Proteomics as a tool to better understand beef tenderness

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Why beef tenderness?

• Consumers’ rating of beef sensory attributes:
  1. Tenderness
  2. Juiciness
  3. Flavour

• Consumers are willing to pay more for tender beef products

• More variation in tenderness than in either juiciness or flavour
Factors determining beef tenderness

Warner-Bratzler shear force, kg

Hours postmortem

Rigor contraction

Tenderisation phase

Background factors

Tough

Tender

Adapted from Wheeler & Koohmaraie, 1994
To improve beef tenderness…

…we need to understand:

– the complex molecular processes occurring *postmortem*
– the relationships between *postmortem* metabolism and proteolysis and tenderness development
Application of proteomics

Hours postmortem
Early *postmortem* changes in muscle

Biopsies from living animals vs samples 1h *postmortem*

24 spots changed

Jia et al 2006, JPR 5, 1763-1769
Changes during rigor development

Samples collected at 1, 2, 3, 6, 10 and 24h postmortem

Jia et al 2007, JPR 6, 2720-2731
Changes during rigor development

Metabolic proteins:

Jia et al 2007, JPR 6, 2720-2731
Changes in the insoluble protein fraction

• Shift in protein solubility
  – Small HSP decreased in the soluble fraction up to 24 h and increased in the insoluble fraction

• Higher abundance of fragments of structural proteins
  – Reflects degradation of structural proteins

Bjarnadottir et al 2010, JAFC 58, 7408-7414
Protein markers for beef tenderness

Jia et al 2009, JAS, 87, 2391-2399

13 tender
44N (7d pm)

13 tough
69N (7d pm)

Peroxiredoxin-6
Malate dehydrogenase
Protein DJ-1
Stress-70 protein

Myosin light chain 1
Histidine triad nucleotide-binding protein 1
UPF0386 protein C11orf97 homolog

Jia et al 2009, JAS, 87, 2391-2399
Protein markers for beef tenderness

• Proteins found by both methods:
  – Actin, myosin light chain

• Proteins of similar function:
  – Structural, metabolic, apoptosis-related

• Proteins not earlier associated with beef tenderness:
  – Galectin-1 (apoptosis, regulates cell proliferation)
  – Annexin A6 (Ca^{2+} regulation)
Proteomics and beef tenderness

• New knowledge/insight

• Prediction of meat tenderness

• Contribute through selective breeding programs
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