# Building Blocks of Meat

How biology and physiology impact production, performance, and carcass quality, acceptance and yield.

Dr. Jennifer N. Martin Associate Professor & Meat Extension Specialist Department of Animal Sciences Colorado State University



### • Envision a high-quality meat-eating experience















### If we know the target...why haven't we figured out an easier way to get there?



### Producing High Quality Meat is an Art... ...and a science

#### In order to produce high quality meat, it helps to understand...

- The science of muscle, fat, and skeletal development
- The variables influencing carcass performance and eating quality









### **Building High Quality Meat** Starts at the Cell Ends at the Rail



### From the Cell to the Rail



Myocytes

**Mesenchymal Stem Cells** 







**Fibroblasts** 



### **Science of Skeletal Development**

# High quality meat animals begin with good skeletal structure

- Similar to the foundation of a house
- Bones serve as levers for skeletal muscles

#### **Skeletal structures form prenatally**

- At birth, bone content is high (2:1)  $\rightarrow$  decreases as animal grows
- Nutrition, use, hormones, and management can influence skeletal development and bone growth

#### **Postnatal Skeletal Changes**

• Bone growth occurs longitudinally



### **Science of Skeletal Development**

#### If we're talking about meat, why do we care about bones?

- Skeletal system creates foundation for muscle development
- As bones grow longitudinally → muscles grow
- Large frame size = faster rate of lean meat growth (tend to be later maturing)
- Large-framed animals produce leaner meat



arge and medium hame pictures depict minimum grade requirements. The small frame picture represents an animal typical of the grade



### **Science of Muscle Development**

#### Muscle development begins in early gestation

- Number of skeletal muscles cells is largely set by last month of pregnancy
- After birth, muscle growth is **hypertrophic** (growth in size)

#### What does this mean?

- Prenatal factors influence skeletal muscle development
- Management of pregnant females during mid-gestation correlated with muscling

–Poor nutrition during gestation = light muscling, low yield







### **Science of Muscle Development**

#### **Postnatal Muscle Changes**

- At birth, focus is on small muscles associated with the skeleton
- After birth, substantial changes in muscles not associated with the skeleton –Reflection of use, location, nutrition, etc.

#### Not all muscle fibers are created equally...

- Primarily Type I fibers at birth
- Muscle fiber type influenced by:
  - –Use
  - -Breed-type
  - -Nutritional plane



Fiber Type influences multiple quality attributes!

Trait	Type I	Type IIA	Type IIX
Metabolism	Oxidative	Oxidative & Glycolytic	Glycolytic
Speed	Slow	Medium	Fast
O2 Requirement	Aerobic	Aerobic	Anaerobic
Size	Small	Small	Large
Lipid Content	High	High	Low
Myoglobin	High	High	Low
Fatigue Resistance	High	High	Low
Mitochondrial Act.	High	High	Low
Color	Red	Intermediate	White
Example	Diaphragm	Psoas major	Chuck/Round

### **Science of Fat Development**

#### Lipid cells develop in late gestation and early postnatal period

• Development follows a sequential order:

-Visceral  $\rightarrow$  subcutaneous  $\rightarrow$  intermuscular  $\rightarrow$  intramuscular (marbling)



#### Given the value of marbling, significant efforts to understand intramuscular fat

How can we create more marbling?



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Zhao et al., 2019



# The foundation is built... Now what?



**Google Images** 

### **Balancing Postnatal Changes**

As animal matures, less energy is directed towards muscle growth and more towards fat deposition

- Muscle > Bone
- Fat > Muscle

# Fat deposition is energy inefficient (especially IMF)

 Animals will only deposit IMF if all other nutritional needs are met



### What Influences Meat Quality?

#### After birth, many variables impact growth and meat quality

- Nutrition & composition of diet
- Stress
- Hormones
- Supplements
- Environmental Conditions



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What Role Does Nutrition Play in Meat Quality?







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#### **Deposition of intramuscular fat requires an excess of energy**

- Historically, grain-based feedstuffs provide a high-energy diet
  - Energy utilized in intramuscular fat deposition
- Excess energy can be obtained with forage-based diets, but composition of the forage can impact composition of fat
  - Fat composition is associated with flavor

# Similarly, the composition of alternative feedstuffs can influence meat composition & quality



### Why does the composition matter?

As we explore alternative feedstuffs, we must understand their contributions to meat quality

#### Not all alternatives are created equal!

It is imperative to evaluate the nutritional composition of alternative feedstuffs

- Do they meet maintenance needs?
- Will they provide enough energy to deposit IMF?
- What supplements might be needed to address deficiencies?

### **Producing High Quality Meat is an Art...**













...a Science ...a Balance





**Building High Quality Meat** Starts at the Cell Ends at the Rail

Understand the Science Respect the Art Perfect the Balance



## Thank you

