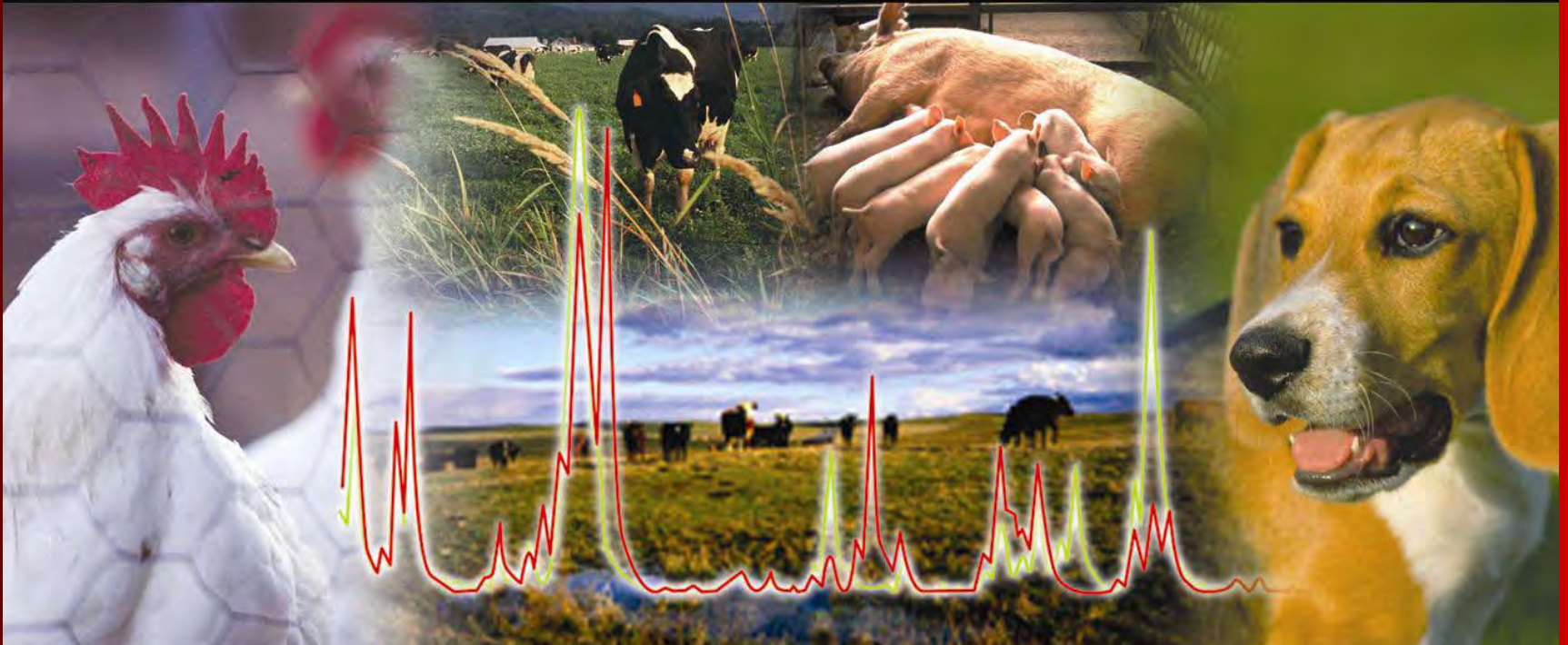




**MMI GENOMICS, INC.**



**Creating value in animal production and management through genomics.**



# **DNA-Based Animal Identification Programs**

Integrated Traceability  
Technologies for Animal  
Identification

September 29, 2005

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Tom Holm  
Business Development Manager  
MMI Genomics Inc.

# About MetaMorphix

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MetaMorphix, Inc. (MMI) is a life sciences company that uses the code of life, DNA, to improve the global food supply and human health.

Use advanced technology platforms to:

- Improve animal health
- Reduce production costs
- Enhance the yield, quality and uniformity of livestock products
- Select and manage animals for traits that maximize production value and efficiency
- Trace animals and animal products from farm to fork

# Biotech Revolution in Genomics

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- Advancements in human healthcare
  - Disease discovery & screening
  - Drug development
- Applications in human identity testing
  - Parent verification
  - Forensics, convicted felon database
- Knowledge base is expanding in livestock species
  - Whole genome sequence for swine, chickens and cattle
  - Discovery of genes that effect economically important traits

# Application of Genomics in Livestock Production Systems

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In the future every production animal will be genotyped and a DNA sample will be stored in long-term archive

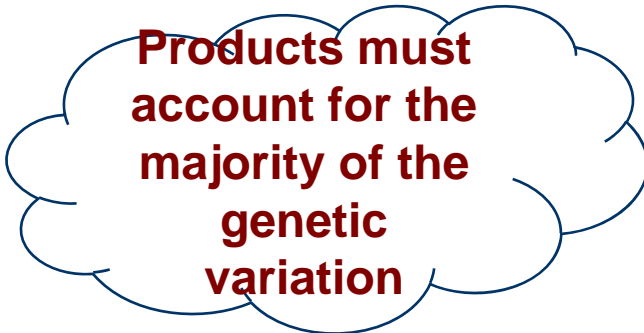


## Genomics-based Products Enable

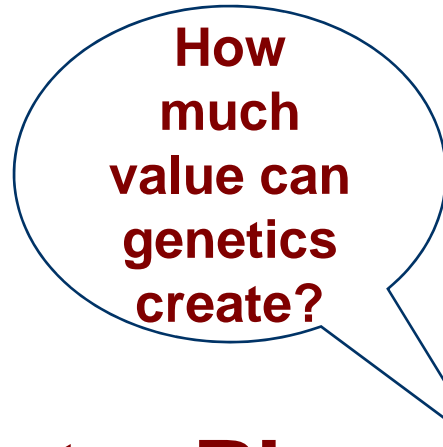
- Enhanced Breeding and Selection
  - Targeted to economically important traits
- Disease Surveillance and Food Safety
  - Source Verification and Animal Traceability
- Improve Animal Production Efficiency
  - Management systems based on genetic potential
- Enhance End Product Quality and Consistency
  - Certification of Branded Meat Programs

# Genomics Discovery in Livestock

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**Products must  
account for the  
majority of the  
genetic  
variation**



**How  
much  
value can  
genetics  
create?**

**Genetics + Management = Phenotype**

**Discovery based on a Genome-Wide Strategy**



16 February 2001

# Science

Vol. 291 No. 5507  
Pages 1145-1434 59

## MMI Genomics Livestock Genomes

### MMIG Genomic Assets

- Whole Genome Sequences of Cattle, Chickens and Swine
- Bioinformatics Systems
- High Throughput Genotyping Platform

Strategic

Partnerships



### Value Creation

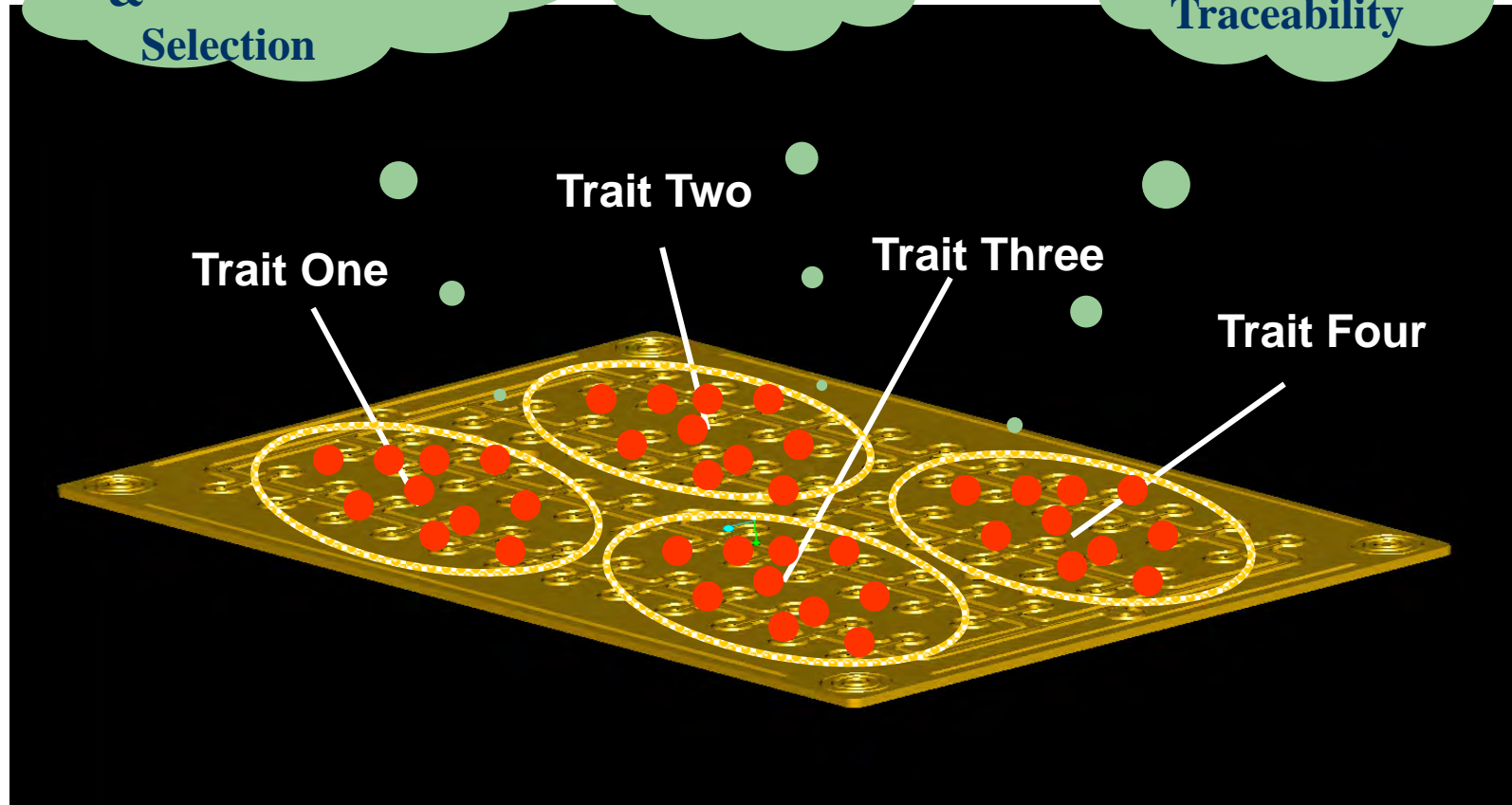
- Diagnostics to Enhance Animal Breeding and Selection
- Source Verification and Traceability
- Management based on an Animal's Genetic Potential
- Certification of Branded Meat Products

# DNA-based Diagnostics on a Chip

- **Breeding  
& Management  
& Selection**

**Branding**

- **Source  
Verification**
- **Traceability**



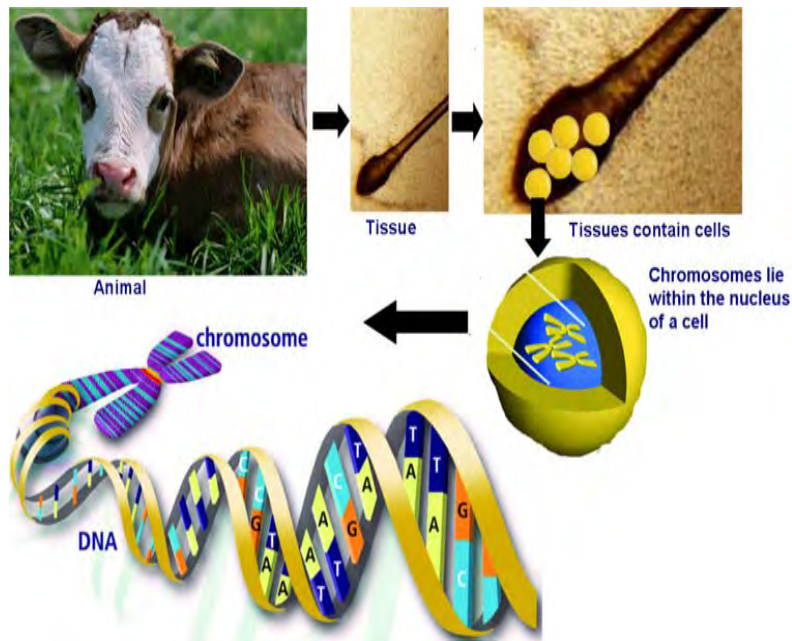


# **Animal Identification Systems**

DNA-based Animal ID Programs



# DNA Basics: Unique Animal ID



Unique  
Permanent  
Tamper-proof



- DNA sequence is highly conserved within a species
- Every individual contains unique DNA sequence
- Every cell contains exact copy of DNA sequence
- Differences in DNA sequence can be detected

Fail-safe Method for  
Verification of  
Animal Identity

## DNA-Based ID Enhances NAIS

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- Complements all other technologies ultimately adopted for NAIS
- Re-establish identity in the event of lost tags/identifiers
- Allows system-wide audits to ascertain the overall performance and integrity of NAIS
- Absolute verification of true identity in the event of an animal health or food safety emergency

# DNA-based Traceability

## Key System Components

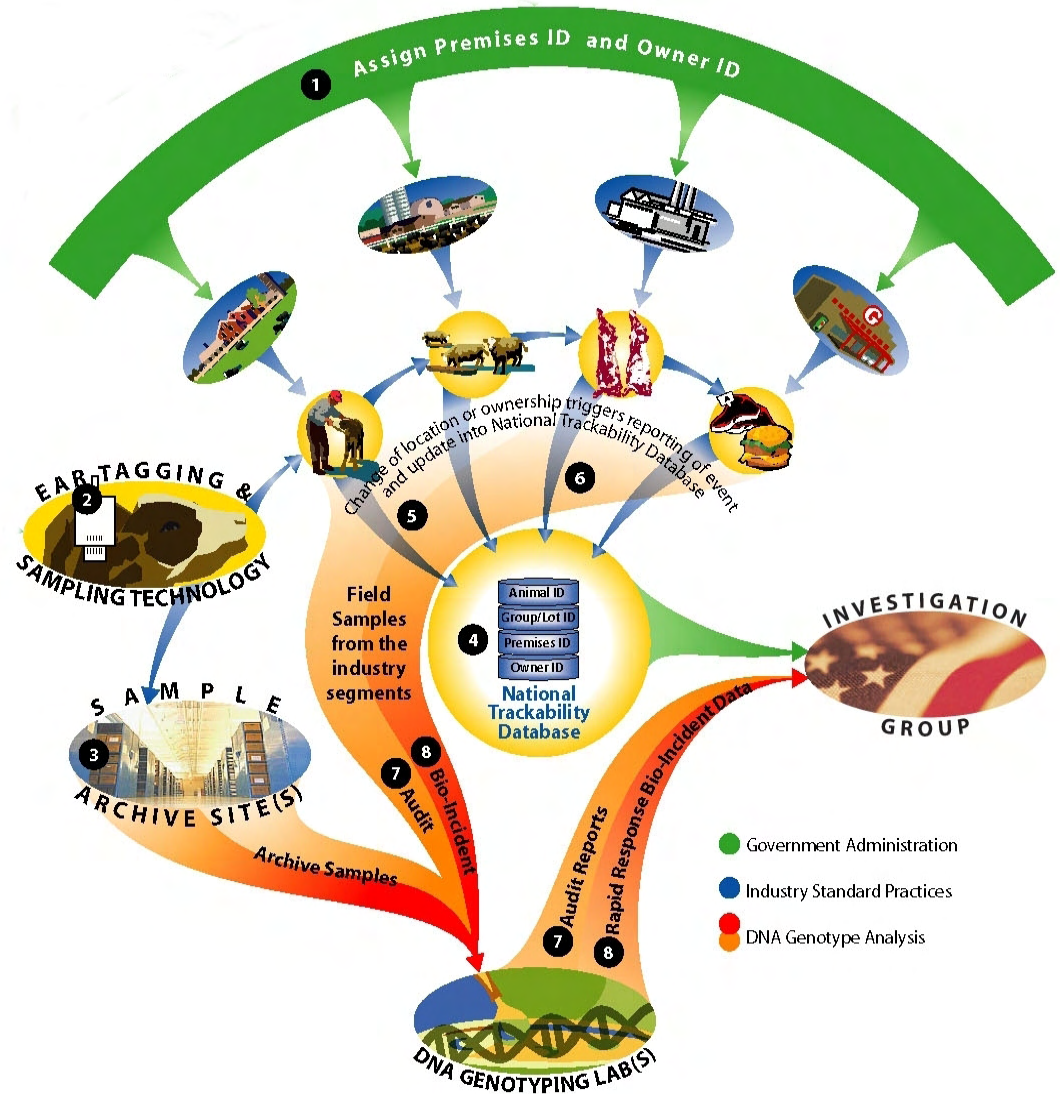
- NAIS components
  - Visual/RFID
  - Database management
- Tagging & Sampling
- Sample Archive
- DNA-based Identity Testing

## Key System Features

- Integrated into NAIS infrastructure
- Traceability of live animals and animal products

## Key System Benefits

- Fail-safe method for determining true identity
- DNA-based system-wide audits
- Verification of true identity for bio-incident resolution
- Identification of animals with lost or stolen tags



# Tagging and Sampling Technology

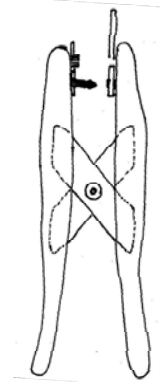


Tagging and sampling at origin premise



## Simultaneously tagging and sample collection

- DNA Sample Collector attached to RFID tag
- Attachment is tamper-evident
- DNA sample collected as a small drop of blood



Automated  
Tagger/Sampler



## Sample card sent to archive facility

- Ship by regular US Mail
- Simultaneous reporting of AIN's to NAIS

“Archive Samples” stored until needed

# NAIS System-wide DNA Audits

## “Audit Samples” Collected



- Random premises and samples
- All production segments, geographies
- Statistically significant numbers

## Pull Corresponding Archive Samples



## DNA Profiling and Matching Analysis

- Quantitative estimate of system performance
- Investigate non-matches
- Implement corrective procedures

**Audits are independent of primary animal ID technology**

# Bio-Incident Verification of ID

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## “Suspect Samples” Collected



Live animals, body parts or meat products

## Pull Corresponding Archive Samples



## DNA Profiling and Matching Analysis


- Confirm or exclude identity of suspect
- Query NAIS database to identify cohorts & locations
- Further actions as needed to contain the event

**Systematic approach to bio-incident ID verification**



# Colorado Pilot Project

Rapid Response  
DNA-based Identity Verification  
Demonstration



# Project Overview

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- Participants
  - Research Management Systems (RMS )
  - Dept. of Animal Sciences - Colorado State University (CSU)
  - Run under auspices of Tri-National Livestock Health and Identification Consortium and the Colorado Livestock Identification and Tracking Project
  - Coordinated by the Colorado State Veterinarian, Colorado Department of Agriculture
- Experimental Objectives
  - Evaluate the application of DNA analysis to re-establish and verify actual identities of cattle as traceability tool
  - Verification of individual animal identity within 48 hours

# Test Program Design

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- Cattle were individually identified with RFID tag
- Blood and hair samples collected
  - Duplicate blood card samples on 34 pairs (2-way match)
  - Duplicate blood card and hair samples on 26 pairs of samples (3-way match)
  - Unique non-matching samples
- All samples (including previously archived samples) sent to MMIG's lab for analysis
- Samples were sent blind (no sample ID information provided)
- The lab was asked to create DNA profiles on all samples and identify the matching sample sets
- Identity matching had to be confirmed within a 48 hour window from the time the samples were shipped

# Three-Way Blind Match



# Rapid Response – Time frame

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Date	Time	Event
16-Nov-2004	16:16 MST	DNA samples shipped from Fort Collins, CO to Davis, CA via FedEx First Overnight
17-Nov-2004	08:30 MST	Receipt of DNA samples confirmed via telephone by MMIG representative
17-Nov-2004	14:10 MST	Confirmation via telephone that DNA had been extracted and PCR analysis was in progress
18-Nov-2005	08:15 MST	MMIG representative confirmed via telephone that DNA analysis had been completed
18-Nov-2005	08:45 MST	Results of DNA analysis received and evaluated by RMS representative
18-Nov-2005	08:55 MST	Results verified by RMS representative
18-Nov-2005	08:56 MST	Results reported to Colorado State Veterinarian via e-mail
18-Nov-2005	09:00 MST	Confirmation from Colorado State Veterinarian via telephone that results had been received
		<b>Total time required for rapid response: 32 hours, 14 minutes</b>

# Summary of blind DNA testing results

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Test Group	Number of samples	Test results	Success rate
Duplicate blood cards	34 pairs	All samples correctly matched	100%
Duplicate blood cards with matching hair samples	26 sets	All samples correctly matched (3-way match)	100%
Single blood cards with matching hair samples	5 pairs	All samples correctly matched (2-way match)	100%
Blood cards differing in purity and card-coverage	12 cards	Complete DNA profiles obtained for all samples	100%
Randomly chosen blood cards and hair samples	10 samples of each type	Matching vs. unique samples correctly identified	100%

100% success rate of animal identification

## Conclusions and Implications

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- DNA analysis highly effective tool for recovery (lost tags) and verification of individual animal identity
- Individual animal identity can be determined and verified using DNA profiles, with a success rate of 100% and within a forty-eight hour time period
- DNA profiling can enhance the effectiveness of animal traceability systems
- An animal's DNA profile is a unique, permanent identifier that is tamper-proof, and remains effective despite the loss of other forms of identification, and expands animal tracking systems from post-harvest sector back to the animal of origin



# **DNA-Based Animal Identification Programs**

Summary and Conclusions



# Summary

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Regardless of the technologies, methods or systems that are ultimately adopted for tracking animals on a nationwide basis,

## **A component of NAIS based on sample archive and DNA identity testing**

- Complements all other technologies and system components
- Provides a number of benefits to the overall system that cannot be achieved by other means

# Benefits of a DNA Testing Component

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- Fail-safe method for establishing identity that is unique, permanent and tamperproof
- A mechanism to quantitatively estimate the overall performance and integrity of the traceability system (system-wide audits)
- A systematic approach for absolute verification of an animal's true identity in the event of an animal health or food safety emergency
- Expands the traceback system by permitting the tracking of specific meat products back to the animal of origin

# Value Added DNA Benefits

- Enhanced breeding and selection
- Optimized animal management and marketing based on genetic potential
- Creation and certification of branded meat products with specific palatability attributes



## Our Vision in Livestock

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In the future every production animal will be genotyped and a DNA sample will be stored in long-term archive



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# Thank You!

Questions?

See us at Booth 306



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