The Value of Marbling in Consumer Acceptance of Beef

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- In a 2004 Australian Journal of Experimental Agriculture, Professor B.M. Bindon, CEO of CSIRO Cooperative Research Centre for Cattle and Beef Quality, stated:
  - "Marbling is the most emotive word in the vocabulary of beef producers, beef processors, feedlotters and meat scientists"

  and
  - "…ask for a comment and you will receive a point of view that either extols the virtues of this trait or alternatively tries to discount totally the idea marbling is linked to beef quality."

- In a later statement relating marbling to the Australian export market, Professor Bindon stated:
  - "In the modern Australian beef sector, marbling is of unquestioned significance."

- I find this all very interesting because in preparing the body of scientific literature used to form this presentation, there is very little debate in the virtues, role or importance that marbling plays in overall beef palatability

Today, this presentation will review

- The role marbling has in beef palatability
- The economic importance of marbling in global beef trade
- Research needs related to marbling
- As a beef marketing company (brand) built on the attributes marbling offers the beef consumer, what we ( ) see as future

- Nearly all beef scientists and connoisseurs of beef indicate there are three key attributes to beef palatability
  - Tenderness
  - Juiciness
  - Flavor

Tenderness is clearly a threshold trait

- When not met, it becomes the most important single palatability attribute
- Researchers have clearly defined the threshold level at which most consumers are satisfied
- Most will also argue that the beef industry has made great progress in improving or understanding tenderness issues
  - Especially the great success achieved by the recent Check-off funded muscle profiting research

So what role does marbling have in beef tenderness?

- Herein may lie some of the emotive basis of marbling's role as the common perception in the meat production/meat processing/foodservice industries is higher marbling gives rise to more tender beef (Thompson, 2004)
- In an excellent literature review by Dikeman (1996), he concluded that the relationship between marbling and tenderness was low and variable

So what role does marbling have in beef tenderness?

- Research results suggest that marbling accounts for about 8-18% of the variation in beef tenderness
- How might that occur?
  - Millar (1994) stated "a higher percentage of IM fat simply results in a lower density steak which requires less resistance to bite through"

and

  - "The deposition of marbling in the perivascular cells of connective tissue" may also be beneficial (Millar, 1994)

- The association of marbling and juiciness is more clearly defined
  - Research has shown that higher fat levels in marbled meat stimulates salivation and gives the perception of increased juiciness of meat while chewing

- More and more recent studies clearly suggest that flavor is the ultimate driver of beef demand
  - Beef is blessed to be a flavor the consumer craves

The literature clearly states the role of beef flavor

- In a large multi-city study, flavor was the most important factor affecting consumer meat buying preference when tenderness was held constant (Sitz et al., 2005)
- In a three-city study, Texas Tech meat scientists (Felderhoff et al., 2007) found flavor was 2½ times as important as tenderness in consumer acceptability
- Huffman et al. (1996) found flavor had a stronger relationship (R^2=.67) to overall steak palatability ratings than any other factor when consumers prepared meat at home

The literature clearly states the role of beef flavor

- Platter et al. (2003) determined that small changes in sensory ratings of flavor greatly influenced the overall acceptability of steaks
- Even for chuck cuts like the clod, flavor had the largest simple correlation (.86) to overall ratings

- In an excellent recent review of beef flavor by Calkins and Hodgen (2007), they clearly stated that beef flavor is a very complex palatability attribute influenced by literally hundreds of compounds

- The unique and widely accepted, even craved, flavor of U.S. grain-fed beef is directly associated with at least 80-90 days on a high concentrate diet
  - A flavor now desired by beef consumers worldwide

- As previously stated, beef flavor is influenced by many factors, but research clearly links IM fat and flavor
  - Miller et al. (2000) stated "As IM fat increases, the fat flavor increases which is preferred by most U.S. consumers"
  - Miller (2001) stated the minimal level of IM fat is approximately 3% — above 7.3% in meat may have a negative effect
  - Smith et al. (1983) suggested an upper limit of 10.5% and Savell et al. (1986) suggested 12%

- If the marbling/flavor relationship exists, then the USDA quality grades should reflect consumers' preferences
  - In 1926, USDA adopted the quality grading system based primarily on age and marbling levels
  - Today, about 97-98% of the 26-28 million fed cattle have a quality grade score applied to each carcass
  - As early as 1951, Melton reported in an ASAS abstract that consumer acceptance of grain-fed beef was improved as reflected by USDA quality grades

  - Smith et al. (1983) stated "There is a linear decrease in flavor desirability as quality grade went from USDA Prime through USDA cutter"
  - Since then, numerous excellent studies have shown the same results

Summary of three studies

USDA Quality Grade	Unpleasant dining experience Ratio	%	Updated Version
Prime	1 in 33	3%	0%
Premium Choice	1 in 10	10%	2%
Low Choice	1 in 6	16%	8%
Select	1 in 4	25%	17%
Standard	1 in 2	50%	-

Source: Smith et al., 1992; Huffins et al., 1993; and George et al., 1997

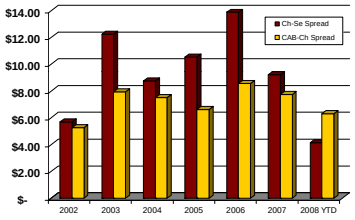
Marbling – As related to dietary health

- Obviously, most of what you read in the popular press or in dietary guidelines tout the merits of "lean" beef
- Some very interesting recent research by Dr. Steve Smith and co-workers (2007) has shown
  - That the fatty acid profile of IM fat is dramatically different than SQ fat
  - IM fat is high in oleic acid, which means harmful saturated and trans-fatty acids
  - His data showed that Select ground beef had the worst ratio of healthy monosaturated to saturated fatty acids (.75) than Prime (1.33) because of the marbling effect

Marbling's economic value

- Is there an economic value associated with higher quality grades and marbling levels?
  - From 1960 to the late 1990's, the Choice-Select spread was $2-4/cwt carcass
  - Prime premiums existed
  - Few cattle were sold on grids

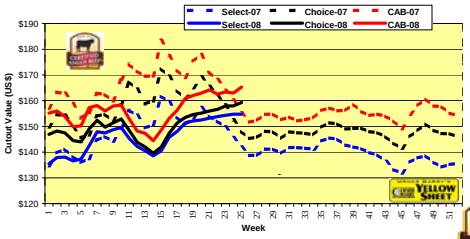
- In the last ten years, driven by the consumers desire for enhanced beef quality, market differentiation has developed



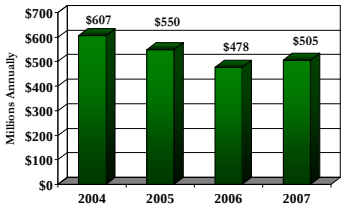
Source: Urner Barry, 2008 YTD through May

- Today, over 40% of all fed cattle are marketed on grids where some level of premium exists for quality grade
- Forrestall et al. (2002) stated "No factor is more important in beef grid marketing than quality grade."

- In 2002, Urner-Barry purchased the "Yellow Sheet" and started reporting a CAB®-Low Choice spread

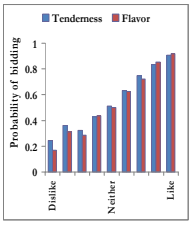


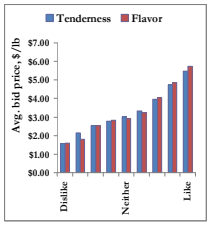
- Cattle-Fax (Blach, 2007) reported over $500 million per year is paid for Premium Choice/Prime



Approximately $20/head

The connection between beef's taste attributes and purchasing behavior





If beef tastes great, people not only are more likely to buy it, but also will pay more for it.

Source: Platter, 2003

Marbling research

- Thousands of research studies have clearly shown the numerous factors that influence marbling levels
  - Genetics
  - Nutrition
  - Health
  - Age
  - Disposition
  - Breed
  - Feedstuff
  - Carcass composition endpoint
  - Environment
  - Implants
  - Beta agonist II
  - Weaning Age
  - Creep feeding

Want to single one out? – Compositional endpoint

	Calves				Yearlings			
	.4	.5	.6	.7	.4	.5	.6	.7
Prime	0.13	0.02	0.10	0.21	0.08	0.04	0.04	0.08
Premium Choice	18.73	26.54	28.74	36.05	16.50	22.83	29.44	28.05
Low Choice	44.28	46.06	46.68	43.43	41.02	43.46	43.37	45.45
Select	35.60	26.89	24.24	20.07	41.44	33.08	26.95	26.11
Standard	1.25	0.49	0.24	0.25	0.96	0.58	0.20	0.31
% YG 4 and 5	0.36	2.50	12.92	38.24	0.17	1.39	6.64	26.18

I would argue there have been three major technological advances (as related to products) in the past 50 years

Technology	Data Implemented	Effect on Marbling
Implants	Late 1950's	Slight to extensive negative effect
Ionophores	Early 1970's	No effect
Beta agonists	Early 2000	Beta I – Limited effect Beta II – extensive negative effect

Research perspective: What is amazing is what is not known

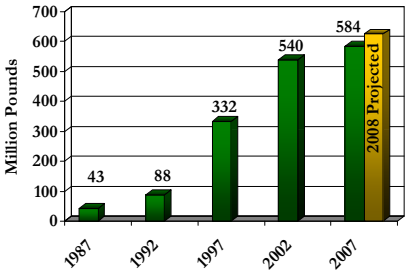
- The mechanism in which these management factors affect marbling
- The early cellular differentiation process in which marbling is formed
- The cellular mechanism in which genetic selection affects marbling levels
- The poor understanding of beef flavor

Certified Angus Beef LLC overview

- Certified Angus Beef LLC was founded on the principle of using research-based quality specifications to drive consumer acceptance
  - In 1978, an Ohio State meat scientist, Dr. Bob VanStavern, developed the eight specifications for the first U.S. beef brand

with modest marbling being the key quality foundation spec

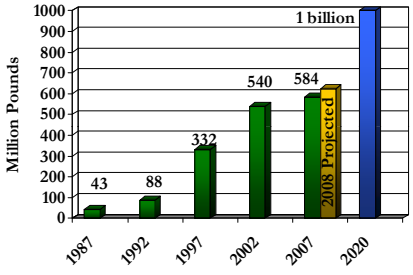
Since then…



CAB's Fiscal Year is October-September

Fiscal Year

Where we can get to



CAB's Fiscal Year is October-September

Fiscal Year

Our greatest limitation…

- Cattle not achieving modest levels of marbling
  - We identify over 13 million cattle
  - About 2.2 million qualify or about 17%

The opportunity for our industry is great

	Ideal	Actual
Prime	7	2
Top Choice	29	19
Select	31	38
Standard	0	6

"We are leaving $26.81 on the table in lost quality."

Source: 2005 NCBA Quality Audit

Summary

As research progress continues to refine methods for monitoring tenderness levels, including DNA marker assisted EPDs for genetic selection,…

the ultimate driver for beef demand will be flavor

Summary

…and then the "emotive" discussions involving the role of marbling will be significantly ($P<.05$) reduced

Brief summary of key literature citations

- Bindon, B.M. 2004. A review of genetic and non-genetic opportunities for manipulation of marbling. Australian J. of Exp. Agric. 44:686-696.
- Blach, R. 2007. Economic impact of Premium Choice on prices received by beef producers. Cattle-Fax special report.
- Calkin, C.R. and J.M. Hodgen. 2007. A fresh look at meat flavor. Meat Science 77:63-80.
- Dikeman, M.E. 1996. The relationship of animal leanness to meat tenderness. RMC 49:87-101.
- Felderhoff, C.A., C.P. Lyford, J. Malaga, D.D. Harris, J.C. Brooks, J.M. Mehaffey, R. Polkinghorne, and M.F. Miller. 2007. National consumer survey reveals beef flavor is the most important trait affecting satisfaction. Proc. 60th Annual Reciprocal Meat Conference.

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- Goodson, K.J., W.W. Morgan, J.O. Reagan, B.L. Gwartney, S.M. Courington, J.W. Wise, and J.W. Savell. 2002. Beef customer satisfaction: factors affecting consumer evaluations of clod steaks. J. Anim. Sci. 80:401-408.
- Forristall, C., G.J. May, and J.D. Lawrence. 2002. Assessing the cost of quality. ISU NCR 134 Conf. Paper.
- Huffman, K.L., M.F. Miller, L.C. Hoover, C.K. Wu, H.C. Brittin, and C.B. Ramsey. 1996. Effect of beef tenderness on consumer satisfaction with steaks consumed in the home and restaurant. J. Anim. Sci. 74:91-97.
- Millar, R.K. 1994. Quality characteristics. Muscle Foods: pp 333-360.
- Miller, M.F., M.A. Carr, C.B. Ramsey, K.L. Crockett, and L.C. Hoover, 2001. Consumer thresholds for establishing the value of beef tenderness. J. Anim. Sci. 79:3062-3068.

Brief summary of key literature citations

- Platter, W.J. 2003. Effects of anabolic implants, marbling, and tenderness on consumer acceptability and purchasing decisions for beef. PhD Diss. Colorado State University, Fort Collins.
- Platter, W.J., J.D. Tatum, K.E. Belk, P.L. Chapman, J.A. Scanga, and G.C. Smith. 2003. Relationships of consumer sensory ratings, marbling score, and shear force value to consumer acceptance of beef strip loin steaks. J. Anim. Sci. 81:2741-2750.
- Savell, J.W., H.R. Cross, and G.C. Smith. 1986. Percentage of ether extractable fat and moisture content of beef longissimus muscle as related to USDA marbling score. J. Food Sci. 51:838.
- Sitz, B.M., C.R. Calkins, D.M. Feuz, W.J. Umberger, and K.M. Eskridge. 2005. Consumer sensory acceptance and value of domestic, Canadian, and Australian grass-fed beef steaks. J. Anim. Sci. 83:2863-2868.

Brief summary of key literature citations

- Smith, G.C., J.W. Savell, H.R. Corss, and Z.L. Carpenter. 1983. The relationship of USDA quality grade to beef flavor. Food Technol. 37:233-238.
- Smith, S. 2008. Cellular regulation of intramuscular fat deposition and composition. J. Anim. Sci. (Suppl) Vol. 86.
- Tatum, J.D. 2008. Producing flavorful beef. Certified Angus Beef LLC white paper.
- Thompson, J.M. 2004. The effects of marbling on flavor and juiciness scores of cooked beef, after adjusting to a constant tenderness. Australian J. of Exp. Agric. 44:645-652.