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Research Priorities

The beef industry has defined two core research objectives:

1. To ***enhance industry sustainability and reduce production costs***, priority outcomes are to enhance feed and forage production, quantify the environmental impact of Canada's beef industry, increase feed efficiency, decrease the impact of animal health issues and production limiting diseases, and ensure animal care.
2. To ***improve beef demand and quality***, priority outcomes are to reduce food safety incidences, define quality and yield benchmarks supporting the Canadian Beef Advantage, and improve beef quality through primary production improvements and the development and application of technologies to optimize cutout values and beef demand.

Within the core objectives, more specific priority areas are established:

- Animal Health and Welfare
- Beef Quality
- Feed Grains and Feed Efficiency
- Food Safety
- Forage and Grassland Productivity

For all priority areas, proposed research needs to give strong consideration to the following overarching aims:

- Improved communication, collaboration and understanding between researchers and industry.
- Research results accompanied by cost:benefit analysis to inform technology transfer and adoption of research results on-farm.
- Encouragement of interdisciplinary teams undertaking systems-based approaches integrating the entire value chain where appropriate.

The BCRC has established clearly defined research outcomes for the second Beef Cattle Industry Science Cluster through a comprehensive stakeholder engagement process. Specific outcomes listed below are identified as short-, medium-, and long-term, which are expected to be achieved by 2016, 2018, and 2023 respectively.

Priority: Animal Health & Welfare

Outcome 1: Improved Surveillance of Production Limiting Disease and Welfare Issues

Short Term

- Improved diagnostic tests for production limiting diseases.
- Nation-wide benchmarking survey of the incidence and economic impact of production limiting diseases, health management, biosecurity practices, and welfare practices in beef cattle (cow-calf, backgrounding and feedlot) conducted.

Medium Term

- National production limiting disease surveillance program developed, identifying opportunities to collaborate with wildlife disease surveillance programs.

Long Term

- National surveillance system in place to monitor the incidence of and etiology of re- and emerging production limiting diseases.

Outcome 2: Improved Understanding and Management of Pain and Stress in Beef Cattle

Short Term

- Practical, cost-effective methods of objectively quantifying and mitigating pain and stress in beef cattle under production conditions developed (e.g. diet, castration, dehorning, branding, weaning, transport).

Medium Term

- Benchmarks to understand the additive effects of beef production practices on pain, stress, immunity and health developed.
- Scientifically valid beef cattle welfare audit program developed.

Outcome 3: Improved Prevention of Animal Disease and Welfare Issues

Short Term

- Strategies to optimize or improve the effectiveness of existing vaccination programs identified and developed.
- Reduced incidence of reproductive failure through improved nutritional management, diagnostic tests, vaccination and biosecurity.
- Reduced neonatal loss through improved maternal nutrition, timing of vaccinations, and extension / technology transfer to cow/calf sector.
- Modifications to current beef production practices that reduce the need for antimicrobials to prevent or treat respiratory disease in the feedlot identified or developed (e.g. vaccination, weaning, transport and diet).
- Improved control of internal and external parasites.

Medium Term

- Practical modifications to high energy feeding programs that reduce the incidence of metabolic diseases in feedlot cattle identified or developed (e.g. acidosis, bloat, acute interstitial pneumonia).
- Improved immune system function, vaccine efficacy and animal health management to reduce the need for Health Canada Category I and II antimicrobial drugs by 50%.

Long Term

- Reduced incidence of metabolic diseases in beef feedlots without increased use of antimicrobials.
- Implementation of improved animal management systems in the industry which will reduce stress and improve animal health and productivity.

Priority: Beef Quality

Outcome 1: Improved Consumer Satisfaction with Canadian Beef

Short Term

- Effectiveness and value of genetic markers for tenderness validated in commercial cattle.
- Electrical stimulation recommendations re-evaluated to reflect increased carcass weights.
- Objective in-plant measures of tenderness that can be used at line speed validated.

Medium Term

- National Beef Quality Audit (consumer satisfaction) demonstrating that 65% of inside round, 80% of cross-rib, 90% of top sirloin and 99% of strip-loin steaks are sufficiently tender and that no tenderness enhancement is necessary.
- Potential interactions between tenderness genotype and animal management (e.g. implants, backgrounding, grassing, finishing, etc.) identified and appropriate breeding and management recommendations developed.

Long Term

- Data collected to inform consumer messaging regarding the relevant nutritional characteristics of beef, including protein, mineral, vitamin, and lipid components.

Outcome 2: Validation of the Canadian Beef Advantage Relative to International Competitors

Short Term

- Packaging and other technologies to improve shelf life and appearance for export developed.
- Canada's beef carcass quality and yield benchmarked relative to international competitors.
- Beef InfoXchange System data integrated with research analysis in order to monitor changes in industry practices and identify emerging issues.

Medium Term

- Improved algorithms for prediction of lean meat yield and / or retail product percentage.
- Genomic and grading technologies that allow for market segmentation according to carcass quality and/or yield implemented.
- Beef Quality Audit enhanced through development and implementation of processes that facilitate the automated collection, recording and evaluation of carcass quality parameters.
- Beef Quality Audit demonstrating a reduction in carcass defects below 2012 levels.

Long Term

- Data collected through the Beef InfoXchange System analyzed to benchmark Canada Beef Advantage attributes, refine research priorities, and identify improvement opportunities.

Outcome 3: Extension, Outreach and Policy

Short Term

- Complete a systematic literature review on the nutritional attributes of beef to address consumer concerns, inform consumer education programs, and identify appropriate research directions and applications.
- Enhanced consumer education regarding their role and responsibility in ensuring beef quality through selection of appropriate cut-specific preparation and cooking methods.

Priority: Feed Grains & Feed Efficiency

Outcome 1: Improved feed efficiency through animal breeding

Short Term

- Cost-effectiveness of genetic markers for feed efficiency validated in commercial feedlot cattle.

Medium Term

- Impacts of genetic selection for feed efficiency on other economically relevant beef production traits (longevity, fertility, weaning weight, wintering costs, carcass weight, yield and quality grades, tenderness, etc.) quantified.
- Potential interactions between feed efficiency genotype and management (e.g. implants, backgrounding, grassing, finishing, etc.) identified and appropriate breeding and management recommendations developed.

Long Term

- Relative contributions of various animal digestive and metabolic processes and rumen microbes to feed efficiency quantified.

Outcome 2: Improved feed supply and utilization

Short Term

- The cost:effectiveness of alternative / by-product energy feeds, considering impacts on animal performance, health, product quality, and nutrient management have been identified, evaluated and determined.
- Corn and cereal forage variety differences in nutrient profile and ensiling potential characterized.
- Feeding and production systems that improve feed efficiency by 15% developed.

Medium Term

- Agronomic strategies to increase feed grain energy yield per acre identified.

Long Term

- New feed grain varieties developed with improved feed grain energy yield per acre.

Outcome 3: Improved management of manure nutrients

Medium Term

- Nutrient management decision tools that incorporate diet nutrient composition, manure handling and transport costs, value of manure nutrients and organic matter, manure management systems (e.g. raw vs. stockpiled vs. composted) soil types, and nutrient uptake by crops developed.

Outcome 4: Research Training and Capacity

- Key feed efficiency research capacity (expertise and facilities) is maintained
- Feed grain breeding research capacity (expertise) is reinvigorated.

Priority: Food Safety

Outcome 1: Improved Food Safety along the Beef Supply Chain

Short Term

- Technologies targeting multiple pathogens in cattle and beef production and processing facilities developed and implemented.

Medium Term

- Objective approaches for verifying effectiveness of packing plant equipment cleaning processes developed and adopted for 85% of processed cattle.
- Increased surveillance to detect, characterize and quantify the relative human health risk of (re)emerging pathogens.
- Effective probiotic intervention to eliminate pathogens from beef developed.

Outcome 2: Responsible Antimicrobial Use Demonstrated

Short Term

- On-farm data collection and food safety pathogen incidence incorporated into the Canadian Integrated Program for Antimicrobial Resistance Surveillance for beef cattle.
- Microbial genome sequencing used to investigate potential associations between pathogen incidence and antimicrobial use in cattle and the presence of pathogens and development of antimicrobial resistance in microbes found in retail beef and human clinical cases.

Medium Term

- Statistics collected through the Canadian Integrated Program for Antimicrobial Resistance Surveillance (surveillance) demonstrate that:
  - generic *E. coli* samples collected from abattoir samples demonstrate 0% resistance to five or more antimicrobials and 0% resistance to antimicrobials of very high importance in human health, and
  - generic *E. coli* samples collected from retail beef demonstrate less than 2% resistance to five or more antimicrobials, and less than 1% resistance to antimicrobials of very high importance in human health.

Outcome 3: Improved Beef Quality and Food Safety Research and Training Capacity

Short Term

- An industry meat science research chair to address issues facing the beef packing and processing sectors, and reinvigorate food safety research program capacity established.

Long Term

- A meat science program is established at a Canadian university with educational and research components to produce highly qualified personnel serving Canada's beef industry.

Outcome 4: Extension, Outreach and Policy

Short Term

- Enhanced processor education to encourage the consistent adoption of known best practices to minimize the risk of pathogen contamination in beef processing plants.
- Enhanced further processor education to encourage the consistent adoption of proper and thorough cleaning of processing and grinding equipment.
- Enhanced consumer education regarding their role and responsibility in ensuring food safety in the home, including the relative efficacy of alternative in-plant interventions and at-home food handling and storage practices to ensure food safety.
- Research results used to inform the regulatory approval of trim and ground beef irradiation.

Priority: Forage & Grassland Productivity

Outcome 1: 33% Improvement in Yields and Nutritional Quality of tame, native and annual species through improved pasture, forage and grazing management and plant breeding

Short Term

- Improved grazing and management strategies that optimize hay yields and beef production from native range and tame pastures.
- Varietal and species differences in the ability of grasses, legumes and annual forages to maintain nutritional quality throughout the grazing season and in extended stockpiled or swath grazing systems to help inform producers' seed selection decisions quantified.

Medium – Long Term

- New annual and perennial grass and legume varieties with improved stand longevity, quality, yield, and adaptability (e.g. flood and drought resistance) through traditional and/or advanced plant breeding techniques developed.

Outcome 2: Environmental Sustainability

Short Term

- The "environmental footprint" (carbon sequestration, plant and animal biodiversity, endangered species, soil erosion, watershed protection, etc.) and socio-economic (environmental goods and services) impact of the forage-beef sector in Canada, including the effects of optimal environmental production practices (e.g. stocking rates, riparian area protection) on the above has been quantified.

Outcome 3: Research and Training Capacity

Short Term

- Industry research chairs focused on tame grass and legume breeding and management/grazing established to serve Central and Eastern Canada and in the Prairies and B.C. established.

Long Term

- Reinvigorate and enhance long-term breeding programs, while capturing near-term opportunities that are currently under development.

Outcome 4: Extension, Outreach and Policy

- Enhanced public education regarding the impact of Canada's forage and beef industry on Canada's environment and economy.
- Grazing Mentorship Program or other similar formal producer extension programs used to encourage pasture rejuvenation every 5 years and the adoption of grazing-tolerant, drought resistant and bloat-safe legumes into pasture mixtures.

- Annual and perennial varieties that have been previously developed and registered but are not commercially available are investigated, and varieties showing significant potential benefits for the beef industry are accelerated to be market ready.
- On-farm decision making tools quantifying the return-on-investment from pasture rejuvenation, weed control, fertilization are developed.