Effect of Ethanol Co-Products on Carcass and Beef Quality

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DDGS Research in Ruminants

• NCR-88 Beef Growing-Finishing Systems
  ➢ Summarized studies in 1984 (NCR No. 297)
    – Characterization of fermentation by-products
      o Higher protein concentration than corn
      o Similar or greater RUP
      o Similar energy concentration as corn
    – DDGS as a protein source
      o Replacement for other protein sources
        » When combined with urea of equal value as SBM
      o As a bypass source
        » Fortified with urea > urea alone
        » More efficient protein source when combined with urea than SBM
A Prophetic Statement

- DDGS as an energy source
  - “if abundant supplies of wet distillers’ grains should become available—as a result, for example, of increased production of fuel alcohol—this by-product could be used as an energy source in livestock feeds.”

  NCR No. 297
What Will be The Impact on Beef Quality?

- Ethanol Co-Products
  - high in NDF
  - high in fat
  - some high in moisture
  - palatable
  - inexpensive
Effects of Ethanol Co-Products

- Hot carcass weight
- Marbling
- Yield grade
- Quality grade
- Fat depth
- Ribeye area
Data Set

- 106 treatment means
- 21 studies
- 625 pens
- 4,752 cattle
- Co-prod = 0 to 75%
- DOF = 151, 58 to 299
- In BW, lb = 727, 421 to 948
- ADG, lb = 3.31, 1.81 to 4.55
- DMI, lb/d = 20.6, 15.4 to 26.0
- FTG = 6.3, 5.1 to 8.3
- End BW, lb = 1212, 997 to 1394
- HCW, lb = 754, 632 to 870
- Fat, in = 0.42, 0.19 to 0.62
- REA, in² = 12.8, 11.1 to 15.0
- Choice, % = 55.9, 16.7 to 95
- YG = 2.7, 1.8 to 3.6
YG = 2.56 + 0.0080*DG - 0.00014*DG^2

R^2=0.903; n=89

YG vs Level of Distillers Grains

Percent Dist Grains (DM basis)

Yield Grade

29%
Fat Depth and Co-product

Fat depth, in

Co-product, %

Raw
Fitted

22%
Marbling Score

Marbling vs DG
Marbling vs DG and YG

MARB vs DG
MARB = 516.73 + 1.055*DG - 0.032*DG^2
R^2 = 0.933; n = 86

MARB vs DG and YG
MARB = 374.72 - 6.44*DG + 54.67*YG + 2.54*DG*YG + 0.139*DG^2 - 0.062*DG^2*YG
R^2 = 0.962; n = 74

23%
MARB vs DG

\[ \text{MARB} = 516.73 + 1.055 \times \text{DG} - 0.032 \times \text{DG}^2 \]
\[ \text{R}^2 = 0.933; \ n = 86 \]

MARB vs DG and YG

\[ \text{MARB} = 374.72 - 6.44 \times \text{DG} + 54.67 \times \text{YG} + 2.54 \times \text{DG} \times \text{YG} + 0.139 \times \text{DG}^2 - 0.062 \times \text{DG}^2 \times \text{YG} \]
\[ \text{R}^2 = 0.962; \ n = 74 \]
Effects on Marbling and YG

• At intermediate concentrations, co-products increase YG
  ➢ effect on increasing fat depth

• At intermediate concentrations, co-products increase YG, but maintain marbling
The graph shows the relationship between marbling score and coproduct given YG. The data points indicate that the optimal coproduct for achieving a marbling score of 26% is approximately 30 units. The graph includes lines for different YG categories (YG 1 to YG 5) with distinct colors, allowing for easy comparison across different categories. The marbling score ranges from 0 to 800, while the coproduct ranges from 0 to 70.
Effects on Marbling and YG

- At a given YG end point, effects of co-products are variable
- At low YG (lower energy diets or lean cattle)
  - co-products reduce marbling at any inclusion
- At YG 3
  - co-products have no effect on marbling up to 20% inclusion
- At high YG (extended DOF, early-maturing cattle or heifers)
  - co-products increase marbling at low to intermediate inclusion
Are They Really Effects of Co-Products?

- Difficult to separate from this dataset
- During, experimental feeding of ethanol co-products, energy, protein and ether extract of diet are permitted to fluctuate
- Therefore, is marbling affected because of co-products or something that co-products affect?
  - ether extract intake
  - starch intake
  - energy intake
Marbling and Dietary Fat

Dietary Fat, %

Marbling Score

- Raw
- Fitted

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Marbling and ME Intake

Marbling score vs ME Intake, Mcal/d

NE₀:
- 0% Co-product: 61.4
- 10% Co-product: 62.4
- 20% Co-product: 62.0
- 30% Co-product: 60.1
- 40% Co-product: 62.7
- 50% Co-product: 61.1

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Ether Extract and Co-Product

Ether extract, %

Co-product, % DM
ME Intake and Co-Product Content

Co-product, %

ME Intake, Mcal/d

0  10  20  30  40  50  60  70  80

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Co-product Effects

• Effect of ether extract on marbling score is clear
  ➢ virtually no change in marbling between 3.7% and 5.7% ether extract

• Effect of co-product on marbling score is dependent on ME intake
  ➢ At ME intakes up to 30 Mcal/d, co-product inclusion at up to 50% is not detrimental to marbling
  ➢ At lower ME intakes, co-product inclusion is actually positive on marbling
When feeding ethanol co-products, the effect of the inherent increase in dietary ether extract may be of greater influence on marbling than that of increased ME intake.
REA and Co-product

Co-product, %

REA, in²

- Raw
- 1150-lb
- 1250-lb
- 1350-lb
Effects on REA

• If one ignores final BW, REA is decreased by co-product inclusion at a rate of 0.004 in$^2$ for each percentage increase in co-product inclusion

• When including final BW, the effect of feeding co-products is almost canceled out

  ➢ 1 lb increase in final BW = 0.004 in$^2$ increase in REA
Summary

- Feeding ethanol co-products:
  - increased YG 0.17 units up to 30% inclusion
  - had no effect on marbling at up to 30% inclusion when end point YG = 3
    - reduced marbling 25 and 50 points at 40% and 50% inclusion, respectively
  - reduced marbling at up to 40% inclusion when end point YG ≤ 2
  - slightly increased marbling at up to 30% inclusion when end point YG = 4
    - reduced marbling 20 and 80 points at 40% and 50% inclusion, respectively

- Marbling depression may be due to excessive dietary fat or reduced dietary starch
Summary

• The effects of ethanol co-products are on REA are dependent on end weight
  ➢ When considering both co-product inclusion and end-weight, the effects of co-products on REA are minimal
Fatty Acid Composition

Omega-6:Omega-3

Calculated Ratio

SF C DG C DG S DG W DG D DG

SEM = 0.506
$P < 0.027$

SEM = 0.506
$P < 0.001$

SEM = 0.506
$P < 0.038$
FA Profile Summary

- Ethanol co-products increased the omega-6:omega-3 ratio
- Sorghum co-products yielded better omega-6:omega-3 ratios
- Wet co-products yielded better omega-6:omega-3 ratios
- Omega-6:omega-3 ratios were at least three times greater than recommended (2.3:1)
Research Needs

• Additional data points to strengthen analyses
  ➢ carcass trait data missing
    – summarize existing pen data for a more robust analysis?
    – analyze response on quality grade using appropriate statistics (categorical data)
    – incorporate data from Texas research
    – conduct multiple component analyses to prevent collinearity between independent variables
      o yield grade and co-product content
      o ether extract and energy intake
Research Needs

• Conduct research to test two hypotheses:
  
  ➢ Ether extract of diet, and not an intrinsic component of ethanol co-products, affects marbling deposition
  
  ➢ Overall energy intake, and not an intrinsic component of ethanol co-products, affects marbling deposition