Ch 10 Beef Carcass Evaluation, Grading and Pricing

Dr. Fa-Jui Tan

1st step in beef carcass evaluation

- To determine CLASS or SEX group
  - Class: based on evidences of maturity and sex condition at the time of slaughter
  - a product subdivision based on essential physical characteristics that differentiate between major groups of the same species

- Classes of beef carcasses
  - bullock
  - bull
  - steer
  - heifer
  - cow
<table>
<thead>
<tr>
<th>“Kind” of beef carcass</th>
<th>“Class” of beef carcass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veal</td>
<td>heifer</td>
</tr>
<tr>
<td>Calf</td>
<td>cow</td>
</tr>
<tr>
<td>Beef</td>
<td>Steer</td>
</tr>
<tr>
<td></td>
<td>bull</td>
</tr>
<tr>
<td></td>
<td>bullock</td>
</tr>
</tbody>
</table>

**Kind**

Based on evidences of maturity (but not sex condition) at the time of slaughter

Based on:

- **lean color (major factor)**
- lean texture
- fat character
- bone and cartilage color, size and ossification
- General **contour** of the carcass

- Veal, calf, beef
Veal

- grayish pink to dark grayish pink color
- smooth and velvety texture
- slightly soft, pliable fat
- narrow and very red ribs

補充

Age
- < 9 months
- Most slaughtered when they are 8 – 16 weeks old

Meat
- Lighter color than beef (veal: light pink color)
- Very little fat
- Has a more delicate flavor
- Generally tender

Veal - meat from a bovine usually less than 3 months old. Color of the lean is light grayish pink. Note: For grading purposes, chronological age is not important.

Bob Veal - an immature veal calf, usually under 21 days of age.

Milk-fed Veal - meat from the carcass of very young calves which have been fed principally on milk with little or no grain or roughage ration.
Weaning

• dairy calves
  – Most weaning: at 2 to 3 days of age.
• Beef cattle
  – calves can be successfully weaned at 45 to 60 days of age, if sufficient nutrition and a high degree of management are provided.
  – More realistically, weaning at 120 to 150 days of age still allows ranchers to capitalize on many of the benefits of early weaning without many of the management difficulties associated with weaning at very young ages.


Calf

• grayish red to moderately red lean color
• flakier type of fat
• wider ribs with less red color

• 補充
• Age
  – > 5 month
  – Calf - a young prepuberty bovine of either sex. The lean meat is usually grayish red to moderately red in color.
• Meat
  – Deeper red
  – With some marbling and external fat

http://bovine.unl.edu/bovine3D/eng/glos.jsp?#K
• **Calf** - a young *prepuberty bovine* of either sex, The lean meat is usually grayish red to moderately red in color.

### Beef

• more advanced maturity
• moderately red in young beef carcasses to very dark red in mature beef carcasses
• flaky fat
• Flat ribs
• **Ossified cartilages in the lumbar and sacral regions**
<table>
<thead>
<tr>
<th>Different kinds of cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Lean color</td>
</tr>
<tr>
<td>Veal</td>
</tr>
<tr>
<td>grayish pink to dark grayish pink color</td>
</tr>
<tr>
<td>Calf</td>
</tr>
<tr>
<td>grayish red to moderately red lean color</td>
</tr>
<tr>
<td>Beef</td>
</tr>
<tr>
<td>moderately red in young beef carcasses to very dark red in mature beef carcasses</td>
</tr>
<tr>
<td>Lean texture</td>
</tr>
<tr>
<td>Veal</td>
</tr>
<tr>
<td>smooth and velvety texture</td>
</tr>
<tr>
<td>Calf</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Beef</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>fat</td>
</tr>
<tr>
<td>Veal</td>
</tr>
<tr>
<td>slightly soft, pliable fat</td>
</tr>
<tr>
<td>Calf</td>
</tr>
<tr>
<td>flakier type of fat</td>
</tr>
<tr>
<td>Beef</td>
</tr>
<tr>
<td>flaky fat</td>
</tr>
<tr>
<td>ribs</td>
</tr>
<tr>
<td>Veal</td>
</tr>
<tr>
<td>narrow and very red ribs</td>
</tr>
<tr>
<td>Calf</td>
</tr>
<tr>
<td>wider ribs with less red color</td>
</tr>
<tr>
<td>Beef</td>
</tr>
<tr>
<td>Flat ribs</td>
</tr>
<tr>
<td>Bone ossification</td>
</tr>
<tr>
<td>Veal</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Calf</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Beef</td>
</tr>
<tr>
<td>Ossified cartilages in the sacral and lumbar regions</td>
</tr>
</tbody>
</table>

**Determination of Class**

- Steer
- Bullock
- Bull
- Heifer
- Cow
- Calves and Veal
Determination of Class

• Steers
  – rough and irregular shaped fat deposit in the cod region
  – a relatively small pizzle eye
  – a relatively small pelvic cavity
  – a curved aitch bone

  – **Steer** - 1) a male *bovine* that was *castrated before reaching sexual maturity (puberty)*; (2) a carcass that does not exhibit secondary sex characteristics associated with bulls or bullocks.

Bullocks

• heavy development of rounds, noticeable crests, thickly fleshted chucks
• large pizzle eyes
• considerable external fat
• **rough and irregular shaped scrotal fat**
  – Vs. smooth fat deposit of the udder in heifers
• Darker, coarser lean texture vs. steers
  – But not as dark (coarse) as bulls
Bulls

- heavy development of rounds, crests, chucks
- large pizzle eyes
- external fat
  - Rough, irregular scrotal fat
- dark red and coarse textured lean
- more matured bone

- Bull vs. bullock: difference only on skeletal maturity
  - Bullock: A skeletal maturity
  - Bull: B or older maturity

- Bull: only yield grading, no quality grading  P106 Table 10.1

Heifers

- Smooth, uniform fat in the udder region
- no pizzle eye
- A slightly larger cavity
- A straighter aitch bone
- less heavily muscled
  - More angular than steers, especially in the round, loin, rib, and chuck areas
Cows

- relatively large pelvic cavity
- nearly straight aitch bone (pelvis to accommodate parturition, calving)
- Rather large udder (usually removed during slaughter)
  “Wet” – many years of lactation
- prominent hips
- Bones
  - Old cow, fused sacral vertebrae → one bone
  - Hard, white bone
  - cartilage associated with vertebrae and aitch bone
    completely ossified

Veal and Calves

- Carcasses also classified as steers, heifers, and bull
- But, not attained sexual maturity

- Evaluation
  - ribeye area
  - 12th rib fat thickness
  - %KPH
  - hot carcass wt
• **Heifer** - a female *bovine* that has not calved. Heifer carcasses exhibit slightly bent aitch bones, narrow pelvic cavities, and smooth udder fat, if present. Heifer and steer carcasses are not segregated for grading purposes.

• **Cow** - a female *bovine* that has given birth to at least one calf. The delivery of the calf causes the pelvic cavity to get larger and the aitch bone to be straighter than the pelvic cavities and aitch bones of heifers. The udders are normally removed from cow carcasses.

• **Bullock** - an uncastrated or latently castrated male *bovine*. In the carcass it is difficult to determine if the animal was an intact male at the time of slaughter. So, the secondary sex characteristics are used to differentiate between steers and bullocks. Bullocks must be in the A skeletal maturity group, otherwise, they are classified as bulls.

• **Bull** - (1) a live uncastrated male *bovine*; (2) a male *bovine* carcass in the B or older skeletal maturity group which exhibits masculine secondary sex characteristics.

• **Steer** - 1) a male *bovine* that was castrated before reaching sexual maturity (puberty); (2) a carcass that does not exhibit secondary sex characteristics associated with bulls or bullocks.
- "Kind" of beef carcass: Veal, Calf, Beef
- "Class" of beef carcass: Steer, bullock, heifer, cow, bull

<table>
<thead>
<tr>
<th>Market Kind and Class</th>
<th>Market Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slaughter cattle</td>
<td>Quality Grade</td>
</tr>
<tr>
<td>Steer</td>
<td>Prime, Choice, Select, Standard, Commercial, Utility, Cutter, Canner</td>
</tr>
<tr>
<td>Bullock</td>
<td>Prime, Choice, Select, Standard, Utility</td>
</tr>
<tr>
<td>Heifer</td>
<td>Prime, Choice, Select, Standard, Commercial, Utility, Cutter, Canner</td>
</tr>
<tr>
<td>Cow</td>
<td>Choice, Select, Standard, Commercial, Utility, Cutter, Canner</td>
</tr>
<tr>
<td>Bull</td>
<td>Not eligible for quality grade</td>
</tr>
</tbody>
</table>

Steel, heifer and bull: Prime, Choice, Good, Standard, Utility

Why? None

Slaughter calves

Steel, heifer and bull: Prime, Choice, Good, Standard, Utility

Why? None
Weight and Dressing Percentage

• Hot carcass weight
  – obtained on beef carcasses just before chilling
• chilled carcass weight
  – usually calculated from hot carcass weight

• Hot carcass weight is 1 to 2% higher than chilled carcass weight.

• Chilled carcass weight = Hot carcass weight x 0.985
  dressing percentage = Chilled carcass weight/ live weight x 100

Beef Carcass Grading

• U.S.D.A (U.S. Department of Agriculture) Agriculture Marketing Service

• Brief history
  – 1916 1st standard
  – 1927 official grading began (voluntary)
  – Updated regularly

• “Official United States Standards for Grades of Carcass Beef”
Ribbing

- Beef carcasses ribbed before being graded
- Cutting carcass btwn 12th and 13th rib
  - to expose ribeye muscle, marbling and fat thickness

- “Ribbing is the process of cutting one or both sides of the carcass between the 12th and 13th rib to expose the ribeye (longissimus) muscle, marbling, and fat thickness.”

- Beef carcasses must be ribbed before they can be graded

Blooming

- Meat cut surface

- myoglobin $\rightarrow$ oxygenated Mb
  - purplish red $\rightarrow$ bright red

- 30-45 min to reach maximum blooming for quality grading

- Notice:
  - “dark cutters”: some beef carcasses, ribbed color remains dark red to almost black
  - uncovered ribeye $\rightarrow$ dehydration
Dark cutting beef

- result from preharvest stress
- depletes muscle glycogen stores and thus reduces the glycogen needed to produce the lactic acid that reduces the pH of postmortem muscle.

- The abnormally high pH (>6.0) increases the light-absorption and water-binding abilities of postmortem muscle and results in an undesirable, dark, firm, and dry cut lean surface

- the stress factors that induce the condition
  - Weather, growth promotants, genetics, disposition, and handling practices before harvest

Beef Quality Grading (BQG)

- Based on
  - degree of marbling
  - degree of maturity
  - color, texture, firmness of lean in the ribeye muscle

- 8 grades
  - USDA Prime, Choice, Select, Standard, Commercial, Utility, Cutter, Canner
Marbling

- Marbling is the intermingling or dispersion of fat within the lean (intramuscular fat).

- estimated on the ribeye muscle cut surface at the 12th rib

- Degrees of marbling
  - abundant, moderately abundant, slightly abundant
  - moderate, modest
  - Small, slight
  - traces, practically devoid, devoid

- Moderate$^0$, moderate$^{50}$, moderate$^{100}$

• Intramuscular fat
  – deposited within the muscle in loose network of perimysial connective tissue in close proximity to blood vessels.

• Intermuscular fat
  – fat deposited between muscles.
Marbling (Con’t.)

- Amount of marbling in the eye muscle is divided into ten degrees:

1. Devoid 6. Modest
2. Practically devoid 7. Moderate
3. Traces 8. Slightly abundant
5. Small 10. Abundant

Marbling (Con’t.)

- Marbling
  - an indicator of eating quality
  - however, as it increases caloric content also increases.

  - Marbling is associated with length of time on feed, type of feed, and genetic capacity for laying down this fat deposit.

- Marbling ↑
- → eat quality ↑
- → but, calorie ↑
Marbling vs. feeding and genetic

- feeding longer, (or more) → marling ↑
- types of fed (concentrate)
- genetic
- Concentrate vs. roughage

Maturity

- Eating quality characteristics (tenderness, juiciness, and flavor) are related to animal age.

- Maturity: animal physiological age (not chronological age → most unknown)

- physiological age
  - estimation of chronological age
  - including
    - bone characteristics
    - cartilage ossification
    - ribeye muscle color and texture
When age increasing

- Cartilage ossification (becoming bones)
- Bone whitening (becoming harder, flinty-like and white)
- Lean color darker (myoglobin accumulation)
- Coarser texture (muscle fiber increasing in size)

Physiological age VS. chronological age

- Better indicator of bone, cartilage and muscle maturation characteristics, why?

- At the same chronological age
- Bones, cartilage and muscle characteristics
- Older vs. younger
- Heifer > steer > bullock
Maturity of each class of slaughter cattle eligible for each quality grade

<table>
<thead>
<tr>
<th>US Grade</th>
<th>Class and Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bullock</td>
</tr>
<tr>
<td>Prime</td>
<td>A</td>
</tr>
<tr>
<td>Choice</td>
<td>A</td>
</tr>
<tr>
<td>Select</td>
<td>A</td>
</tr>
<tr>
<td>Standard</td>
<td>A</td>
</tr>
<tr>
<td>Commercial</td>
<td>—</td>
</tr>
<tr>
<td>Utility</td>
<td>A</td>
</tr>
<tr>
<td>Cutter</td>
<td>—</td>
</tr>
<tr>
<td>Canner</td>
<td>—</td>
</tr>
</tbody>
</table>

• Maturity
  – ABCDE
  – A: Younger
  – E: Older
  – CDE “hard bone”

• \( A^0, A^{10}, A^{20}, \ldots, A^{100} \)
  – \( A^0 \)--younger
  – \( A^{100} \)--older
### Chronological age vs. Maturity

<table>
<thead>
<tr>
<th>Month</th>
<th>Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>A&lt;sup&gt;0&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>A&lt;sup&gt;50&lt;/sup&gt;</td>
</tr>
<tr>
<td>30</td>
<td>A&lt;sup&gt;100&lt;/sup&gt; = B&lt;sup&gt;0&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>B&lt;sup&gt;50&lt;/sup&gt;</td>
</tr>
<tr>
<td>42</td>
<td>B&lt;sup&gt;100&lt;/sup&gt; = C&lt;sup&gt;0&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>C&lt;sup&gt;50&lt;/sup&gt;</td>
</tr>
<tr>
<td>72</td>
<td>C&lt;sup&gt;100&lt;/sup&gt; = D&lt;sup&gt;0&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>D&lt;sup&gt;50&lt;/sup&gt;</td>
</tr>
<tr>
<td>96</td>
<td>D&lt;sup&gt;100&lt;/sup&gt; = E&lt;sup&gt;0&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

- **Cow:** not eligible for US Prime
- **Bullock must in A maturity**
  - If not in A → bull
  - no quality grade
Beef Quality Grading (Con’t.)

• Maturity Con’t. (bone ossification)
  – There are five maturity groups and they are designated by the letters A, B, C, D, and E.
    • A and B maturities are from young cattle and carcasses from mature cattle are designated C, D, and E.
    • Because of ossification that has occurred in the bones and cartilage, these C, D, and E maturity carcasses are called “hard boned.”

p.113

• Ossification process
  – Not occur simultaneously
    – Posterior-anterior progression
      • Begins in the sacral region, lumbar, thoracic, and cervical vertebrae P. 114
      • Fig 10.13, P.118
      • “Buttons” start to ossify at 30 months of age
        – P113 Fig. 10.5
### Beef carcass skeletal characteristics vs. maturity

- P. 119, Table 10.3

<table>
<thead>
<tr>
<th>級別</th>
<th>骨質</th>
<th>脊椎骨上之軟骨尖</th>
<th>骨氐骨</th>
<th>腰椎骨之軟骨尖</th>
<th>瘦肉顏色</th>
</tr>
</thead>
<tbody>
<tr>
<td>A級</td>
<td>脊骨（即脊椎骨本身）：軟而色紅且多孔。</td>
<td>胸椎骨上之軟骨尖：軟而色白且肋骨小而趨於圓形。</td>
<td>骨氐骨：僅部份融合。</td>
<td>腰椎骨上之軟骨尖：僅稍許骨化（硬化成骨）。</td>
<td>瘦肉顏色：鮮艷。</td>
</tr>
<tr>
<td>B級</td>
<td>脊骨：輕微硬化，僅略帶紅色。</td>
<td>胸椎骨上之軟骨尖：輕微骨化。</td>
<td>骨氐骨：完全融合。</td>
<td>腰椎骨上之軟骨尖：完全骨化。</td>
<td>瘦肉顏色：鮮艷。</td>
</tr>
<tr>
<td>C級</td>
<td>脊骨：顏色頗白。</td>
<td>胸椎骨上之軟骨尖：幾乎完全骨化。</td>
<td>骨氐骨：完全融合。</td>
<td>腰椎骨上之軟骨尖：完全骨化。</td>
<td>瘦肉顏色：較A級及B級之顏色深暗些。</td>
</tr>
<tr>
<td>D級</td>
<td>脊骨：色白而堅硬。</td>
<td>胸椎骨上之軟骨尖：完全骨化，且只有少許此類軟骨尖之輪廓殘存，肋骨平坦，色白且相當寬大。</td>
<td>骨氐骨：完全融合。</td>
<td>腰椎骨上之軟骨尖：完全骨化，且軟骨尖的輪廓完全消失。</td>
<td>瘦肉顏色：暗紅色。</td>
</tr>
<tr>
<td>E級</td>
<td>脊骨：色白而極堅硬，屠體相當成熟。</td>
<td>胸椎骨上之軟骨尖：完全骨化。</td>
<td>骨氐骨：完全融合。</td>
<td>腰椎骨上之軟骨尖：完全骨化，且軟骨尖的輪廓完全消失。</td>
<td>瘦肉顏色：暗紅色。</td>
</tr>
</tbody>
</table>
• At 42 months of age (which maturity ?)
  – Cartilage (esp. dorsal edge of thoracic vertebrae) starts to ossify extensively
  – **Connective tissue cross-linkage** ↑ (C₀ maturity)
  – Increasing toughness
  – < 42 months (A, B maturity) → legible for USDA Prime, Choice, Select & Standard → “**block beef**” (roasts and steaks)
  – Other quality grades → used in processed products
Beef Quality Grading (Con’t.)

- Maturity Con’t.
  - **Color of lean** becomes darker due to accumulation of myoglobin and texture becomes coarser with age.

Beef Yield Grading

- A numerical values from 1 to 5
- Based upon the yield of boneless, closely trimmed (appro. 0.3 in. = 0.76 cm) retail cuts from the round, loin, rib, and chuck (RLRC).
  - 75% of wt of carcass
  - 90% carcass value why?

<table>
<thead>
<tr>
<th>Parts</th>
<th>Wt %</th>
<th>Value %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round</td>
<td>23</td>
<td>29</td>
</tr>
<tr>
<td>Loin</td>
<td>17</td>
<td>29</td>
</tr>
<tr>
<td>rib</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>chuck</td>
<td>26</td>
<td>21</td>
</tr>
<tr>
<td>Other parts (brisket, foreshank, plate…)</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
Beef Yield Grade

• Range: 1.0 to 5.9
• 3.0-3.9 → YG 3

• Factors influencing BYG (carcass cutability)
  – Fat thickness at the 12th rib
  – Ribeye area
  – Hot carcass wt
  – % KPH

• Regression equation
  – YG = 2.5 + (2.5 × adjusted fat thickness, 12th rib)
    + (0.0038 × hot carcass wt)
    + (0.2 × % KPH)
    - (0.32 × ribeye area)

  – % retail cuts = 51.34
    - (5.78 × adjusted fat thickness, 12th rib)
    - (0.0093 × hot carcass wt)
    - (0.462 × % KPH)
    + (0.740 × ribeye area)
<table>
<thead>
<tr>
<th>Yield Grade</th>
<th>% Retail cuts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>54.6</td>
</tr>
<tr>
<td>1.1</td>
<td>54.4</td>
</tr>
<tr>
<td>1.9</td>
<td>52.6</td>
</tr>
<tr>
<td>2.0</td>
<td>52.3</td>
</tr>
<tr>
<td>3.0</td>
<td>50.0</td>
</tr>
<tr>
<td>4.0</td>
<td>47.7</td>
</tr>
<tr>
<td>5.0</td>
<td>45.4</td>
</tr>
<tr>
<td>5.9</td>
<td>43.3</td>
</tr>
</tbody>
</table>

**Beef Yield Grade**

- **Regression equation**
  - Not used in actual daily YG
  - 4 Factors influencing BYG (carcass cutability)
    - Fat thickness at the 12th rib
      - Average of 3 pts or a single measurement
        » How to do?
        » Why?
        » Sometimes, adjusted, why? How?
    - Ribeye area
      - How to do?
      - Why choose this method?
      » Not overestimate?
    - Hot carcass wt
      - Shroud? P.125
    - %KPH
      - 0.5-6% (avg 3%) Fig. 10.19, P.126
Veal and Calf quality grading evaluation

- Beef → quality and yield grading
- Bull → yield grading only (no quality grade, why?)
- veal, calf → quality grading only (no yield grade, why?)

- Veal and calf QG
  - Evaluation of “Conformation” and “Quality”

Veal and calf quality grade

- **Conformation**
  - An evaluation of the fleshing of the carcass
  - Comparison
    - Superior vs. (inferior):
      - a high proportion of meat to bone
      - A high proportion of the wt of the carcass in the more valuable parts
      - Thickly fleshed
      - Full and thick in relation to the length
      - Have a plump, well-rounded appearance (a very angular, thin, and sunken appearance)
Veal and calf quality grade

• Quality
  – Usually evaluated in the unribbed carcass
  – Based on
    • Amount of feathering between ribs
    • Amount of flank muscle fat streakings

• others
• Lean firmness
• Distribution of feathering
• The amount of fat covering on the diaphragm (skirt)
• The amount and character of the external and kidney and pelvic fat

Feathering

• fat intermingled within the lean (intercostal muscles) between ribs

• 9 grades

• moderately abundant, slightly abundant, abundant
• Moderate, modest
• Small, slight
• Traces, practically none

P. 120
Marbling vs. Feathering & fat streaking

- 1 級富量 (abundant)
- 2 級多量 (moderately abundant)
- 3 級次多量 (slightly abundant)
- 4 級中量 (moderate)
- 5 級普通量 (modest)
- 6 級少量 (small)
- 7 級微量 (slight)
- 8 級稀量 (traces)
- 9 級 幾乎全無 (practically devoid)
- 10 級 全無 (devoid)

- moderately abundant
- slightly abundant
- moderate
- modest
- small
- slight
- traces
- practically none

P. 130

- Fig. 10.25
- Feathering and flank fat streakings vs. lean color (veal), maturity (calf)

- Color darkness ↑, maturity ↑ → need more feathering & flank fat streakings (why?)
• Other considerations
  – Lean firmness
  – Feathering distribution
  – Fat at diaphragm
  – KPH

Beef vs. Veal & Calf

• 極佳級 (U.S. Prime)
• 特選級 (U.S. Choice)
• 可選級 (U.S. Select)
• 合格級 (U.S. Standard)
• 商用級 (U.S. Commercial)
• 可用級 (U.S. Utility)
• 切塊級 (U.S. Cutter)
• 製罐級 (U.S. Canner)
• U.S. Prime
• U.S. Choice
• U.S. Good
• U.S. Standard
• U.S. Utility