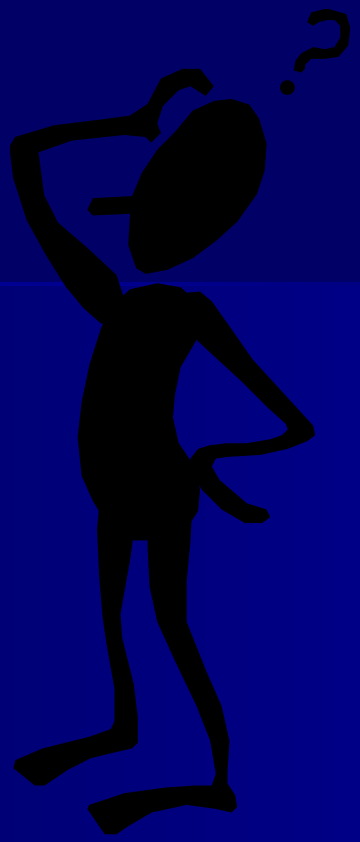
Antibiotic Treatment of Morbid Animals and its Effect on Meat Quality

2008 RMC



Not an Expert!

Hypothesis?

- Livestock that experience sickness during growing will have carcasses with less marbling and tougher meat.
- Two questions
  - Does morbidity affect meat quality?
  - Does antibiotic treatment of morbid animals positively affect meat quality?

Definitions

- Antibiotic
  - A drug or chemical administered to an animal to fight an acute bacterial infection
- Morbid Animal
  - An animal that is showing signs of disease process including fever, anorexia, or depression

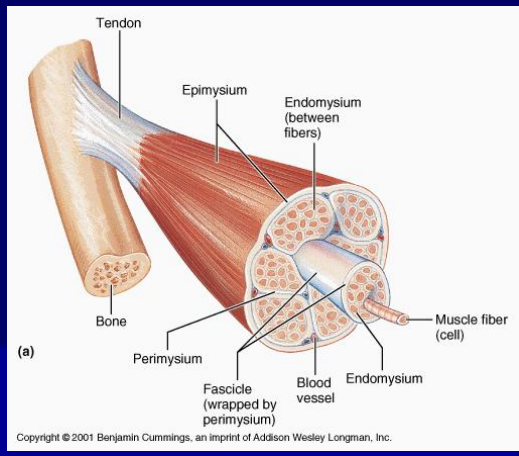
Definition - Meat Quality

- Meat Quality (related to demand!)
- Visual Appraisal
  - Color
  - Marbling
  - Trimness
- Palatability

Meat Palatability

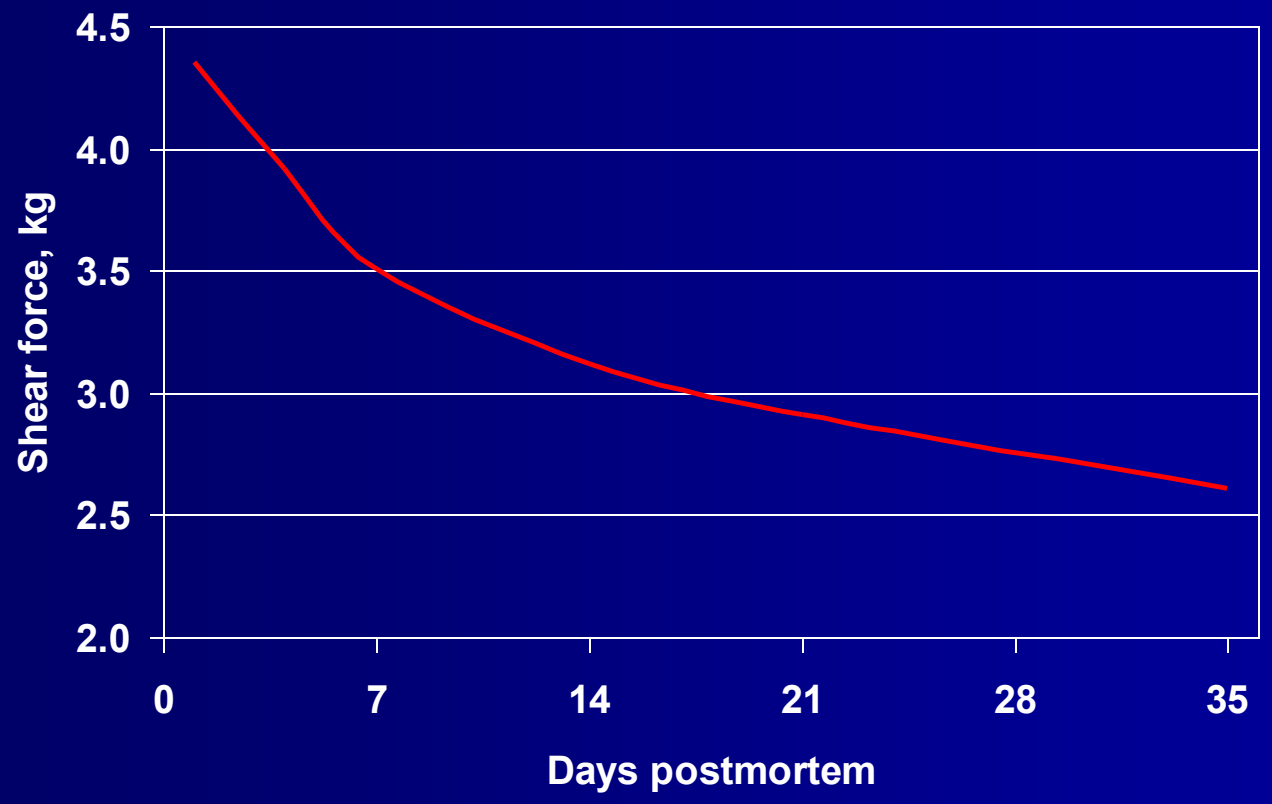
- Tenderness
  - Contributes 50% of the variation in consumer ratings of overall desirability
- Juiciness
  - 10% contribution
- Flavor
  - 40% contribution

Three factors in tenderness

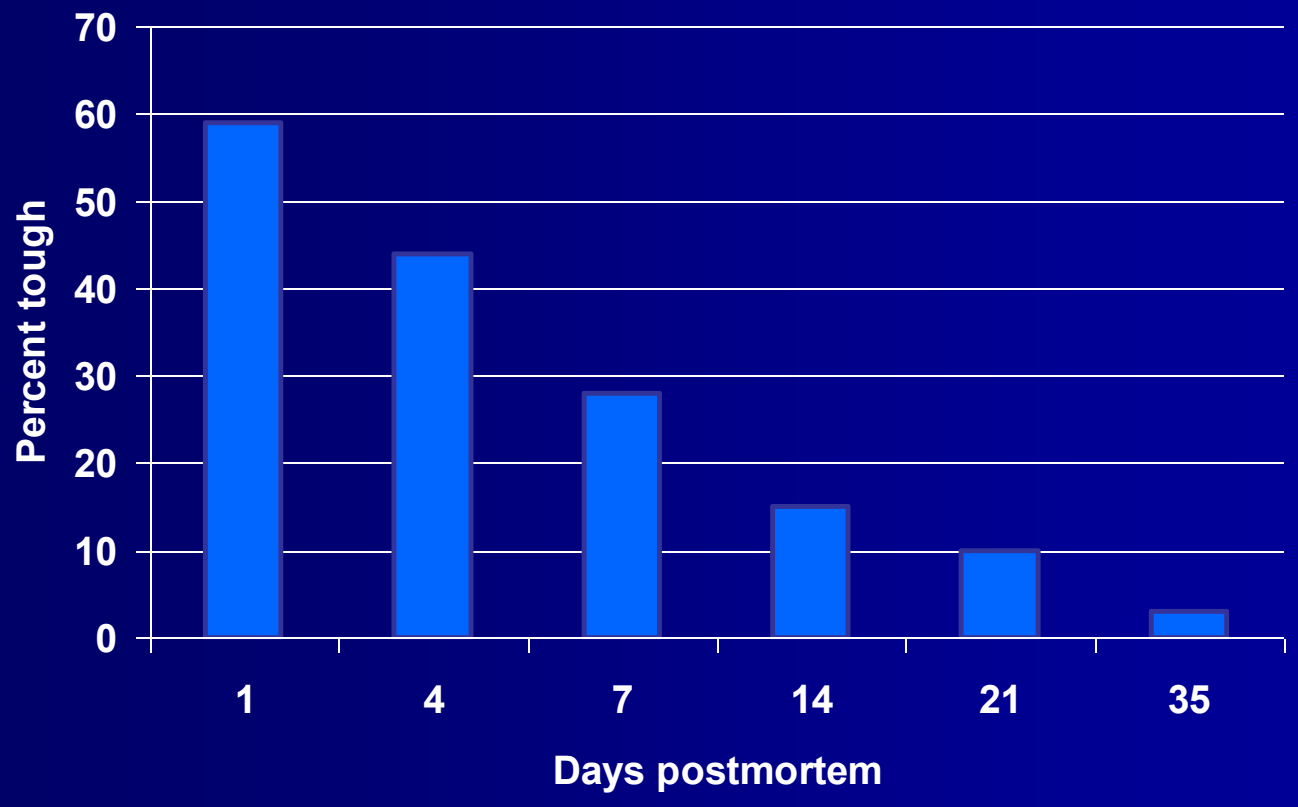


- Background
  - Connective tissue amount and type
- Compositional
  - % Fat and water
- Structural
  - Sarcomere length
- Protein
  - Integrity of contractile proteins

Aging and Beef Tenderness

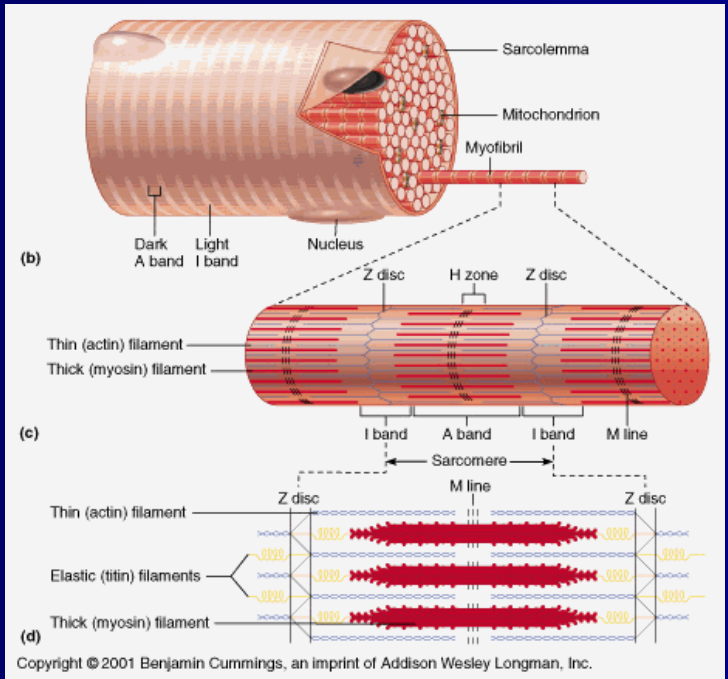


Aging and Beef Tenderness



What causes meat tenderization during aging?

- Calpains
  - Calcium activated enzymes that degrade structure of contractile proteins



The major concerns

- Beef carcasses with higher USDA Quality Grades (Prime and Choice) are more valuable, but the percentage of high grading carcasses has declined.
- Tenderness is the most important factor determining consumer acceptance of beef.

Two different, but related issues to investigate

- Impact of animal health on intramuscular fat accretion
  - Marbling
- Impact of animal health on meat tenderness
  - Calpain Activity affected by ioinc strength and oxidation (Maddock et al., 2005)

Previous Work (limited)

- Gardner et al., 1999
- Single source of feeder calves into a commercial yard
- Tracked for morbidity
- Evaluated at slaughter for lung lesions

Gardner, et al., 1999

Trait	Times treated for respiratory disease			SE
	0	1	>1	
No. of steers	102	89	13	
Initial wt, kg	293.2	287.6	293.2	5.23
Final wt, kg	523.2	512.9	497.9	7.19
ADG, kg/d	1.53	1.49	1.35	.04
Dressing percentage	63.5	63.7	62.6	.35
Hot carcass wt (HCW), kg	332.2	326.6	311.8	4.80
Fat thickness, cm	1.17	1.09	.76	.06
Longissimus muscle area (LMA), cm^2	86.0	85.0	82.5	1.46
LMA/100 kg HCW	25.9	26.1	26.7	.41
Internal fat (KPH), %	2.3	2.3	1.9	.07
Yield grade	2.6	2.6	2.2	.11
Maturity score[b]				
Skeletal	142.8	144.9	151.5	3.26
Lean	139.4	134.4	129.2	3.64
Overall	141.1	139.7	140.4	2.61
Marbling score[c]	337.5	336.0	317.7	7.23
Quality grade				
Choice, %	4.9	4.5	.0	
Select, %	82.4	83.2	76.9	
Standard, %	12.8	12.4	23.1	
Yield grade				
1, %	13.7	19.1	38.5	
2, %	58.8	62.9	46.2	
3, %	26.5	18.0	15.4	
4, %	1.0	.0	.0	

Gardner et al., 1999

Trait	Respiratory tract lesion[a]			SE
	None	Inactive	Active	
No. of steers	117	78	9	
Initial wt, kg	289.4	290.0	315.0	6.00
Final wt, kg	526.5	505.5	495.4	8.06
ADG, kg/d	1.58	1.43	1.17	.04
Dressing percentage	63.6	63.6	61.8	.40
Hot carcass wt (HCW), kg	334.8	321.5	306.9	5.44
Fat thickness, cm	1.15	1.06	1.04	.08
Longissimus muscle area (LMA), cm^2	86.6	83.4	85.2	1.68
LMA/100 kg HCW	25.9	26.0	27.9	.47
Internal fat (KPH), %	2.3	2.2	2.0	.08
Yield grade	2.6	2.5	2.4	.12
Maturity score[c]				
Skeletal	144.1	145.1	140.0	3.81
Lean	139.0	132.7	138.9	4.23
Overall	141.5	138.9	139.4	3.03
Marbling score[d]	340.1	332.6	303.3	8.89
Quality grade				
Choice, %	5.1	3.8	.0	
Select, %	86.3	78.2	66.7	
Standard, %	8.6	18.0	33.3	
Yield grade				
1, %	15.4	20.5	22.2	
2, %	59.0	60.3	66.7	
3, %	25.6	18.0	11.1	
4, %	.0	1.3	.0	

Gardner et al., 1999

Trait	Times treated for respiratory disease			SE
	0	1	>1	
No. of steaks	102	89	13	
Shear force, kg				
7 d	3.6	3.8	3.7	.12
14 d	3.1	3.1	2.9	.08
21 d	2.8	2.9	3.0	.07
< 3.84 kg, %				
7 d	68.6	59.6	62.2	
14 d	89.2	95.5	100.0	
21 d	100.0	98.9	100.0	
> 4.5 kg, %				
7 d	9.8	14.6	7.7	
14 d	.0	1.1	.0	
21 d	.0	1.1	.0	

Trait	Respiratory tract lesion[a]			SE
	None	Inactive	Active	
No. of steaks	117	78	9	
Shear force, kg				
7 d	3.6	3.8	4.0	.14
14 d	3.1	3.1	3.2	.10
21 d	2.8	2.9	3.0	.08
< 3.84 kg, %				
7 d	68.4	60.3	55.6	
14 d	94.0	89.7	100.0	
21 d	100.0	98.7	100.0	
> 4.5 kg, %				
7 d	10.3	12.8	22.2	
14 d	.0	1.3	.0	
21 d	.0	1.3	.0	

Effect of Treatment

- Some animals that had lesions were never treated, some treated animals had no evidence of lesions
- One treatment for BRD did not result in altered carcass or meat quality.

Snowder et al., 2007

- Review of MARC feedlot data
- Larger study
- Also a survey

Snowder et al., 2007

Table 2. Number of calves and unadjusted means (±SD) for growth, carcass, and LM palatability traits by health classification[1] and overall

	HEALTHY		BRD		Overall	
Trait[2]	No. of calves	Mean	No. of calves	Mean	No. of calves	Mean
ADG, kg	14,970	1.00 ± 0.30	2,966	1.02 ± 0.30	17,936	1.00 ± 0.30
HCW, kg	1,014	337 ± 40	612	330 ± 41	1,626	334 ± 40
Adjusted carcass fat, cm	1,014	0.68 ± 0.45	612	0.63 ± 0.43	1,626	0.66 ± 0.45
Marbling score	1,015	499 ± 70	612	490 ± 71	1,627	495 ± 71
REA, cm^2	1,015	79.0 ± 10.5	611	78.0 ± 10.3	1,626	78.7 ± 10.4
KPH fat, %	1,015	2.8 ± 0.7	612	2.7 ± 0.7	1,627	2.8 ± 0.7
Retail product, kg	980	211 ± 28	585	208 ± 28	1,565	210 ± 28
Retail product, %	980	65.8 ± 5.2	585	66.3 ± 5.2	1,565	66.0 ± 5.2
Fat trim wt, kg	980	61.7 ± 21.9	585	57.6 ± 21.1	1,565	60.1 ± 21.7
Fat trim, %	980	19.1 ± 6.0	585	18.3 ± 6.0	1,565	18.8 ± 6.0
Fat in ribs, %	980	33.2 ± 7.5	587	32.9 ± 7.6	1,567	33.1 ± 7.6
Fat in LM palat, %	980	4.0 ± 1.4	588	3.8 ± 1.3	1,568	3.9 ± 1.3
Bone wt, kg	981	48.3 ± 6.2	585	48.2 ± 6.7	1,569	48.3 ± 6.4
Bone, %	980	15.1 ± 1.4	585	15.4 ± 1.5	1,565	15.2 ± 1.4
Shear force, kg	981	5.1 ± 1.2	588	5.2 ± 1.3	1,569	5.2 ± 1.3
Tenderness score	981	5.0 ± 0.7	588	5.0 ± 0.7	1,569	5.0 ± 0.7
Juiciness score	981	5.2 ± 0.5	588	5.2 ± 0.5	1,569	5.2 ± 0.5
Flavor score	981	4.9 ± 0.4	588	4.9 ± 0.4	1,569	4.9 ± 0.4

Snowder et al., 2007

Table 3. Number of calves and unadjusted means (±SD) for growth, carcass, and LM palatability traits of calves treated for bovine respiratory disease by days-on-feed-when-treated group[1]

	EARLY		MID		LATE	
Trait[2]	No. of calves	Mean	No. of calves	Mean	No. of calves	Mean
ADG, kg	1,724	0.98 ± 0.30	914	1.08 ± 0.29	440	1.05 ± 0.32
HCW, kg	217	327 ± 41	304	330 ± 42	91	339 ± 37
Adjusted carcass fat, cm	217	0.60 ± 0.41	304	0.67 ± 0.45	91	0.56 ± 0.43
Marbling score	217	4.92 ± 78	304	4.89 ± 68	91	4.86 ± 67
REA, cm^2	217	77.3 ± 9.9	303	77.9 ± 10.6	91	80.5 ± 9.9
KPH fat, %	217	2.7 ± 0.7	304	2.8 ± 0.7	91	2.7 ± 0.6
Retail product, kg	203	204 ± 26	294	207 ± 30	88	216 ± 24
Retail product, %	203	66.1 ± 5.3	294	66.2 ± 5.3	88	67.2 ± 4.5
Fat trim wt, kg	203	57.6 ± 21.9	294	58.3 ± 21.2	88	55.4 ± 19.0
Fat trim, %	203	18.4 ± 6.2	294	18.5 ± 6.1	88	17.0 ± 5.2
Fat in ribs, %	204	32.8 ± 7.7	295	33.4 ± 7.9	88	32.1 ± 6.3
Fat in LM palat, %	204	3.8 ± 1.4	296	3.6 ± 1.1	88	3.8 ± 1.4
Bone wt, kg	204	47.9 ± 6.3	296	47.8 ± 6.8	88	50.5 ± 6.6
Bone, %	203	15.5 ± 1.5	294	15.3 ± 1.4	88	15.7 ± 1.5
Shear force, kg	204	5.2 ± 1.4	296	5.2 ± 1.3	88	5.3 ± 1.4
Tenderness score	204	5.1 ± 0.8	296	5.1 ± 0.7	88	4.8 ± 0.8
Juiciness score	204	5.2 ± 0.5	296	5.2 ± 0.4	88	5.1 ± 0.5
Flavor score	204	4.9 ± 0.4	296	4.9 ± 0.4	88	5.0 ± 0.4

Effect of Treatment

- Essentially no effect of treatment for BRD on carcass or meat quality!

Stovall et al., 2000 (OK State Feedout)

Trait	No antibiotics	1 Treatment	2 Treatments
n	146	221	39
In weight, lbs	554	555	541
ADG	2.83	2.85	2.90
HCW	705	705	702
MARB (300 = Small 0)	288	266	249
YG	2.5	2.4	2.4
% Choice	66	59	41

R. L. Larson, 2005

- Review paper found BRD and other disease in feedlot cattle likely affected:
  - Carcass weight
  - Longissimus muscle area
  - Marbling
  - Tenderness?

Larson, 2005

- Attributed changes in carcass/meat quality to:
  - Metabolic effects (cortisol and cytokines)
  - Anorexia caused metabolic disruption
  - Fewer “effective” days on feed due to cattle not eating when sick

Questions

- Metabolic change due to morbidity that is lessened or altered due to antibiotic treatment?
- Anorexia simply lead to less “effective” days on feed

Conclusions

- Limited data on the relationship between animal health and carcass/meat quality
- Treatment may or may not affect meat quality attributes
- Production issues are certainly affected by animal health