest level. The AP-FS has suggested that the HACCP programme be adopted in 'pre-harvest' production. At a 1995 conference in Washington, DC, the Chairman of the Beef Quality Task Force of the NBCLA suggested that the beef industry evaluate the existing BQA programme to ensure adherence to the principles and objectives of the HACCP programme rather than the development of a new pre-harvest plan. A recommendation was made that the term 'quality assurance,'
critical management points' (QACMP) be used instead of the term 'critical control point' (CCP) in order to enlist the support of the beef industry.

Microbiological risks

Several bacteria found in beef products pose risks to the consumer. These include *Salmonella* sp., *Shigella* sp., *Campylobacter jejuni* and *C. coli*, *Listeria monocytogenes*, *Staphylococcus aureus* and *E. coli* O157:H7. Sources of animal exposure include other animals, feed, water, humans and the environment. The source of human infections is not always clear. Apparently, the incidence of enteric microbial infections among farm, ranch and feedlot employees is quite low. It would appear that farm workers should be at increased risk of pathogen transfer from cattle to humans because of close physical contact during routine husbandry procedures, but this has not been the case.

There has been a national effort to learn more about *E. coli* O157:H7. To date, little is known about the ecology of this bacterium. The USDA National Animal Health Monitoring System (NAHMS) collected nearly 12,000 faecal samples from 100 volunteer feedlots across the 13 major feeding states to determine the prevalence of *E. coli* O157:H7 and *Salmonella* (8). Overall, *E. coli* O157:H7 was recovered at higher rates from pens of cattle which had been on feed for the shortest period of time (3.01%). Samples from pens of cattle which had been on feed the longest period of time, and were closer to slaughter, were least likely to give positive results for *E. coli* O157:H7 (1.08%). The organism was detected in one or more samples from 63% of the feedlots. In contrast, other workers (1) found that 0.33% of the faecal samples and 10% of feedlot pens sampled gave positive results for *E. coli* O157:H7.

The isolation rate of *Salmonella* species from faecal samples obtained during the NAHMS feedlot study was higher than the isolation rate of *E. coli* O157:H7. Overall, 5.5% of the faecal samples gave positive results for *Salmonella*. Samples collected from pens of cattle which had been on feed for longer periods of time yielded a higher positive culture rate (7.4%) than those samples from pens of cattle which had recently arrived in the feedlot (3.5%). The five most common serotypes of *Salmonella* which were recovered in this study were not those commonly associated with human illness (8).

Biosecurity has been suggested as a possible management tool to reduce the prevalence of *E. coli* O157:H7. If the prevalence of 0.71% found in beef cows grazing on pasture (1) is compared to the prevalence of 0.33% (1) to 1.61% (7) for feedlot cattle, there does not appear to be a practical difference. As previously mentioned, the percentage of samples giving positive results for *E. coli* O157:H7 declines as days on feed in the feedlot increases. The data would suggest that concentrating and mixing older calves does not increase the shedding rate of *E. coli* O157:H7 (1, 7).

Sanitation has also been proposed as a means of controlling *E. coli* O157:H7. The definition of sanitation varies widely among the commodity groups. Swine are raised primarily in a concrete environment, whereas beef cattle spend most of their lives on grass pastures. Feedlot cattle are kept in dirt pens, and the space allocated to each animal is relatively small compared to that of pastured cattle. The term 'sanitation' in the feedlot refers to keeping the pens well drained, scraping the pens frequently to remove excessive organic matter and controlling mud. In the feedlot industry, proper pen maintenance is considered a good management practice. By properly maintaining the pens, there is less organic material on cattle being sent to the packing plant, gains and feed efficiency are improved and the expectations of cattle owners are met. Since the percentage of faecal samples which give positive test results for *E. coli* O157:H7 declines as time in the feedlot increases, the concentration and maintenance of cattle on outdoor dirt surfaces while using industry standard pen management practices appear not to increase the risk of shedding *E. coli* O157:H7.

Feeding practices have been associated with an increased risk of shedding *E. coli* O157:H7. Rasmussen and Bosworth (5) reported that *E. coli* O157:H7 concentrations can increase one hundred-fold when feed is withheld from cattle for 24 hours. Using sheep which had been experimentally infected with *E. coli* O157:H7, other researchers caused shedding by withholding feed or changing the diet (4). Rasmussen and Bosworth (5) indicated that only a small percentage of cattle are at risk, since most are slaughtered within 12 to 24 hours after leaving the feedlot.

Cattle feeding management

There are a number of safeguards built into cattle production in the USA. The extended time required for an animal to complete the different phases of production allows ample time for clearance of violative residues from products used during earlier phases of production. This also allows time for the immune system of the cattle to mature and to become more capable of clearing environmental microbial contaminants. Typically, the finish feeding phase in beef feedlots will take over 120 days, and the animal will be 16 to 26 months old when entering the food chain. Experience with BQA has shown that cattlemen produce a good product and are good stewards. Problems which have surfaced have usually been easy and inexpensive to solve. In every case, finding a potential fault before it becomes a problem has improved long-term production.
Risk assessment and management

Feedstuffs

Feedlots are judged by their feed conversions, average daily gains and cost of gains. A feed quality assurance programme is essential to ensure that safe, high-quality ingredients are used to produce the final feed. This is necessary to maximise performance and to avoid contamination. Contaminated feedstuffs may pose health threats to farm workers, the cattle, the environment and the consumer.

Feed contamination risks include physical, chemical and microbiological risks. Examples of physical contamination include rocks, dirt or metal. Chemical contamination is usually more serious and includes such contaminants as pesticides, industrial chemicals, animal drugs and other organic compounds, such as mycotoxins. The classic microbiological risk is Salmonella.

Feedstuffs can become contaminated in many ways. During harvest, storage capacity at grain elevators is frequently inadequate and grain is often stored temporarily outdoors on the ground or piled into large open buildings. During transportation, feedstuffs can become contaminated in rail cars or trucks which have been inadequately cleaned. Feed handling systems can become contaminated and may be the source of a continuing problem. Feed ingredients themselves can be contaminated, such as mycotoxins in corn or Salmonella in improperly rendered animal by-products.

An estimated 5% to 20% of livestock feeds contain detectable Salmonella contamination (2). Generally, Salmonella are present in low numbers and are not among the serotypes which usually cause clinical disease in livestock consuming the feed or human foodborne illness. However, the likelihood remains that some Salmonella cases reported in livestock result from contaminated feed, although the number is estimated to be quite low. Processes such as pelleting the feed reduce Salmonella numbers through heat and drying. Feedstuffs suspected of containing higher levels of Salmonella, such as rendered by-products, are fed as a very small proportion of the total ration, thereby taking advantage of the dilution effect.

To minimise risks posed by feedstuffs, feedlots follow a quality control programme for feedstuffs. A quality control programme for receiving, storing, processing, blending and delivering feedstuffs not only assists in preventing chemical and biological residues, but ensures high quality feeds which will enhance performance. All products used during feed production or processing must be approved by the FDA/USDA/EPA. This includes pesticides, herbicides and feed conditioners. All equipment fluids, solvents, etc., must be stored in an area separate from the feed storage or feed production areas. Directions for usage and disposal given by the manufacturers must be followed. Proper training for pesticide and herbicide handling must be available to all who work with these products. The training should include proper application, personal safety, management of accidental spills and prevention of contamination of the feed and water supply.

Monitoring of the quality of feed from all sources is essential. Sampling programmes include testing for basic quality defects and properly storing samples for a period which will exceed the finishing period of the cattle by six months. Suppliers should be involved in the quality control efforts of the cattle feeding operation. The provision of products which meet quality assurance guidelines, recording of serial and lot identification numbers and inventory management is an important role for suppliers.

High-risk feeds are those purchased as a single load or batch which will be fed to cattle over a prolonged period. Examples include fats, rendered by-products, plant by-products, supplements and additives. Most of these are added as only a small percentage of the total diet. However, they can contaminate large volumes of complete feed. 'Cheap feeds' or 'good deals', such as seed grains, are of high risk to animal health and also pose a high risk to the consumer. Ultimately, this has a negative effect on the entire industry, including the producer. Many high-risk feedstuffs, such as fats, are very expensive to test. Suppliers should be bonded and should provide quality control tests in production plants. Blended fats, screenings and other feedstuffs which could contain questionable compounds must be avoided.

Common concerns regarding high-risk feeds are: polychlorinated biphenyls, chlorinated hydrocarbons, organophosphates (pesticides and herbicides), heavy metals and microbes (Salmonella and Shigella sp.). As there is no diagnostic test to detect the presence of transmissible spongiform encephalopathy (TSE) agents in feed, cattle producers in the USA have applied a voluntary ban on the use of feed derived from sheep by-products since 1989. In August 1997, the FDA mandated a ban on feeding ruminant-derived meat-and-bone meal to ruminants.

A basic risk avoidance programme should include source verification, basic quality control inspection, sampling and testing. A carefully designed checklist will ensure that the quality control risk assessment is consistent. Inspection should include an assessment of colour, odour, moisture, temperature, presence of foreign material and evidence of bird, rodent or insect contamination.

Feed additives and medication

By using only products approved by the FDA-CVM, USDA and EPA, and by adhering to label instructions, the risk of violative residues in cattle resulting from the use of feed
additives and feed medication is negligible. In the USA, there are no provisions for prescribing the use of any feed additive except as directed on the product label. Addition rates of feed additives and medication must be calculated carefully and formulation records accurately maintained. Feed additives and feed medication must be stored in areas in such a way that contamination with other chemicals, rodents and insects is avoided.

Feed additive and feed medication records should include: the date on which the product was received, product name, quantity received, serial or lot numbers, daily use, daily inventory based on product weigh-backs, feed batch logs which identify feed formulation numbers and the identity of animals receiving the product. Scheduled calibration of weighing scales will reduce the risk of accidental inaccurate dosing.

Feed manufacturing facilities handling Type A (highly concentrated), Category II (requiring a withdrawal time) medication are required to register with the FDA and to secure an FD-1900 permit. A separate FD-1900 permit is necessary for each Type A, Category II medication used. The use of medication in this class requires regular FDA inspection, which monitors compliance with labelled instructions, proper dosing and record keeping, thereby reducing risk of misuse. Other classes of feed additives do not require an FD-1900 permit for use. Feeds used under a Veterinary Feed Directive (VFD) will be a new category of medicated feeds. At present no beef cattle products have been approved for use under a VFD.

The QACMPs for feedlot feedstuffs, ingredients and feed additives are shown in Table I. These QACMPs are based on the principles of HACCP. They should be tailored to the management system and needs of the individual feedlot.

Health maintenance, prevention and individual cattle treatment

The beef industry in the USA has experienced much success in controlling violative drug residues. In the report of the 1993 National Residue Program (USDA-FSIS), no violative antibiotic or sulfonamide residues were found in random samples of slaughter steers and heifers. One steer of 671 feedlot animals gave positive results, however, showing the presence of a violative ivermectin residue (6). This record has been achieved by placing emphasis on identifying each animal treated, by recording with accuracy the treatment, date of treatment, dosage, and by following prescribed withdrawal times.

Residue risk avoidance commences with a management programme which allocates a unique number to every animal entering the feedlot. Source verification and the transfer of medication and health maintenance records for cattle entering the feedlot minimise the risk of accidental violative residues which could occur if cattle are sold to packing plants before the projected marketing date of the group.

All products (vaccines, deworming preparations, pesticides, antibiotics, etc.) should only be used in accordance with approved label instructions. Product use records are kept for each group of cattle: such records include the date used, product used, serial or lot numbers of the products, dosage, route of administration and site of administration of all injections. These records are kept in the herd or pen file for the group of cattle. Personnel administering animal health products must adhere strictly to the veterinary drug orders and treatment protocols designed for their feedlot. Veterinarians must review treatment protocols regularly.

Any medication which must be used other than as directed on the label must be administered in accordance with the instructions of the attending veterinarian. Withdrawal times for animal health products used in an extra-label manner must be extended significantly. The Food Animal Residue Avoidance Data Bank (FARAD) serves as an information source for veterinarians to ensure that safe withdrawal times can be assigned to animals treated in an extra-label manner.

Nevertheless, not all cattle perform normally. Reduced growth rates often necessitate early marketing. These animals often have organ (kidney or liver) damage, are lame or have been injured. Treatment records for such animals should be reviewed by both the veterinarian and the feedlot manager before the animals are released for slaughter.

Most animal health products used at processing, such as vaccines and anthelmintics, require a pre-slaughter withdrawal period. The minimum withdrawal time for the group should reflect the longest withdrawal time required for any of the products given. Cattle which have recovered from illness may have some organ damage and may not eliminate medications normally. A residue screening test, such as the live animal swab test (LAST), may offer a margin of safety if these cattle need to be shipped close to their withdrawal time.

Pesticides

External parasites can be a severe economic threat to the cattle, affecting feed intake, feed efficiency and hide quality. Only EPA- and FDA-approved pesticides for cattle treatments may be used, and these products must be used in compliance with label directions. Improper application may cause injury to the applicator, the cattle or the environment, or may result in pesticide residues.

A complete record of pesticide use must be kept. The record must include product identification, serial or lot number, the date the product is used, the amount used, the person who
Table I
Quality assurance critical management points for feedlot feedstuffs, ingredients, and additives
A checklist containing the following elements, adjusted to suit each feedlot operation, should be maintained, signed and dated by management before cattle are released

<table>
<thead>
<tr>
<th>Process or step</th>
<th>Potential problem</th>
<th>Criteria or limits</th>
<th>Monitoring procedure and frequency</th>
<th>Corrective or preventive action</th>
<th>Records</th>
<th>Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed facilities</td>
<td>Min.</td>
<td>Assume contamination is present</td>
<td>Observe/record inspection</td>
<td>Clean and inspect</td>
<td>Inspection record</td>
<td>Records kept at mill and main office</td>
</tr>
<tr>
<td>Receiving feedstuffs</td>
<td>CMP</td>
<td>Source verification; Invoice date and description; Employee training; Use of approved products only</td>
<td>Sample every load, test and store; Visual inspection of product and truck</td>
<td>Reject load; Keep in a quarantined store until cleaned; Use EPA-approved disposal methods</td>
<td>Receiving log test reports and invoices</td>
<td>Check records and invoices in office (receiving log test log-in) kept by feeding management daily, weekly and monthly</td>
</tr>
<tr>
<td>Feed additives</td>
<td>CMP</td>
<td>Source verification; Invoice date; Description and batch numbers; Employee training; Use of approved products only</td>
<td>Keep a physical inventory of additives daily as appropriate against inventory balance</td>
<td>Notify management; Check batch records; Make quarantine/withdrawal adjustment if necessary</td>
<td>Receiving log; Invoices; Use log</td>
<td>Check records invoice in office (receiving log and use log daily and monthly); Withdrawal report before release</td>
</tr>
<tr>
<td>Feed formulas</td>
<td>CMP</td>
<td>All formulas managed by nutritionist</td>
<td>Checked by nutritionist; Establish days on feed against withdrawal; Batch checked daily</td>
<td>Withdrawal errors; Maximum level chart</td>
<td>Formulation sheets and batch sheets; Feeders log</td>
<td>Check records (formula- and batch-log) daily and before release</td>
</tr>
<tr>
<td>Batch/Load</td>
<td>Maj.</td>
<td>Establish route and sequence balance minimum; Established minimum, maximum and exceptions; Employee training</td>
<td>Batch checklist; Accumulation and total batch/load sheets; Daily audit</td>
<td>Withdrawal errors; Maximum level chart</td>
<td>Mill log; Batch logs; Truck log; Feeders log</td>
<td>Balance logs</td>
</tr>
<tr>
<td>Feed delivery</td>
<td>Min.</td>
<td>Employee training; Establish route; Loads match call</td>
<td>Balance load total against feeders log daily</td>
<td>Assign delivery load against delivery</td>
<td>Load records; Group feed log</td>
<td>Check records (delivery call); Records checked before release</td>
</tr>
<tr>
<td>Cattle release</td>
<td>CMP</td>
<td>All withdrawal times are met</td>
<td>Records of show list reviewed and balanced</td>
<td>Stop release</td>
<td>Release form signed</td>
<td>All forms examined before release</td>
</tr>
</tbody>
</table>

Min.: potential site of minor problem
CMP: critical management point (problem will arise if not controlled at this point)
Maj.: potential site of major problem
EPA: Environmental Protection Agency
Table II
Quality assurance critical management points for feeder cattle residue avoidance
A checklist containing the following elements, adjusted to suit each feedlot operation, should be maintained, signed and dated by management before cattle are released

<table>
<thead>
<tr>
<th>Process or step</th>
<th>Potential problem</th>
<th>Criteria or limits</th>
<th>Monitoring procedure and frequency</th>
<th>Corrective or preventive action</th>
<th>Records</th>
<th>Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle receiving</td>
<td>CMP</td>
<td>Assume cattle are contaminated</td>
<td>Observe/record variation</td>
<td>Sort and examine</td>
<td>Receiving record</td>
<td>Records in office of foreman</td>
</tr>
<tr>
<td>Processing products</td>
<td>Min.</td>
<td>Group identity; Name/serial numbers; Withdrawal time; Employee training; Use of approved products only</td>
<td>Set clear dates; Inventory</td>
<td>Establish minimum sale date for group</td>
<td>Receiving and pen/lot sheet</td>
<td>Check records (receiving, feed, delivery and group records) before release</td>
</tr>
<tr>
<td>Health management</td>
<td>Maj.</td>
<td>Individual identity; Release withdrawal time established; Employee training; Use of approved products only</td>
<td>Check projected days on feed against withdrawal; Inventory</td>
<td>Conduct LAST test for non-performers</td>
<td>Receiving and individual health records</td>
<td>Check records (receiving, feed and group records) before release</td>
</tr>
<tr>
<td>Mass medication</td>
<td>Maj.</td>
<td>Group identity; Withdrawal time; Use of approved products only</td>
<td>Check projected days on feed against withdrawal; Inventory</td>
<td>Conduct LAST test for non-performers</td>
<td>Receiving and pen/lot sheet</td>
<td>Check records (receiving, feed and group records) before release</td>
</tr>
<tr>
<td>Feeding management</td>
<td>Min.</td>
<td>Release withdrawal time established; Employee training; Use of approved products only</td>
<td>Inventory additives and medication daily</td>
<td>Lock and separate</td>
<td>Mill log; Pen log</td>
<td>Balance logs and inventory</td>
</tr>
<tr>
<td>Pesticides management</td>
<td>Min.</td>
<td>Employee training; Pesticide use plan; Use of approved products only</td>
<td>Inventory pesticides (individuals: daily; groups: weekly; lot: monthly)</td>
<td>Lock and separate</td>
<td>Keep individual and premises records</td>
<td>Check records (receiving, feed and group records) before release</td>
</tr>
<tr>
<td>Lot release</td>
<td>CMP</td>
<td>All withdrawal times met</td>
<td>Records of show list reviewed</td>
<td>Stop release</td>
<td>Release form signed by department</td>
<td>All forms examined before release</td>
</tr>
</tbody>
</table>

Min.: potential site of minor problem
Maj.: potential site of major problem
CMP: critical management point (problem will arise if not controlled at this point)
LAST: live animal swab test
administered the pesticide, the animal or animals treated with the pesticide, and the pre-slaughter withdrawal time. If a pesticide is used as part of routine health maintenance, the record of use can be included on the health maintenance record kept for the group or lot of cattle. A record of premise pesticide used must also be kept.

All employees who work with pesticides must be trained in the safe usage of the products. Regular training updates (approximately every six months) are important for all employees whose work is associated in any way with pesticide use. Many States require pesticide applicators to be licensed in order to use certain products.

The QACMPs for the feeder cattle residue avoidance programme are shown in Table II. These are based on the principles of HACCP and can be modified to meet the needs of the individual feedlot.

**Animal welfare**

Animal performance can be optimised only if an atmosphere of respect is established between all involved in the production process. Cattle which are treated by people with patience and with an understanding of animal behaviour are less likely to become ill or to perform poorly. Animal handling techniques can be the pivotal point for animal stress. Stress leads to performance problems which, in turn, can lead to quality defects. Regardless of experience, every feedlot employee can benefit from a review of cattle behaviour.

Proper pen maintenance and the provision of adequate water is not just an issue of animal well-being, but is also vital for optimising cattle performance. Excellent pen maintenance is necessary for confined cattle. Mud is a big profit drain in confined cattle, causing increased feed requirements for maintenance and decreased feed efficiency. Mud also causes considerable loss of hide value and increases the cost of processing at the packing plant. Environmental management and an adequate supply of fresh, clean water are important elements of quality cattle management.

**Conclusion**

Feedlots in the USA produce a very safe product. The prevalence of violative chemical residues has been near zero for many years, thus the risk of chemical residues remaining in beef products is quite small. Ongoing HACCP-type programmes, with scientifically documented critical management points, will help the industry maintain this record.

There are known foodborne pathogens present in any animal production system, including beef feedlots. Little is known about the ecology of many of these microbes at the feedlot level. As a result, an HACCP-based control programme for microbes is not feasible in beef feedlots until critical management points are found through research. Research has already demonstrated numerous CCPs at the harvest and post-harvest levels. In beef packing plants, this includes such CCPs as dehairing, steam pasteurisation, washing carcasses and organic acid sprays. Each of these CCPs reduces the risk of sending a contaminated product to the next production level.

Further research may define QACMPs which will reduce the risk of microbial contamination in the feedlot. Realistically, it should be understood that microbes are everywhere. As a result, it is unlikely that microbial risk-free cattle will ever be sent from the feedlot to the packer. Good management at the feedlot, adoption of research-based QACMPs at the feedlot and full utilisation of CCPs from the packer to the consumer will result in a high-quality, wholesome, safe supply of beef to meet the protein needs of consumers.

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**Risques et prévention de la contamination des ateliers d’emboîche bovine : la situation aux États-Unis d’Amérique**

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**Résumé**

Il n’existe pas actuellement de points de contrôle critiques ou de points de gestion critiques scientifiquement définis permettant de contrôler, avant l’abattage, les micro-organismes responsables de toxi-infections alimentaires. Des travaux de recherche sont cependant en cours, pour la plupart financés par des associations de producteurs. Le secteur des producteurs de bovins de boucherie s’est doté de
programmes particulièrement dynamiques d’assurance de la qualité de la viande. Des groupes d’éleveurs ont pris le ferme engagement de réduire la présence de micro-organismes responsables de toxi-infections alimentaires dans la viande bovine.

Dans les ateliers d’embouche, les bovins en période de finition excrètent moins d’Escherichia coli O157:H7 que les animaux récemment arrivés. De plus, les quantités de micro-organismes excrétés sont moins importantes chez les bovins prêts à abattre que chez les plus jeunes. La prévalence d’E. coli O157:H7 chez les bovins en ateliers est similaire à celle des bovins engraissés au pâturage. Autrement dit, la concentration de bovins dans des enclos sur terre battue n’accroît pas le risque d’excrétion d’E. coli. L’entretien des enclos, considéré comme une bonne pratique d’élevage, semble être un moyen adéquat d’y limiter la présence d’agents pathogènes.

Rien ne permet d’affirmer que les programmes d’hygiène alimentaire avant l’abattage permettront d’éliminer complètement la menace d’agents pathogènes tels que E. coli O157:H7 et Salmonella. Cependant, le contrôle des micro-organismes responsables de toxi-infections alimentaires est appelé à s’intégrer dans les programmes d’amélioration de l’hygiène alimentaire qui concernent les producteurs, les abattoirs (découpe et conditionnement), les distributeurs, les détaillants et les consommateurs.

Les responsables d’ateliers d’embouche ont lancé, il y a déjà plusieurs années, un programme d’élimination des résidus chimiques. Aussi, le risque de retrouver de tels résidus dans la viande de bovins à l’engrais, aux États-Unis d’Amérique, est-il quasiment nul. Les programmes de prévention de type “analyse des risques, points critiques pour leur maîtrise” (hazard analysis and critical control point: HACCP), qui déterminent des points de gestion critiques scientifiquement fondés, contribueront à maintenir ce risque à un niveau négligeable.

Mots-clés

Riesgos y prevención de la contaminación de la carne de ganado vacuno cebado en corrales: la perspectiva estadounidense

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Resumen
No existen en la actualidad puntos críticos de manejo o puntos críticos de control, definidos científicamente, que permitan el monitoreo, en las fases previas al sacrificio, de microorganismos responsables de intoxicaciones alimentarias. Investigaciones al respecto están en curso: gran parte de la investigación centrada en las fases previas al sacrificio es financiada por organizaciones de productores. El sector de productores de carne vacuna ha instaurado programas de garantía de calidad de la carne que conocen hoy un gran dinamismo. Grupos de ganaderos han expresado también su decidida voluntad de reducir la presencia en la carne de microorganismos responsables de intoxicaciones alimentarias.
En los corrales de engorde, los animales que se acercan al final del período de engorde excretan menos microorganismos Escherichia coli O157:H7 que los novillos que acaban de llegar al corral. Lo mismo cabe decir del ganado en edad de sacrificio en relación con animales más jóvenes. La prevalencia de E. coli O157:H7 en el caso de engorde de ganado en corrales es similar a la que presenta el ganado criado a campo. Ello sugiere que la concentración del ganado en corrales no incrementa el riesgo de excreción de microorganismos E. coli. El adecuado mantenimiento de los corrales, considerado una buena práctica de manejo, parece constituir un medio apropiado para mantener un nivel bajo de patógenos en las instalaciones.

No parece probable que los programas de protección alimentaria para las fases previas al sacrificio consigan eliminar completamente la amenaza de microorganismos tales como E. coli O157:H7 o Salmonella. El manejo de los microorganismos deberá formar parte de un programa integral de protección alimentaria que implique tanto a los productores, las plantas de procesamiento, los distribuidores como a los minoristas y los consumidores.

Hace varios años, los productores de carne de bovinos cebados en corrales dieron comienzo a un programa para evitar la presencia de residuos en sus productos. Gracias a ello, el riesgo de residuos químicos en la carne procedente de corrales de engorde es, en Estados Unidos de América, prácticamente nulo. La aplicación de programas de prevención del tipo análisis de riesgos y control de puntos críticos (hazard analysis and critical control point, HACCP), con puntos críticos de manejo definidos científicamente, contribuirá a garantizar que dicho riesgo permanezca a un nivel ínfimo.

Palabras clave

References