

Using Ethanol Industry Co-Products in Dairy Rations

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Objective

- Perform meta-analyses of literature data to determine lactation performance responses to inclusion of distillers grains in diets of lactating dairy cows

The Dataset

- 1980 thru current
- 21 Trials and 53 control vs. DG comparison
- n of 690 cows each for control and DG treatment

The Dataset

<u>Location</u>	<u>Trials</u>	<u>Comparisons</u>
SD	6	11
WI	4	8
FL	2	14
Finland	2	5
Taiwan	2	4
Ireland	1	2
OH	1	2
ID	1	3
NE	1	2
IN	1	2

The Dataset

➤ DG Form

- 41 Dry DG Comparisons
- 12 Wet DG Comparisons

➤ DG Level

- 21 Comparisons at 5-15% of diet DM
- 15 Comparisons at 16-25% of diet DM
- 17 Comparisons at 26-48% of diet DM

The Dataset

➤ Forage Base

- 30 Comparisons with >50% corn silage
- 16 Comparisons with >50% haycrop
- 7 Comparisons with 50:50 Mix

➤ Average DIM at Trial Start

- 27 Comparisons at 0-77 DIM
- 26 Comparisons at 80-135 DIM

The Dataset

➤ Diet CP

- 15 Comparisons at <16% CP
- 27 Comparisons at 16-18% CP
- 11 Comparisons at >18% CP

➤ Diet Formulation for Rumen Escape Amino Acids

- Only 4 trials and 7 comparisons
 - 2 trials and 2 comparisons with RPLM
 - 2 trials and 5 comparisons with BM

Diet Nutrient Composition or Digestibility

<u>Item</u>	<u>Frequency</u>
CP, % DMB	53/53
RUP, % DMB	29/53
NDF, % DMB	35/53
NFC, % DMB	31/53
NE _L , Mcal/kg DM	38/53
Fat, % DMB	33/53
Nutrient Digestion	2/53

Lactation Performance Summary Statistics

<u>Control</u>	<u>Observations</u>	<u>Average</u>	<u>Std Dev</u>
DMI, kg/d	53	22.3	3.8
Milk, kg/d	53	30.2	5.5
Milk Fat, %	50	3.48	0.36
Milk TP, %	53	2.97	0.22
Milk/DMI	53	1.36	0.23

Meta Analyses

- DG response data analyzed using Mixed Models procedure of SAS with Study included in model as random effect and observations weighted using adjusted standard errors or n (St-Pierre, 2001, JDS 84:741-755).
- DG Form and DG Level Effects included in model as fixed effects for all parameters evaluated. Linear & quadratic contrasts tested for DG Level Effects.
- Full model tested fixed effects of Forage Base, Amino Acid Adjustment, Trial Start DIM, & Diet CP for all parameters with sequential removal of least significant until all $P < 0.25$.
- T-test used to determine if response different from zero. PDIFF used to test differences between responses. Trend and significance noted at $P < 0.15$ and $P < 0.10$.

Results-DMI

		<u>Response, kg/d</u>	<u>P <</u>
<u>DG Form</u>	Dry	0.21 ^a	NS
	Wet	-0.57 ^b	0.17
<u>DG Level</u> ¹	Low	-0.17 ^b	NS
	Medium	0.60 ^a	0.10
	High	-0.97 ^c	0.02
<u>Forage Base</u>	CS	-0.86 ^b	0.02
	HC	0.20 ^a	NS
	Mix	0.13 ^{ab}	NS

¹Quadratic effect (P < 0.002)

Results-Milk Yield

		<u>Response, kg/d</u>	<u>P <</u>
<u>DG Level</u> ¹	Low	0.60 ^a	0.18
	Medium	0.14 ^a	NS
	High	-0.65 ^b	0.20
<u>Diet CP</u>	High	1.04 ^a	0.06
	Medium	-0.15 ^b	NS
	Low	-0.80 ^c	0.12

¹Linear effect (P < 0.03)

Results-3.5% FCM Yield

		<u>Response, kg/d</u>	<u>P <</u>
<u>DG Level</u> ¹	Low	0.65 ^a	0.19
	Medium	0.19 ^a	NS
	High	-1.43 ^b	0.03
<u>Diet CP</u>	High	0.78 ^a	NS
	Medium	-0.19 ^{ab}	NS
	Low	-1.18 ^b	0.07

¹Linear effect (P < 0.006)

Results-Milk Fat %

		<u>Response, % units</u>	<u>P <</u>
<u>DG Form</u>	Dry	0.02 ^a	NS
	Wet	-0.16 ^b	0.004
<u>DG Level</u> ¹	Low	-0.11 ^b	0.02
	Medium	-0.06 ^{ab}	0.20
	High	-0.02 ^a	NS

¹Linear effect (P < 0.02)

Results-Milk Fat Yield

	<u>Response, kg/d</u>	<u>P <</u>
<u>DG Level</u> ¹ Low	0.01 ^a	NS
Medium	-0.01 ^a	NS
High	-0.06 ^b	0.05

¹Linear effect (P < 0.02)

Results-Milk Protein %

		<u>Response, % units</u>	<u>P <</u>
<u>Forage Base</u>	CS	-0.03 ^b	NS
	HC	0.08 ^{ab}	NS
	Mix	0.17 ^a	0.06
<u>Diet AA Adj.</u>	No	-0.01 ^b	NS
	Yes	0.16 ^a	0.002
<u>DIM at Start</u>	Early	0.001 ^b	NS
	Mid	0.15 ^a	0.02

Results-Milk Protein Yield

		<u>Response, kg/d</u>	<u>P <</u>
<u>Forage Base</u>	CS	-0.04 ^b	NS
	HC	0.04 ^{ab}	NS
	Mix	0.13 ^a	0.02
<u>Diet AA Adj.</u>	No	0.02 ^b	NS
	Yes	0.07 ^a	0.07
<u>DIM at Start</u>	Early	0.01 ^b	NS
	Mid	0.08 ^a	0.05
<u>Diet CP</u>	High	0.08 ^a	0.02
	Medium	0.02 ^b	NS
	Low	0.02 ^b	NS

Results-Feed Efficiency (Milk/Feed)

		<u>Response</u>	<u>P <</u>
<u>DG Form</u>	Dry	-0.02 ^b	NS
	Wet	0.09 ^a	0.003
<u>Diet CP</u>	High	0.07 ^a	0.02
	Medium	0.01 ^b	NS
	Low	0.04 ^{ab}	NS

Summary from Meta-Analyses Results

➤ DMI

- ❑ Trend for 0.57 kg/d decrease for Wet DG
- ❑ 0.97 kg/d decrease at 26-48% diet DM level
- ❑ 0.86 kg/d decrease with corn silage based diets

➤ Milk Yield

- ❑ Linear decline in response from +0.60 to -0.65 kg/d as feeding rate increased from 5-15% to 26-48% of diet DM
- ❑ 1.04 kg/d increase with >18% CP diets and 0.80 kg/d decrease with < 16% CP diets

Summary from Meta-Analyses Results

➤ FCM Yield

- ❑ Linear decline in response from +0.65 to -1.43 kg/d as feeding rate increased from 5-15% to 26-48% of diet DM
- ❑ 1.18 kg/d decrease with < 16% CP diets

➤ Milk Fat %

- ❑ 0.16% unit decrease for Wet DG
- ❑ 0.11% unit decrease for 5-15% DG diets
- ❑ Lower & NS decreases for >15% DG diets?

➤ Fat Yield

- ❑ 0.06 kg/d decrease at 26-48% diet DM level

Summary from Meta-Analyses Results

➤ Protein % and Yield

- ❑ DG response positive and improved for mixed forage base, diet amino acid adjusted comparisons, mid lactation trial starts, and > 18% diet CP

➤ Feed Efficiency (Milk/Feed)

- ❑ DG response positive and improved for Wet DG and > 18% diet CP

Type I/Type II Error Analyses

- Average and Std Deviation of FCM and DMI responses for Low & Medium DG feeding levels entered into the spreadsheet of Galligan, Univ. of Penn., New Bolton Center ([Galligan et al., 1991, JDS 74:902-910](#))
- Milk and TMR prices of \$13.50/cwt. and \$0.07/lb. DM used
- Cost of feeding DG calculated using \$92/ton DG, \$185/ton 44-SBM, & \$95/ton shelled corn ([Feedstuffs, 2/28/05 plus \\$20/ton trucking](#)), and 10% & 20% DG inclusion rates

Cost of Decision Errors

Decision Errors	DG at 10% of Diet DM	DG at 20% of Diet DM
Type I Using DG & < Breakeven	\$0.07	\$0.20
Type II Failing to Use DG & > Breakeven	\$0.44	\$0.07

Conclusions

- Lactation responses and current economics support the inclusion of DG in diets for lactating dairy cows
- 5-15% of diet DM was the most favorable inclusion rate
- Reduced DMI & milk fat % may be watch-outs when feeding wet DG
- Diet CP & amino acid status and forage base influenced the DG responses

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