HEALTH BENEFITS AND COMPOSITION OF WAGYU BEEF

Stephen B. Smith
Texas A&M University
College Station, Texas, USA
Focus of this presentation:

• Describe the importance of fatty acid composition in beef quality and healthfulness.
• Compare fatty acid composition of Wagyu and domestic beef.
• Suggest ways to promote Wagyu beef.
I have studied beef production in Australia, Japan, Korea, and China.
High-quality beef cattle production in Asia is migrating west. High-quality beef production started in Japan, migrated to South Korea, and now is growing in China. This is opposite to the flow of Wagyu genetics.
Some of the best Yellow cattle in China are produced in the northwest. Yan Ji Yellow cattle produce very high quality beef.

This is the corner of China where ends near Russia and North Korea.
Back to my topic: Wagyu beef clearly is higher in marbling if it is properly produced.
There seems to be no limit to the amount of marbling in J. Black cattle.
Marbling scores in U.S. domestic beef are much lower than in Japanese A5 carcasses.
But: Increasing marbling in beef is not enough.

- Consumers will balk if they think the product is too fatty.
- Wagyu producers should work to improve the *kind* of fat in their beef.
- Only small changes can be made in CLA and omega-3 fatty acids.
- Very large changes can be made in *oleic acid*. 
Oleic acid and beef quality

- Oleic acid is made by muscle and adipose tissue (fat), so it is natural to beef.
- Oleic acid in beef is positively correlated with greater palatability.
- U.S. beef receives a higher premium in Japan and Korea if the fat is softer (higher oleic acid).
- Oleic acid is good for you.
What is oleic acid?

- Oleic acid is a monounsaturated fatty acid (MUFA).
- Beef also contains small amounts of polyunsaturated fatty acids (PUFA) and conjugated linoleic acid (CLA).
Early work with oleic acid by Dr. Scott Grundy:

- LDL cholesterol is bad for you and HDL cholesterol is good for you.
- A high-oleic acid supplement decreased LDL cholesterol.
Oleic acid increases HDL cholesterol in human studies.

- Oleic acid also decreases LDL and total cholesterol.
- Trans-fats increase LDL and decrease HDL cholesterol.
- These studies did not include beef.

Kris-Etherton and Yu, 1997
We first increased oleic in pork by feeding high-oleic acid sunflower oil.

- Sunflower oil increased oleic acid in pork.
- Sunflower oil decreased all saturated fatty acids.
My 15 minutes of fame...

- Problems: Adding seed oils to diets of pigs is cost-prohibitive.
- PUFA in oils cause production problems.
Current research directions:

- Modify the fatty acid composition of beef without using seed oils.
- Test the effects of the modified beef/ground beef on lipoprotein cholesterol metabolism in men.
- *We have demonstrated that it is practical and effective to naturally elevate oleic acid in beef.*
But first, the MUFA:SFA ratio

- The MUFA:SFA ratio is the ratio of monounsaturated fatty acids (mostly oleic acid) to saturated fatty acids.
- High-quality beef has a high MUFA:SFA ratio (greater than 1.2).
One consistent observation: Oleic acid increases as marbling increases.
Oleic acid in beef increases as marbling fat cells increase in size.

Weaned steers: Low in oleic acid

Finish steers: High in oleic acid

Yearling steers: A little more oleic acid.
Therefore, we can increase oleic acid in beef by grain feeding.

- Grain-fed beef has twice as much oleic acid as beef from grass-fed cattle.
- Grass feeding increases saturated and trans-fatty acids.
Americans eat about 100 grams of fat each day.

Meat contributes about 25 grams of fat per day.
Does the fatty acid composition of beef really matter?

- We can increase oleic acid in beef.
- Would this have any impact on human health?
Human studies in our laboratory (4 total)

- **Participants**
  - Study 1: Hypercholesterolemic men (n = 10)
  - Study 2: Normal men (n = 27)
  - Study 3: Postmenopausal women (n = 17)
  - Study 4: Postmenopausal women and older men (n = 13) (data analysis still in progress)

- **Study design**
  - 5 quarter pound patties per week for 5 or 6 weeks
  - All participants rotated between ground beef high in oleic acid and patties high in saturated and trans-fatty acids.
Sources of ground beef and total fat intake

- **Study 1:** Wagyu and domestic fat trim
  - MUFA:SFA = 0.95 and 1.31, fat intake = 130 g/day!

- **Study 2:** Grass-fed and corn-fed Angus beef (NCBA study)
  - MUFA:SFA = 0.71, 0.83, and 1.10, fat intake = 97 g/day

- **Study 3:** Chub pack and Akaushi ground beef
  - MUFA:SFA = 0.86 and 1.43, fat intake = 65 g/day

- **Study 4:** Chub pack and Akaushi ground beef
  - MUFA:SFA = 0.88 and 1.35, fat intake = 75 g/day
Why ground beef?

- **Practicality**
  - At least 40% of per capita beef consumption in the U.S. (30 kg/y) is consumed as ground beef.
  - 32% of ground beef consumed contains 22 – 30% fat.
  - 35% of ground beef consumed contains 16 – 22% fat.

- **Experimentally**
  - We can hold the fat level constant in ground beef.
Study 1: Fatty acid composition of the High SFA and High MUFA patties

- High SFA ground beef contained more palmitic, stearic, and trans-fatty acids.
- High MUFA ground beef contained more oleic acid.
- *The men added the patties to their diets.*
Study 1: Hypercholesterolemic men

- The high-MUFA ground beef increased HDL cholesterol.
- The high SFA ground beef strongly depressed HDL cholesterol.
Study 1: LDL cholesterol

- Both test ground beef initially increased LDL cholesterol.
- LDL cholesterol returned to normal by the end of the study.
  - Participants usually adjust to the test diets.
Study 1: LDL particle diameters

- High-SFA ground beef decreased LDL particle diameters.
  - Small LDL particles are bad.
- High-MUFA ground beef increased LDL particle diameters.
  - Large LDL particles are better for you.
Study 1 Summary

The high-SFA ground beef increased VLDL-C and triglycerides and depressed HDL-C.

The high-MUFA ground beef increased HDL-C and decreased triglycerides.
Study 2: Our most extensive ground beef study: the NCBA Study

- Men (n = 27) were rotated through three test ground beefs.
- The men consumed five, 114-g patties per week for 5 weeks over three phases.
Production of the three kinds of beef

High SFA/TFA
Hay-fed for 12 mo

High oleic
Corn-fed for 12 mo

Mid oleic
Corn-fed for 8 mo
Preparation of the cattle and ground beef

- Cattle were fed to Select on native Texas pasture or fed to Choice or Prime on our standard corn/sorghum finishing diet.
- Two carcasses of each type were selected based on their subcutaneous fat MUFA:SFA ratios (0.8, 1.1 and 1.4).
- Fat and lean trim were used to produce ground beef with 24% total fat.
- *Final ground beef MUFA:SFA ratios were 0.71, 0.83, and 1.10.*
The amount of oleic acid was highest in the USDA Prime ground beef.

- **Grass-fed Select**: MUFA:SFA = 0.71
- **Choice**: MUFA:SFA = 0.83
- **Prime**: MUFA:SFA = 1.10
Study 2: Triglycerides, LDL, and HDL cholesterol

- Triglycerides were depressed by ground beef consumption.
- There was no effect of the test ground beefs on LDL cholesterol.
- HDL cholesterol increased linearly with oleic acid in the ground beef.
Study 2: Lipoprotein particle sizes

- Only corn-fed beef increased LDL diameter.
- All types of ground beef decreased HDL diameter.
  - We do not know if this is good or bad.
Trial 2 results for SBS: I shouldn’t eat beef unless it’s high in oleic acid.
Study 3: Postmenopausal women

- Women consumed either chubpack ground beef or Akaushi ground beef.
- Total fat intake = 65 grams/day
- Akaushi ground beef increased HDL cholesterol,
Study 4: Older men and women

- Participants consumed either chubpack ground beef or Akaushi ground beef.
- Total fat intake = 75 grams/day
- Chubpack ground beef decreased HDL cholesterol.
All studies averaged together (n = 67)

- Taken together, low MUFA ground beef decreases HDL and LDL cholesterol and LDL particle size.
- High MUFA ground beef does all the right things.
The results with high MUFA beef confirm human studies with oils.

- High oleic acid ground beef decreased LDL and increased HDL cholesterol.
- Ground beef high in SFA and trans-fats increased LDL and decreased HDL cholesterol.
Why did responses differ across studies?

- Age of participant
- Gender of participant
- Total fat intake
  - When fat intake was high, ground beef high in saturated and trans-fat caused HDL cholesterol to decrease.
  - When fat intake was normal, ground beef high in oleic acid caused HDL cholesterol to increase.
Study 1 Revisited

- The high-SFA ground beef was obtained from grass-fed domestic cattle and Wagyu fat trim.
- The high-MUFA ground beef was obtained from high-quality domestic cattle and Wagyu cattle.
Study 1 revisited: Not all Wagyu beef is the same.

- Our first batch of Wagyu ground beef decreased LDL particle size.
- Why did this happen?
The Wagyu fat trims for our study were not consistent.

- Our first batch of Wagyu fat trim had a MUFA:SFA ratio of 1.10 (very poor).
  - This ratio is the same as fast food hamburgers.
- Our second batch of Wagyu fat trim had a MUFA:SFA ratio of 1.35 (very typical).
- Why the difference?
There are clear differences in the MUFA:SFA ratio across regions of Japan and between breed types.

A-5 J. Black from various regions of Japan exhibit differences in their MUFA:SFA ratios.

A-5 J. Black cattle are clearly superior to U.S. domestic cattle in their MUFA:SFA ratio.
What was different about the two batches of Wagyu fat trim?

- Our first batch of Wagyu fat trim was high in saturated fat.
- It was especially high in trans-fat.
- Trans-fats strongly decrease HDL cholesterol.
The *trans*-fats in the low-MUFA Wagyu beef depressed HDL cholesterol.

- We have shown that, as the amount of *trans*-fat in beef increases, HDL cholesterol decreases.
Production systems that increase oleic acid in beef strongly depress total trans-fatty acids.

- Consumption of high-oleic beef ensures reduced consumption of trans-fatty acids.
Japanese cattle are fed in stages, but American cattle are fed just one diet.
日本では成長段階によって餌を変えるが、アメリカでは1種類の餌を与える続ける

- **Young steers; mostly forage-fed**
- **Older steers: mostly concentrate-fed**

まず粗飼料主体、後に濃厚飼料主体にかえます

Are American Wagyu cattle fed the same as Japanese cattle?
There are three ways to increase the MUFA:SFA ratio in beef:

- **Genetics:** Wagyu steers excel in depositing MUFA.

- **Diet:** Corn-fed steers deposit more MUFA than hay-fed steers.

- **Time on feed:** Long-fed steers deposit more MUFA than short-fed steers.

![Graph showing the effect of genetics, diet, and time on feed on MUFA:SFA ratio.](image-url)
Pasture/hay feeding decreases stearoyl-CoA desaturase (SCD) activity.

- SCD activity increases with time on feed except in the hay-fed, Angus steers.
- This increases the conversion of stearic acid to oleic acid.
Why did the one batch of Wagyu fat trim have a MUFA:SFA ratio of only 1.1?

- A MUFA:SFA ratio of 1.1 indicates that the Wagyu cattle were either pasture-fed or short-fed.
  - The high *trans*-fatty acids indicates they were pasture-fed.
- A MUFA:SFA ratio of 1.35 indicates the Wagyu cattle were finished properly.
There is a fourth way to change the MUFA:SFA ratio in beef: The carcass map

- Brisket 양지머리
- Chuck 목심
- Flank 양지
- Loin 등심
- Plate 양지
- Rib 갈비 & 등심
- Round 우둔
- Sirloin 채끝
Brisket has the highest MUFA:SFA ratio.

- The MUFA:SFA ratio in brisket is as high as in Wagyu beef.
Brisket fat has a much lower melting fat than other depots. This improves mouthfeel and makes the brisket “juicier” than the other beef depots. Good quality Wagyu beef has the same mouthfeel.
What can AWA do to benefit the Wagyu beef industry?

- Use the best fat trim to produce ground beef and other processed meats.
- Promote Wagyu beef based on its high concentration of oleic acid.
  - High marbling is important, but fatty acid composition is just as important.
- Raise your cattle to maximize the fatty acid composition.
  - Don’t short-feed Wagyu cattle.
Pasture feeding to USDA Choice drastically reduces oleic acid in ground beef.

- Pasture-fed, Choice ground beef has **4 grams** more saturated and **2 grams** more trans-fats than corn-fed USDA prime ground beef.

- It also has **8 grams** less oleic acid.
Increasing marbling in cattle.

- Angus steers were compared to Wagyu steers.
- Corn-fed steers grew faster than hay-fed steers.
- Corn- and hay-fed steers were fed at the same body weights.