NCBA Ground Beef
Diet/Health Study

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Assumptions: Corn-fed beef is healthier than pasture-fed beef

- Feeding corn to cattle produces the highest quality carcasses.
- Feeding corn to cattle increases the “healthfulness” of beef.
- Pasture-fed cattle cannot achieve the same carcass quality as corn-fed cattle.
- Pasture-fed cattle do not produce beef as “healthy” as corn-fed cattle.
Fats in Pasture-Fed Beef

- A 100-g serving of “pasture-fed” ground beef (10%) fat provides:
  - 65 mg more omega-3 fatty acids (as 18:3n-3) than corn-fed ground beef (RDI = 1.6 g).
  - 2 g more saturated fat than corn-fed ground beef.
  - 2 g less oleic acid than corn-fed ground beef.
Our focus has been to increase oleic acid in beef.

- Beef palatability is positively correlated with the amount of oleic acid in beef.
- Asian markets prefer beef that contains elevated oleic acid.
- Oleic acid has positive health benefits:
  - Increases HDL cholesterol.
  - Decreases LDL cholesterol.
  - Depresses symptoms associated with type II diabetes.
Oleic acid decreases LDL, increases HDL cholesterol.

This appears to be the most consistent effect of high-oleic acid beef.

Kris-Etherton and Yu, 1997
Mildly hypercholesterolemic men (n = 10) were fed high-SFA ground beef (ratio = 0.95) for 5 wk.

Afterwards, the men were fed high-MUFA ground beef (ratio = 1.31) for 5 wk.

The high-MUFA ground beef increased HDL cholesterol.
Both test ground beef transiently increased LDL cholesterol.

There was no significant overall effect on LDL cholesterol.
The LDL:HDL Ratio

- Net effects: The high-SFA ground beef increased the LDL:HDL ratio.
- The high-MUFA ground beef depressed the LDL:HDL ratio.
The high-SFA ground beef strongly depressed LDL particle diameters. This was reversed by the high-MUFA ground beef.
Cholesterol Concentrations and Apparent Hepatic SCD1 Activity

- HDL concentrations decreased as the plasma 16:1/18:0 ratio increased.
- VLDL (and triglyceride) concentrations increased as the 16:1/18:0 ratio increased.
- A high plasma 16:1/18:0 ratio = elevated hepatic stearoyl-CoA desaturase (SCD1) activity.
Conclusions from previous research:

- High SFA ground beef decreases HDL cholesterol and LDL particle diameters and increases triglycerides.
- High-MUFA ground beef increases HDL cholesterol and decreases triglycerides.
  - These effects are caused by alterations in hepatic SCD1 activity.
Men ($n = 27$) were rotated through three test ground beefs. The men consumed five, 114-g patties per week for 5 wk over three phases.
As the MUFA:SFA ratio of the ground beef increased, the concentration of SFA and trans-fatty acids decreased.

MUFA:SFA
- Low MUFA: 0.71
- Mid MUFA: 0.83
- High MUFA: 1.10
Main Effects of Test Ground Beefs

- **Increased LDL diameter**, $P = 0.05$.
  - Only the Mid and High MUFA ground beefs increased LDL diameter.

- **Decreased HDL diameter**, $P = 0.001$.
  - This effect was independent of fatty acid composition.
More Main Effects

- Slight decrease in glucose, \( P = 0.14 \).
- Decreased triglycerides, \( P = 0.09 \).
  - Especially in high-MUFA ground beef.
- Decreased insulin, \( P = 0.006 \).
  - There was a linear effect with increasing MUFA.
HDL and LDL Cholesterol

- HDL cholesterol increased linearly with oleic acid in the ground beef.
- There was no effect of the test ground beefs on LDL cholesterol.
Ground Beef MUFA and the Plasma 16:1/18:0 Ratio

- Although High MUFA ground beef contains more 16:1, it reduced the plasma 16:1/18:0 ratio.
- This indicates a depression in hepatic SCD1 activity.

![Graph showing change in plasma 16:1/18:0 ratio](image)
Triglycerides and the Plasma 16:1/18:0 Ratio

- Plasma triglycerides are highly correlated with the plasma 16:1/18:0 ratio.
- Thus, any dietary factor that decreases the plasma 16:1/18:0 ratio (i.e., hepatic SCD1) is beneficial.
HDL Cholesterol and Triglycerides

- There was a significant, negative correlation between HDL cholesterol and triglycerides.
- This suggests that both were controlled by hepatic SCD1 activity.
LDL Diameters and HDL Cholesterol

- An elevation in HDL cholesterol is associated with increased LDL diameters.
- Both are positive effects and appear to be controlled by the same mechanism.
LDL Particle Diameters and Apparent Hepatic SCD1 Activity

- LDL particle diameters decreased as the plasma 16:1/18:0 ratio increased.
- Thus, hepatic SCD1 activity in part controls LDL diameter.
  - Increased SCD1 activity → increased LDL half-life → smaller diameters.
A new way to promote beef:

- E.V.O.O.
  - Extra virgin olive oil
- E.V.O.B.
  - Extra virgin oleic beef (from steers…)

E.V.O.B. is a new way to promote beef by using extra virgin olive oil.
How was high-oleic acid beef produced?

- **High SFA**
  - Hay-fed for 12 mo

- **Low MUFA**
  - Corn-fed for 8 mo

- **High MUFA**
  - Corn-fed for 12 mo
Production and Oleic Acid

- Age has a strong effect on oleic acid in beef.
- Calf- and yearling feeding may produce different amounts of oleic acid in beef.
Carcass fatness and the MUFA:SFA ratio increase in parallel.
A fourth method to modify the fatty acid composition:

- Fat depots within a carcass differ vastly in their fatty acid compositions.
- Fat trim can be selected for its functionality.
Marbling scores and the marbling MUFA:SFA ratio also increase in parallel.
SCD gene expression is depressed by pasture feeding.
Conclusions:

- Modifying the fatty acid composition of beef has a measurable effect on cholesterol metabolism in human subjects.
- Modifying the fatty acid composition of beef can be done practically.