Poultry Muscle Profiles
Overview of poultry processing

- Stun
- Exsanguination
- Scald
- Pick
- Chill, USDA <45F (7C) in 2 hr
- Age 4-6 hr
- Process
pH Decline

Broilers at 15 min pm, pH 6.2
Turkey hens at 15-20 min pm, pH 6.2-6.8

Ultimate pH, broilers

- 2-3 hr postmortem in red leg muscles with an ultimate pH of 5.9-6.0
- Breast muscle may continue to have metabolic activity for 8-24 h with an ultimate pH of 5.4-5.6.

pH Decline

- May vary with genetic line
- Is influenced by chilling rate
- Affected by preslaughter handling - feed withdrawal, heat stress...
- Varies between birds

Rigor Development

May develop as quickly as 3 min in leg muscles and 15 min in breast fillets.

More rapid in red fiber muscles than white.

Chilling slowed development in red fibers.

Rigor Development

Could not be predicted by biochemical changes
Metabolic activity had ceased in the aerobic muscles by 2 hr.
Anaerobic muscles had metabolic activity at 2 hrs with the *Pectoralis superficialis* having activity up to 8 h

Histological

- **White** - Breast, tenderloin, wings
- **Dark** - thigh, drum
Histological

*Pectoralis* (Major and superficialis) - white anaerobic
Pectoralis minor - white (type II) and intermediate (5.6%)

*Anterior latissimus dorsi* - Homogeneously red, aerobic

*Biceps femoris* - red, aerobic

*Posterior latissimus dorsi* - predominantly anaerobic

*Sartorius* - predominantly aerobic

Histological differences

• Selected for fast growth, breast muscle mass
• From hatch to 20 weeks, broilers have larger (P<0.001) fibers in the *pectoralis* and *biceps* muscles than layers

Fiber diameter of *Pectoralis* in two strains of chicken

<table>
<thead>
<tr>
<th>Age (wk)</th>
<th>Live Weight (g)</th>
<th>Fiber Area (µm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rapid</td>
<td>Slow</td>
</tr>
<tr>
<td>0</td>
<td>36</td>
<td>31</td>
</tr>
<tr>
<td>11</td>
<td>1882</td>
<td>675</td>
</tr>
<tr>
<td>55</td>
<td>3285</td>
<td>1883</td>
</tr>
</tbody>
</table>

Data from Rémignon et al. (1993) as reported by Dransfield and Sosnicki (1999).
Histological profile

- Turkeys - selection for rapid growth and large breast muscle mass
  - Leg weakness
  - Focal myopathy
Growth rate and proteolytic capacities

<table>
<thead>
<tr>
<th></th>
<th>6 wk Weight</th>
<th>Feed Conv.</th>
<th>μ-Calpain</th>
<th>Cathepsin B and L</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Leghorn</td>
<td>650 g</td>
<td>2.527</td>
<td>7.08</td>
<td>3.4</td>
<td>1.44</td>
</tr>
<tr>
<td>Ross</td>
<td>2.4 kg</td>
<td>1.758</td>
<td>0.37</td>
<td>1.53</td>
<td>1.28</td>
</tr>
<tr>
<td>V. High Growth</td>
<td>2.5 kg</td>
<td>1.701</td>
<td>0.57</td>
<td>1.29</td>
<td>1.09</td>
</tr>
</tbody>
</table>

Data from Schreurs et al. (1995) as reported by Dransfield and Sosnicki (1999).
Aging and Shear Force

• Minimum 4 h aging
• SF values for fillets boned 1 and 2 hr postmortem (10.61 and 10.85 kg, respectively) were statistically lower than 0 hr postmortem (15.19 kg).
• SF values did not differ for 4, 6, 8, and 24 hr pm (range 5.23 to 7.73 kg).

## Effect of Aging on Marinated Breast Quarters

<table>
<thead>
<tr>
<th>Aging time (min)</th>
<th>Warner-Bratzler Shear Values (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
</tr>
<tr>
<td>0</td>
<td>5.69&lt;sup&gt;b, x&lt;/sup&gt;</td>
</tr>
<tr>
<td>120</td>
<td>3.46&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>180</td>
<td>2.72&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>240</td>
<td>2.54&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a,b</sup> Means in the same row with no common superscript differ (P<0.05)

<sup>x,y</sup> Means in the same column with no common superscript differ (P<0.05)

### Chemical Traits - Pooled means and ranges across eight genetic lines

<table>
<thead>
<tr>
<th></th>
<th>pH</th>
<th>Fat, %</th>
<th>Protein Extractability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>5.98</td>
<td>1.5 %</td>
<td>68.0%</td>
</tr>
<tr>
<td></td>
<td>(5.88-6.04)</td>
<td>(1.0-2.0%)</td>
<td>(63.1-75.9%)</td>
</tr>
<tr>
<td>Thigh</td>
<td>6.09</td>
<td>6.2%</td>
<td>58.0%</td>
</tr>
<tr>
<td></td>
<td>(6.05-6.15)</td>
<td>(5.0-7.2%)</td>
<td>(51.4-62.5%)</td>
</tr>
</tbody>
</table>

Differences (P<0.05) were found between genetic lines.

Functionality

- Turkey gels were stronger ($P<0.10$) than chicken gels from similar muscles.
- Gels from drum and thigh were stronger ($P<0.005$) than those from breast.
- Protein content
  - was similar between chicken and turkey
  - was higher in breast than drum or thigh.

Functionality traits

• Discussion - Although dark muscles have lower salt-soluble-protein content, those proteins have better emulsifying capacity.

• pH highly correlated (r 0.83) to functional properties

• pH may account for lower functionality in breast.

• System pH was lower than previously determined optimum of 6.2 for breast

• No phosphate in model system

### Color variation and pH in broiler breast meat

<table>
<thead>
<tr>
<th></th>
<th>Visual Score</th>
<th>L*</th>
<th>a*</th>
<th>b*</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>2.4&lt;sup&gt;c&lt;/sup&gt;</td>
<td>48.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.4</td>
<td>5.63&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Normal</td>
<td>3.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>45.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.6</td>
<td>5.70&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Dark</td>
<td>3.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>43.1&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.9</td>
<td>5.81&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

*a-c Means in a column without a common superscript differ (P<0.05)*

Poultry muscle

- Rapid pH decline
- Quick rigor onset with differences between muscles
- Breast predominantly anaerobic, white
- Selection may shift fiber diameters
- 4 hr aging postmortem
- Variation in pH
- Low pH may affect functionality and color
Parts Are Not Parts!

Whole Bird

WOG (88.8% whole bird)

Front Half (51.58% WOG)  Back Half (48.42% WOG)
Whole Broiler with Giblets
8 piece Cut
Front Half

Split breast
- B/S Breast Fillet
- Tenderloin
- Trim
- Bone
- Skin

Back Portion

Whole Wing
- Drummette
- Flat
- Tip

NAMP Buyer's Guide
Breast fillet
(16.56% WOG)

- Very light in color
- B/s breast w/ rib meat - 3-5% fat
- Holds up well during processing
- Firm bite
- Used bone-in, fillet, strips, bites, formed
Tenderloins
(3.72% WOG)

• Fat content, 1.0%
• Readily absorb marination
• Clipped or unclipped tendon
• Fragile
Wings - Drummette Flat

NAMP Buyer’s Guide
Back Half (48.42% WOG)

<table>
<thead>
<tr>
<th>Whole Leg</th>
<th>Back portion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drum</td>
<td>Thigh</td>
</tr>
<tr>
<td>• B/S Drum Meat</td>
<td>• B/S Thigh Meat</td>
</tr>
<tr>
<td>• Bone</td>
<td>• Bone</td>
</tr>
<tr>
<td>• Skin</td>
<td>• Skin</td>
</tr>
</tbody>
</table>

NAMP Buyer’s Guide
**Thigh meat**
*(19.82% WOG)*

- Fat content, 8-10% for b/s thigh fillet
- Very juicy and flavorful
- Used bone in, fillets, bites, or formed items
- Cost effective to add
- Softer bite, less firm than breast meat
- Multiple muscles (more fragile)
Drum
(15.65% WOG)

- Flavorful, juicy
- Sl lower in fat than thigh
- More connective tissue
- Used bone in or formed items.
- Cost effective
- Softer bite, less firm than breast meat
Other Raw Materials

Breast trim

Dark meat trim

Special trim items – visually lean breast fillets, trimmed thighs

Skin
Other Raw Materials (cont.)

Mechanically separated chicken
  categories based on fat content

Ground chicken
  label advantage,
  texture firmer than MSC
  Lighter color
Combining Raw Materials
Combining Raw Materials

Chicken meat—Natural proportion
  light (50-65%), dark (50-35%)

Light or White meat—100% light

Dark meat—100% dark meat
Combining Raw Materials

Skin may be added in natural proportion

Chicken breast vs. Chicken breast meat

Skin is typically added back in an emulsified form

Chicken breast, 18% max

Chicken, 20% max
Nuggets of info!

Cornish Game Hen - Young, special breed, immature birds

Fowl or Spent Fowl - Light or Heavy
- Used in diced meat and other processed meats
- Unique flavor, stringy texture
Nuggets of info!

- Slaughter weight - 3-7 lbs.
- Age at slaughter 4 to 8 weeks
- Tight genetic pool
- Almost all poultry from integrated producers
Feed Mill

BreederStock/CobbVantress
provides grandparent breeding stock

Pullet Farm
pullets grown to 20 weeks

Breeder Farm
pullets become productive at 26 weeks

Hatchery
eggs are in hatchery for 21 days

Broiler Farm
broilers reach market weight in about 46 days

Processing / Further-processing Plant

Distribution

Poultry Industry Supply Chain