

# Differential aging-related changes in protein profiles of dark-cutting and normal-pH beef *longissimus lumborum* muscle



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Animal and Food  
Science

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# Dark-cutting beef



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- Dark-cutting beef is a condition in which beef fails to have a characteristic bright red color when the cut surface is exposed to oxygen.
- About \$165-170 million is lost due to dark-cutting carcasses (USDA, 2017, Prieto et al., 2018).
- In 2016 NBQA reported 0.74 % of total carcasses were dark-cutters (Boykin et al., 2017).
- In Canada, dark-cutting is graded as B4 with 50 cent reduction in price (Holdstock et al., 2014).



Source: UNL Quality Assurance

# Occurrence of dark-cutting beef



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- The occurrence is associated with defective glycogen metabolism resulting from pre-slaughter stress.
- This limits lactic acid accumulation post-mortem, and hence dark-cutting has a greater than normal muscle-pH above 5.8.
- The high muscle pH can sustain mitochondrial function post-mortem.



Photo by Jeff Savell, 2013

# Post-mortem aging and meat color



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The extent to which protein profiles in dark-cutting vs normal-pH beef are altered during aging is still unknown.



Photo by Jeff Savell, 2013



# Hypothesis

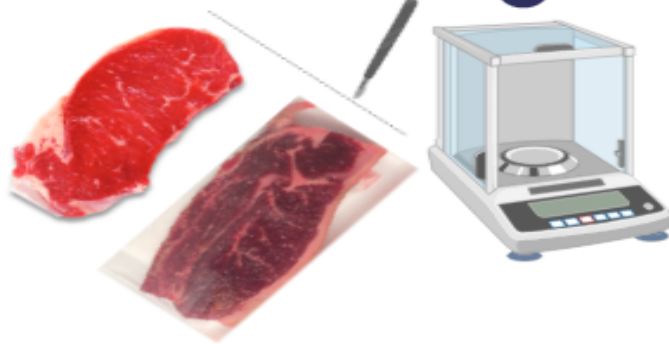
- The changes in protein profiles during aging modulate differences in color characteristics between dark-cutting and normal-pH beef.

## Objective

- To characterize aging-related changes in protein profiles in dark-cutting beef compared with normal-pH beef *longissimus lumbrum* muscle.

# Materials and methods

0.5 g of tissue from n = 6  
normal-pH and  
dark-cutting beef

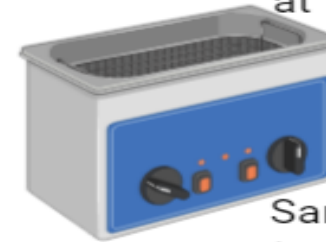


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2 Proteins were extracted in 5 mL of  
Lysis buffer pH 8.2 and  
homogenized for 2 min using a  
tissue teasear

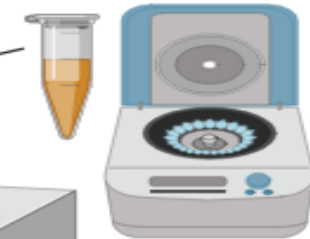


3 Homogenized  
samples were boiled  
at 100° C for 10 min



4

Samples were then  
sonicated and centrifuged  
at 10,000g for 10 min



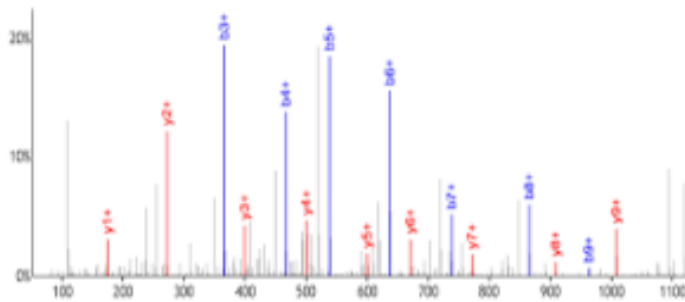
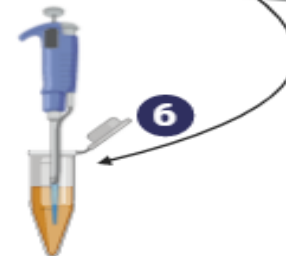
5 Protein concentration was  
determined using a tryptophan  
standard fluorescence assay

5

Extracted proteome samples  
were digested with Trypsin and  
analysed via bottom short gun  
mass spectrometric technique

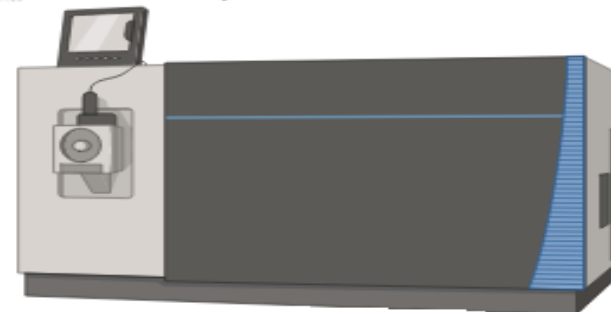


6

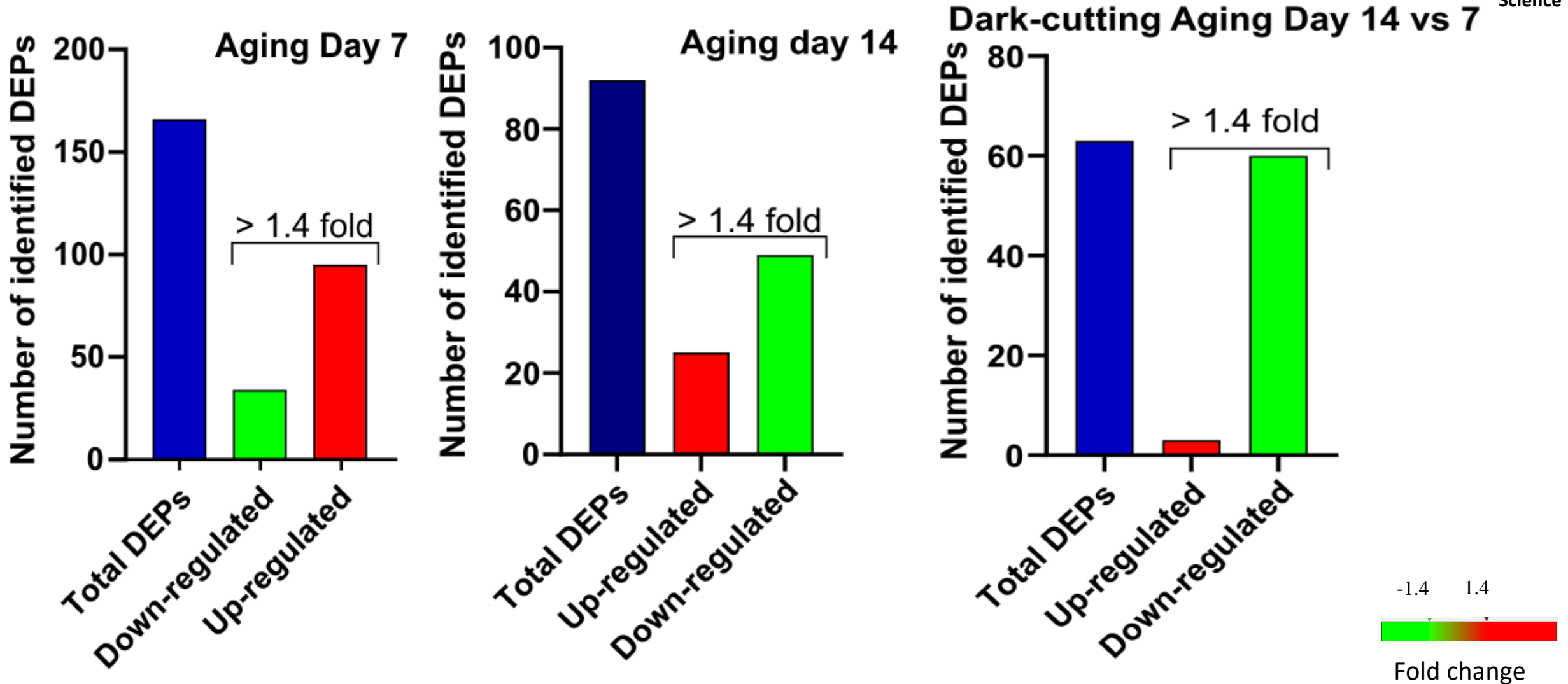


7 MS/MS peptide  
mapping and Data  
base searching

7



# Results: Differentially expressed proteins



# Summary



- By day 7 of aging, dark-cutting beef had greater expression of proteins involved in energy metabolism, stress mediated responses, and redox systems.
- By day 14 of aging, dark-cutting beef had reduced expression of proteins involved in stress mediated responses, glycogen metabolism but greater abundance of mitochondrial complex I proteins.
- Aging of meat has a different regulation mechanism on protein expression profiles in dark-cutting compared with normal-pH beef.