

How Much Corn Milling Coproduct Can be Fed to Finishing Cattle?

- Cost of coproducts relative to corn grain
- How much will the cattle tolerate?
 - Fiber in coproducts
 - Oil in DG
 - Sulfur
 - Moisture
- Environmental consequences of feeding higher levels

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INPUT	
Dry matter of corn, %	88
Dry matter of wet CGF, %	40
Dry matter of wet DGS, %	30
Protein in corn, % DM	8.5
Protein in wet CGF, % DM	20
Protein in wet DGS, % DM	30
Energy in corn, Mcal/lb	0.7045
Cost of corn, \$/bu	2
Cost of urea, \$/ton	300

<<Tips>>

OUTPUT - Calculated nutrient value			
Cost of corn		\$/Mcal NEg	0.05108
Value of wet CGF, \$/ton as fed	36.01		
Value of wet CGF, \$/ton 100% DM	90.02	\$/Mcal NEg	0.05108
Value of wet DGS, \$/ton as fed	33.49		
Value of wet DGS, \$/ton 100% DM	111.63	\$/Mcal NEg	0.05108
Relative Cost			
DGS to CGF wet basis	0.93		
DGS to CGF dry basis	1.24		

Assumptions	NE g Mcal/lb DM	Energy value relative to corn
Corn	0.7045	1.00
Wet CGF	0.6693	0.95
Wet DGS	0.77495	1.10

* DGS = corn distillers grain + solubles

* CGF = corn gluten feed

<<Tips>>

Adjustments: Transportation, Storage, & Storage Loss	
Delivery cost corn, \$/bu	0.000
Storage cost corn, \$/bu	0.010
Processing cost corn, \$/bu	0.025
Delivery cost CGF, \$/ton	8.000
Storage and loss cost CGF, \$/ton	2.000
Incentive cost CGF, \$/ton	2.000
Delivery cost DGS, \$/ton	8.000
Storage and loss cost DGS, \$/ton	2.000
Incentive cost DGS, \$/ton	2.000

OUTPUT - Value coproduct FOB Plant Cost per Mcal NEg			
Cost of corn		\$/Mcal NEg	0.05209
Value of wet CGF, \$/ton as fed	24.55		
Value of wet CGF, \$/ton 100% DM	61.37	\$/Mcal NEg	0.04835
Value of wet DGS, \$/ton as fed	21.96		
Value of wet DGS, \$/ton 100% DM	73.20	\$/Mcal NEg	0.04779
Relative Cost			
DGS to CGF wet basis	0.89		
DGS to CGF dry basis	1.19		

Value of Wet CGF & DGS in Beef Finishing Rations – Nutrient Composition

Cost of corn, \$/bu (88% DM)

Urea, \$/ton	2.00	2.25	2.50	2.75
	\$/ton FOB processing plant			
300	35.34 ¹	39.20	43.05	46.91
	34.97 ²	38.62	42.27	45.92
325	35.75	39.61	43.46	47.32
	35.49	39.14	42.79	44.64
350	36.17	40.02	43.88	47.73
	36.00	39.66	43.31	46.96

¹CGF-40% DM ²DGS-30%DM

Value of Wet CGF & DGS in Finishing Rations Relative to Costs of Corn and Urea

	DM	CP	Energy
CGF	40	20	0.95
DGS	30	30	1.10

\$0.25/bu increase in price of corn

- Wet CGF increases \$3.86/ton
- Wet DGS increases \$3.65/ton

\$50/ton increase in price of urea

- Wet CGF increases \$0.83/ton
- Wet DGS increases \$1.04/ton

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Response of Beef Cattle to Wet DGS Three Feeding Trials - Iowa State University

	<u>% Ration DM as wet DGS</u>			
	<u>0*</u>	<u>16*</u>	<u>28</u>	<u>40*</u>
DMI	19.7	20.0	19.2	18.8
ADG	3.13	3.57	3.45	3.27
F/G	6.32	5.65	5.64	5.70

*72 cattle per group

Response of Feeding Wet DGS to Holstein Steers

	Wet DGS, % Ration DM			
	0	10	20	40
DMI, lb/d	19.4	18.5	18.7	17.2
ADG, lb/d	3.15	3.13	3.06	2.78
F/G	6.18	5.90	6.14	6.19
Carcass, lbs	798	813	799	751
Marbling	565	639	626	602
Backfat, in	0.25	0.29	0.27	0.24
Shear force, lb	3.25	3.32	3.28	3.26
Flavor	6.39	6.40	5.96	6.06

ISU – 430 lb Holstein steers fed 299 days

Response of Feeding Wet DGS to Holstein Steers

	Wet DGS, % Ration DM		
	0	25	50
DMI, lb/d	17.8	18.7	16.8
ADG, lb/d	3.09	3.15	2.95
F/G	5.93	5.94	5.68
Carcass, lb	726	751	707
Marbling	560	561	521
Backfat, in	0.23	0.25	0.19
Shear force, lb	3.25	3.18	3.24
Flavor	5.78	6.12	5.85

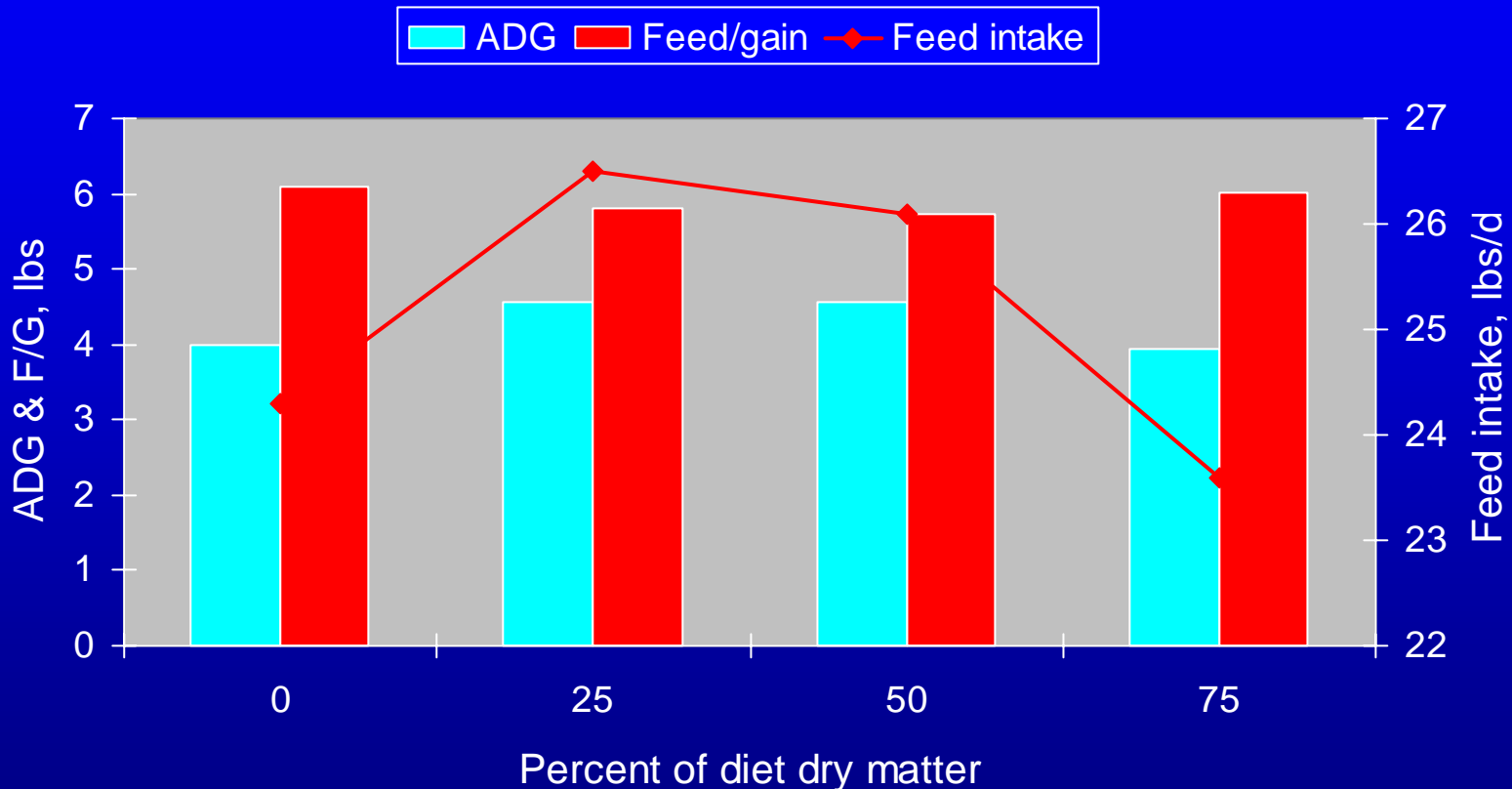
University of Illinois – 421 lb Holstein steers fed 270 days

Performance of Steers Fed High Levels of Wet Corn Gluten Feed

Wet CGF, % DM	0	30	50	90
Grd cobs, % DM	18	12	7.9	0
Dry rolled corn, % DM	71.7	54.2	37.9	5.0
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DMI, lb/d	21.7	21.1	20.6	21.1
ADG, lb/d	3.39	3.38	3.35	3.21
F/G	6.39	6.26	6.15	6.58
Carcass wt, lb	718	740	732	721
% Choice	72.2	83.3	83.3	100
Backfat, in	0.35	0.40	0.41	0.39
Sensory, overall	6.08	6.17	6.18	6.02
Shear force, lb	5.88	5.78	5.48	5.62

ISU – 780 lb steers fed 136 days

Response to Increasing Levels of 50:50 Mixture of WDG and WCGF



University of NE – 815 lb steers fed 113 days

Fiber Content of Coproducts

% DM	Corn gluten feed	Distillers grains	Distillers solubles	Corn grain
Crude fiber	14	13	4	2.6
NDF	40	30	8	9
ADF	13	12	3	3

Will fiber in coproducts provide effective fiber for cattle?

Roughage Requirement of Steers Fed Corn Gluten Feed

Corn Silage	21.3	10.6	10.6	5.3	0
Wet CGF			30.0	45.0	60.0
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DMI, lb/d	21.3	20.2	21.4	20.5	19.6
ADG, lb/d	3.12	3.20	3.22	3.12	3.09
F/G	6.83	6.31	6.66	6.56	6.36
% Choice	94.4	100.0	88.9	100.0	100.0
Backfat, in	0.51	0.45	0.55	0.54	0.52
YG	2.50	2.39	2.66	2.67	2.63

ISU – 740 lb steer fed 188 days

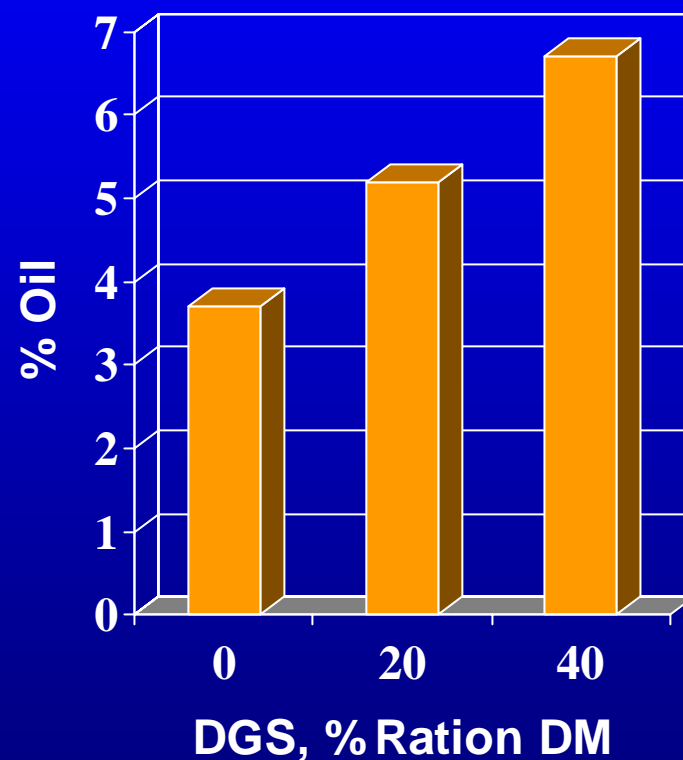
Response of Finishing Steers to Decreasing Roughage When Fed a Blend of Wet Distillers Grains and Wet Corn Gluten Feed

Blend, % DM	-0 -	-----25 -----	-----50 -----	-----75 -----			
A hay, % DM	7.5	5	7.5	2.5	7.5	0	7.5
DMI, lb/d	24.3	26.3	26.5	25.4	26.1	23.0	23.6
ADG, lb/d	3.99	4.70	4.57	4.55	4.56	3.86	3.93
F/G	6.10	5.60	5.80	5.59	5.73	5.97	6.01

University of NE – 815 lb steers fed 113 days

Potential Effects of Oil in Corn Coproducts

- Corn gluten feed: 3 % oil
 - No effect in corn-based ration
- Wet distillers grains with solubles
 - Distillers grains: 10% oil
 - Distillers solubles: 15% oil
- Distillers grains
 - Oil content ranges from 9 to 12.5%



Coproducts – Intake

Digestion trial – 10 observations per diet
Dry Rolled Corn – Hay - Corn Silage Ration

	Control	<u>Solubles, % DM</u>		<u>Wet DGS, % DM</u>	
		4	8	10	20
Dry matter, kg/d	8.00	8.73	8.62	8.41	7.84
Starch, kg/d	5.06	5.07	5.17	4.93	3.99
NDF, kg/d	1.19	1.25	1.19	1.42	1.45
ADF, kg/d	0.43	0.48	0.45	0.56	0.56
Fat, kg/d	0.27	0.36	0.43	0.43	0.50

Coproducts – Digestibility

Dry Rolled Corn – Hay - Corn Silage Ration

	Control	<u>Solubles, % DM</u>		<u>Wet DGS, % DM</u>	
		4	8	10	20
DM digest, %	78.6	78.2	75.7	77.1	76.6
Starch digest, %	96.6	94.2	94.8	95.3	94.2
NDF digest, %	52.9	52.8	44.1	52.0	54.7
ADF digest, %	41.2	44.0	33.9	48.0	48.1
Fat digest, %	63.2	66.0	65.3	68.0	75.0

Effects of Corn Oil and Wet Distillers Grains on Performance of Finishing Heifers

		<u>Corn oil, % DM</u>		<u>Wet DGS, % DM</u>	
	Control	2.5	5.0	20	40
Total lipid, % DM	3.98	6.37	8.76	6.39	8.80
DMI, lb/d	20.0	20.0	18.0	20.0	19.6
ADG, lb/d	3.04	3.01	2.49	3.04	3.19
F/G	6.52	6.59	7.25	6.52	6.15
Carcass wt, lb	693	691	647	693	689
Marbling score	524	519	496	536	538

University of NE - 765 lb heifers fed 113 days – Calan gates

Sulfur and Moisture

Sulfur

- Follow NRC guidelines – Less than 0.4% S in total diet
- Include sulfur in water – Recommendations will be sight specific

Moisture content of diet

- It is our thought that finishing cattle will tolerate high levels of moisture in the feed – up to 40%
- Might be feed management problems

Phosphorus Content of Coproducts

	Corn gluten feed	Distillers grains	Distillers solubles
Total phosphorus, % DM	1.0 – 1.2	0.6 – 0.8	1.0 – 1.25

Phosphorus in DGS ranges from 0.45 to 0.9.
Concentrations vary depending upon mix of grains and solubles and P concentration in corn grain.

Coproducts - Phosphorus Metabolism

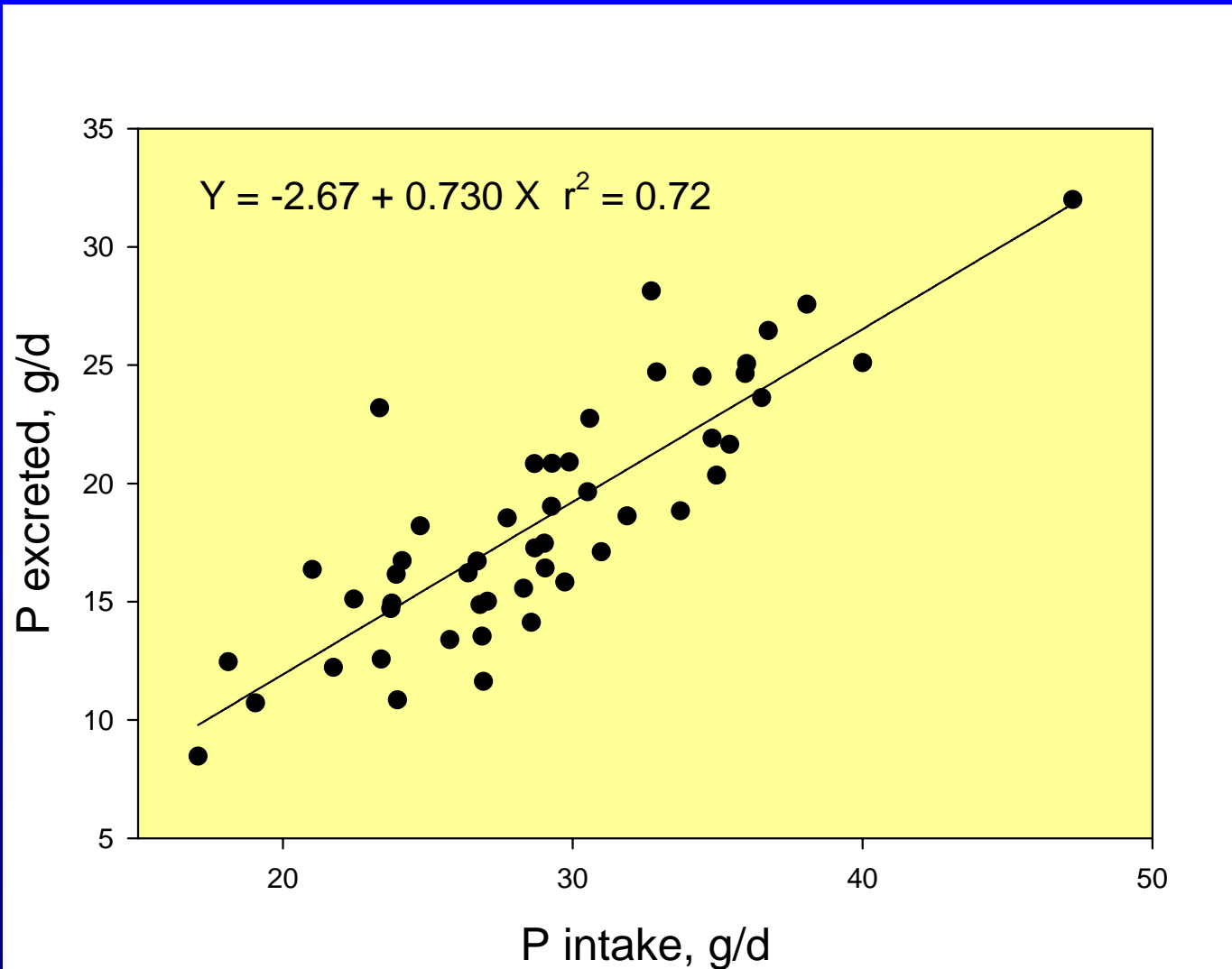
Digestion Trial - Steers

Dry Rolled Corn & Corn Silage

	Control	<u>Solubles, % DM</u>		<u>WDGS, % DM</u>	
		4	8	10	20
P intake, g/d	22.9	29.0	34.5	28.5	28.6
Digested, %	61.2	55.0	53.0	58.6	57.1
Excreted, g/d	13.2	18.4	23.3	17.2	19.0
P retained, g/d	9.7	10.6	11.2	11.2	9.6
P feces, g/d	8.9	13.1	15.7	11.7	12.4
P urine, g/d	4.3	5.3	7.5	5.5	6.6

Phosphorus Excretion

Steers fed control, distillers soluble or wet DG



Protein Fractions in Coproducts

	% CP	% degraded	Urea required Lb/100 lb ^a
CGF	20	70 - 75	1.28
DGS	30	25 - 50	1.96
Corn grain	8.5	60	2.36

30.4% CGF + 69.6% corn = 12% CP mixture

16.3% DGS + 82.7% corn = 12% CP mixture

^aUrea needed to satisfy degraded protein requirement of rumen microbes relative to fermentable energy

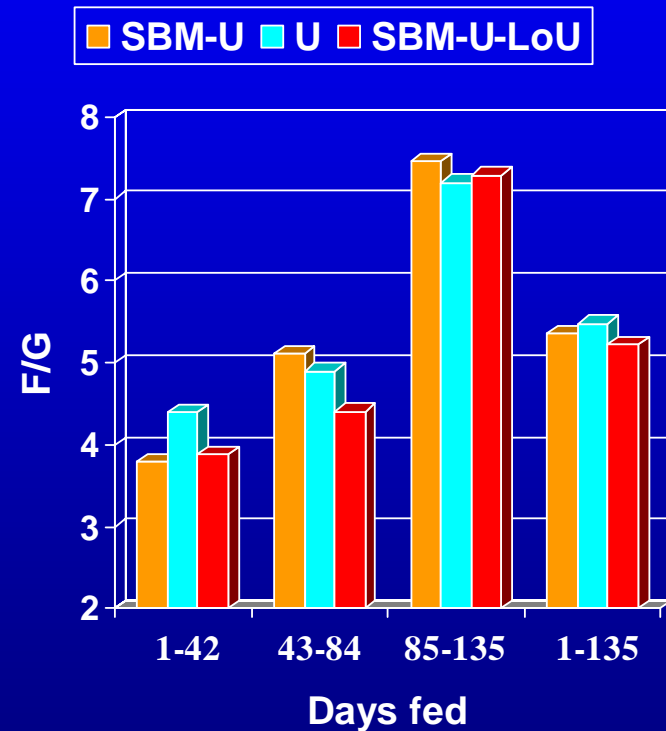
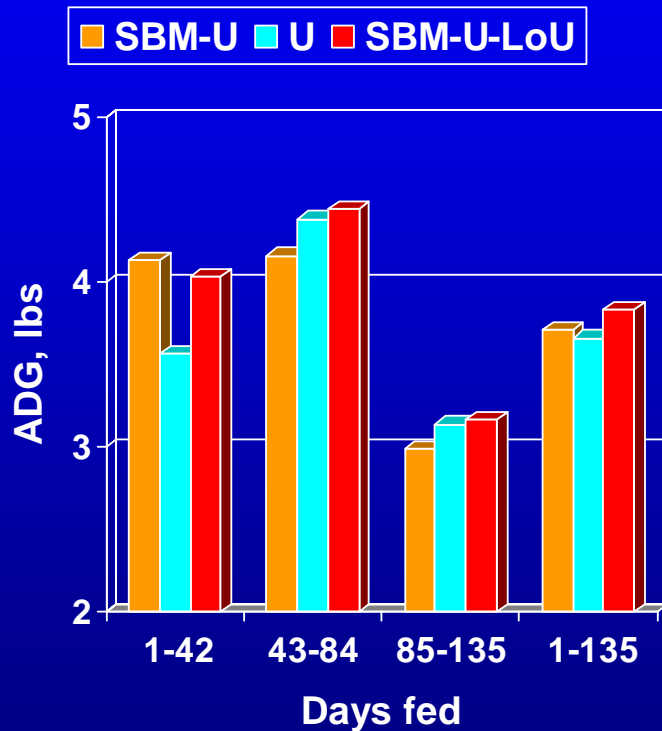
Does all of DIP requirement need to be satisfied when high protein diets are fed?

Response of Finishing Heifers Fed Urea with Dry Distillers Grains

	10 DG	10 DG+U	20 DG	20 DG+U
DIP balance, g/d	-192	58	-111	81
Crude protein, %	11.2	13.4	13.4	15.1
DMI, lb/d	24.5	24.9	23.9	24.6
ADG, lb/d	3.51	3.68	3.55	3.60
F/G	7.02	6.79	6.82	6.95

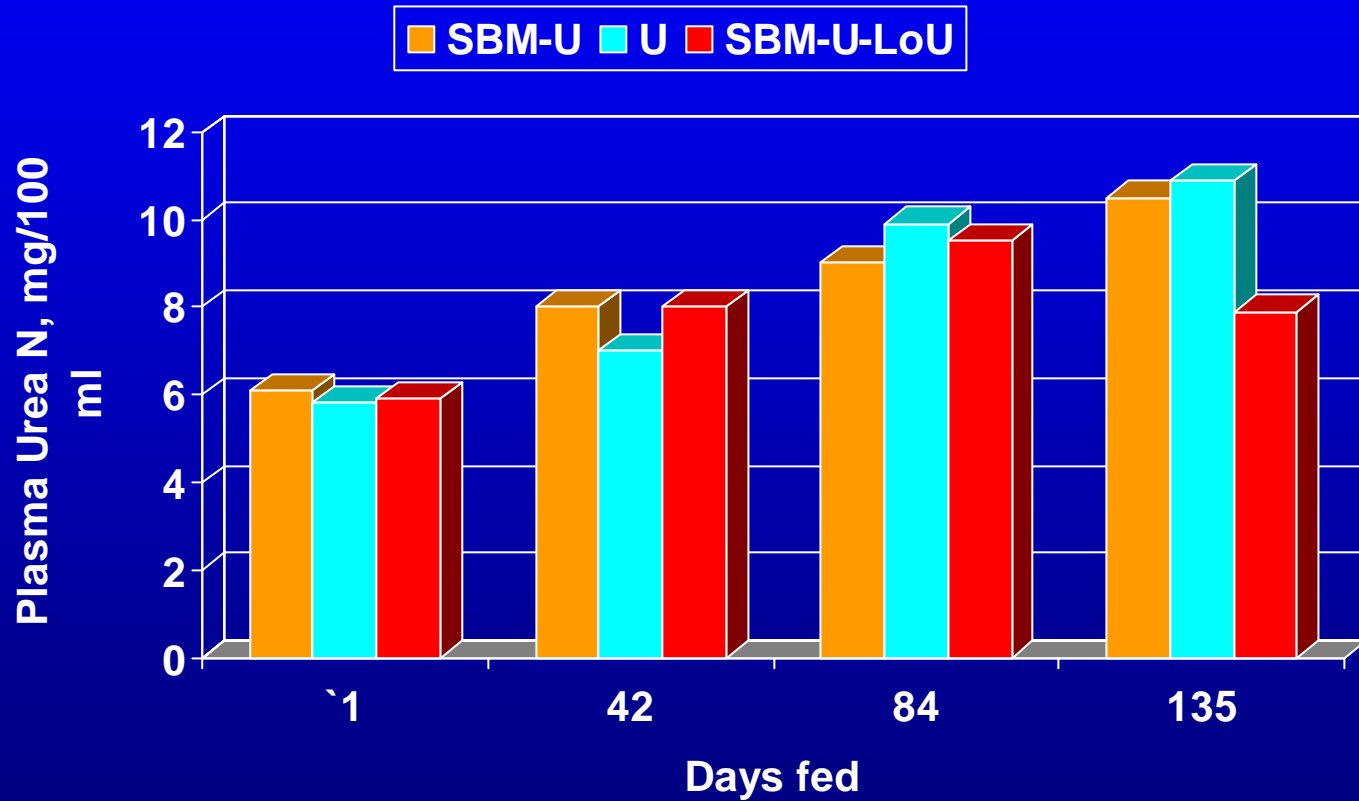
University of NE – 844 lb heifers fed 100 days

Phase Feeding Supplemental Protein to Finishing Steers



ISU – Yearling steers fed dry rolled corn and corn silage

Effect of Phase Feeding Supplemental Protein on Plasma Urea



Conclusions

Upper limit for Today's DGS

- 25 to 30% of diet dry matter for finishing cattle
- Less for growing and cow diets
 - Supply supplemental protein and energy

Modified DGS

1. Less oil and less protein
 - Probably increase up to 40 to 50% of diet DM for finishing cattle
2. Increase particle size
 - Could supply effective fiber for finishing diets
3. Reduce phosphorus
 - Less environmental impact of feeding higher levels

Evaluation of Distillers Solubles

	Ration		
	Urea	SBM	Wet DS 6.5%
DMI, lb/d	19.9	20.5	20.8
ADG, lb/d	2.96	3.37	3.55
F/G	6.72	6.10	5.86
Carcass wt, lb	713	728	755
% Choice	62.5	52.2	45.8
Backfat, in	0.38	0.40	0.40
YG	2.12	2.14	2.16

ISU – 790 lb heifers fed whole corn and 12% alfalfa pellets 125 days

Evaluation of Distillers Solubles

	Distillers solubles, % DM		
	0	4	8
DMI, lb/d	21.0	20.6	19.3
ADG, lb/d	3.46	3.57	3.24
F/G	6.08	5.78	5.99
Carcass wt, lb	780	777	767
% Choice	57.1	58.4	54.2
Backfat, in	0.35	0.36	0.37
YG	2.17	2.08	2.04

ISU – 850 lb steers fed dry rolled corn and 10% corn silage with 5% chopped hay for 126 days

Evaluation of Distillers Solubles

	Distillers solubles, % DM			
	0	4	8	12
DMI, lb/d	20.0	21.1	21.3	20.8
ADG, lb/d	3.86	3.92	3.87	3.95
F/G	5.21	5.40	5.51	5.27
Carcass wt, lb	770	767	780	774
% Choice	81.8	86.9	86.3	83.3
Marbling	585	546	587	563
YG	2.28	2.20	2.32	2.29

ISU – 850 lb steers fed dry rolled corn and 5% corn silage with 5% chopped hay for 109 days

Evaluation of Corn Steep Liquor

	Steep liquor, % DM	
	0	10
DMI, lb/d	20.6	20.8
ADG, lb/d	3.11	3.33
F/G	6.62	6.23
Carcass wt, lb	798	798
% Choice	77.8	64.7
Backfat, in	0.27	0.22
YG	1.98	1.66

ISU – 840 lb steers fed whole corn and 12% alfalfa pellets
for 145 days

Evaluation of Corn Steep Liquor

	Steep liquor, % DM		
	0	6	12
DMI, lb/d	23.1	22.4	22.2
ADG, lb/d	3.64	3.48	3.55
F/G	6.37	6.47	6.26
Carcass wt, lb	780	773	771
% Choice	57.1	54.2	50.0
Backfat, in	0.35	0.34	0.34
YG	2.17	2.00	1.79

ISU – 975 lb steers fed dry rolled corn and 10% corn silage with 5% chopped hay for 84 days