Fat removal from distillers grains

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Outline

- New process for oil removal
- Previous data on reduced fat distillers
- Impact of de-oiled distillers solubles
  - growing calves
- Impact of de-oiled modified distillers grains plus solubles and distillers solubles
  - feedlot performance
- Conclusions

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DRY MILLING- WDG(+S)

GRAIN

↓ GRIND, WET, COOK, ENZYMES
YEAST

FERMENTATION

↓

STILL → ALCOHOL & CO_2

↓

STILLAGE

↙ ↘

DISTILLERS GRAINS
WDG, DDG

DISTILLERS SOLUBLES

↘ ↙

WDGS
DDGS

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Distillers Grains Plus Solubles Production

Wet Distillers Grains
Starch

Thin Stillage
Ethanol

Wet Distillers Grains
WDG

Solubles
Whole Stillage

Wet Distillers Grains with Solubles
WDGS
(or Modified, or Dry)

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Introduction

- In 2012, approximately 50% of ethanol plants are removing oil and producing a de-oiled product
- This thin stillage is centrifuged to remove "free" oil which can be marketed
- In general:
  - 12-13% fat (normal)
  - 1/3 in solubles, 2/3 in grains
  - Remove the 1/3 in solubles
  - De-oiled: 8-9% fat (new normal?)

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Effects of the grains to solubles ratio in diets containing wet distillers grains fed to feedlot steers

C. M. Godsey, M. K. Luebbe, G. E. Erickson, T. J. Klopfenstein. University of Nebraska, Lincoln.

Abstract #82: 2008 Midwest ASAS

2009 Nebraska Beef Report

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Objective

To determine if the grains to solubles ratio in feedlot finishing diets containing wet distillers grains (WDG) plus solubles affects cattle performance and carcass characteristics.

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Materials and Methods

- 336 crossbred steers (390 ± 14 kg)
- Limit fed at 2% BW for 5 d prior to initiation
- Weighed 2 consecutive days
- Blocked by initial BW
- 7 treatments
- 6 replications/treatment

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Materials and Methods

- Delayed implant 30 d following initiation
  - Revalor S®
- 140 DOF
- Slaughtered at commercial abattoir
  - Identification, HCW, liver score
- 48 hr chill
  - Fat depth, LM area, marbling score
  - YG calculation

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Diet Design

- By-product feeds were supplied from separate ethanol plants
  - No solubles added back to WDG
- WDG and solubles combined with other ingredients in feed truck at time of feeding

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Experimental Diets

Ingredient	CON[a]	20% Distillers			40% Distillers		
		100:0	85:15	70:30	100:0	85:15	70:30
Corn[b]	82.5	67.5	67.5	67.5	47.5	47.5	47.5
WDG	--	20.0	17.0	14.0	40.0	34.0	28.0
Solubles	--	--	3.0/20	6.0/20	--	6.0/40	12.0/40
Alfalfa hay	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Supplement[c]	5.0	5.0	5.0	5.0	5.0	5.0	5.0

[a] Control diet contained 5.0% molasses on a DM basis. Supplement formulated to contain 1.3% urea, 0.13% tallow, 0.06% potassium, 150 mg/hd/d Thiamine, 320 mg/hd/d Rumensin, and 90 mg/hd/d Tylan.
[b] Corn was a 50:50 blend of high-moisture corn and dry-rolled corn (DM basis)
[c] Treatment supplement formulated to contain 1.5% limestone, 0.13% tallow, 150 mg/hd/d Thiamine, 320 mg/hd/d Rumensin, and 90 mg/hd/d Tylan

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Lipid Analysis Comparison

Diet	Inclusion (% DM) WDG	Inclusion (% DM) Solubles	% EE (DM basis) [a]	Solvent Extraction [b]
Control	0	0	3.1	3.1
100:0	20	0	4.6	4.6
85:15	17	3	5.1	4.7
70:30	14	6	5.7	4.9
100:0	40	0	5.9	5.9
85:15	34	6	6.9	6.3
70:30	28	12	8.0	6.7

[a] Ether extract analysis for WDG and solubles were 10.0% and 27.8% EE (DM basis), respectively
[b] Solvent extraction analysis for solubles was 16.1% fat (DM basis)

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WDG Level X Solubles Ratio Interaction

	CON	20% Distillers 100:0	20% Distillers 85:15	20% Distillers 70:30	40% Distillers 100:0	40% Distillers 85:15	40% Distillers 70:30	Interaction P-Value
DMI, kg/d	11.6	11.7	11.5	11.6	11.3	11.2	11.6	0.49
ADG, kg/d	1.67	1.78	1.74	1.75	1.75	1.75	1.82	0.61
G:F	0.144	0.152	0.151	0.154	0.154	0.156	0.158	0.90
HCW, kg	392	401	398	402	399	399	406	0.62
Marbling[a]	557	558	564	567	543	528	564	0.46
Fat depth, mm	13.49	14.67	13.83	14.50	15.77	14.97	16.28	0.86
LM area, cm^2	90.6	90.2	91.8	89.8	88.1	89.6	88.9	0.85
YG[b]	3.12	3.33	3.15	3.36	3.51	3.36	3.58	0.98

[a] Marbling score = 400 = slight^{00}, 500 = small^{00}, etc.
[b] Calculated YG = 2.5 + (Fat depth*2.5) + (0.0038*HCW) – (0.32*LMA)+(0.2*KPH)

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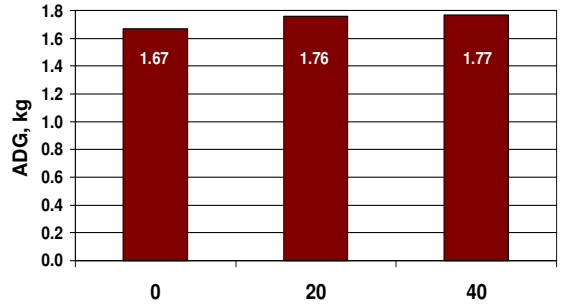
WDG Level Performance



L = 0.02
Q = 0.17
SEM = 0.02

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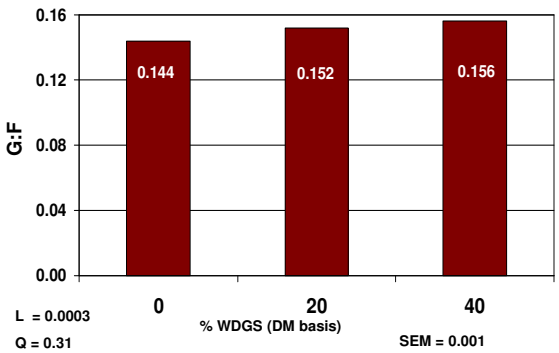
WDG Level Performance



L = 0.0003
Q = 0.31
SEM = 0.001

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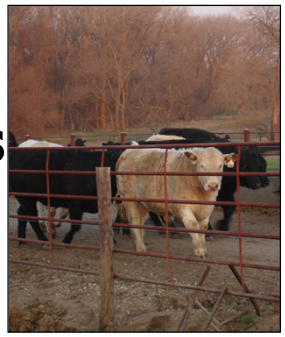
DG: Solubles Ratio



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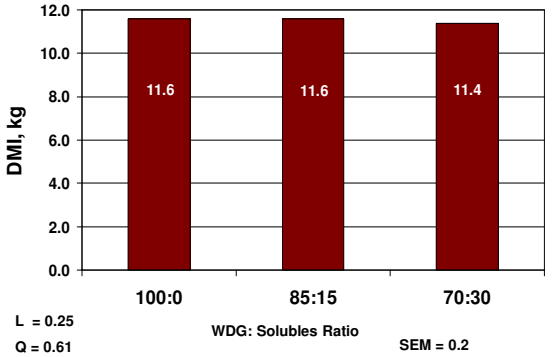
DG:Solubles Ratio Performance



L = 0.25
Q = 0.61
SEM = 0.2

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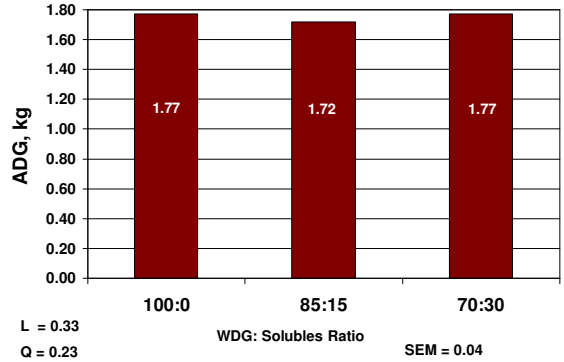
DG:Solubles Ratio Performance



L = 0.33
Q = 0.23
SEM = 0.04

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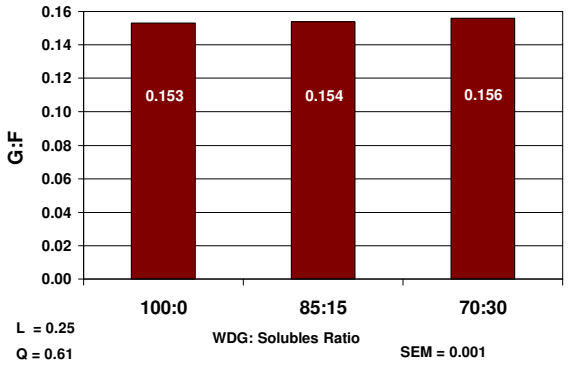
DG:Solubles Ratio Performance



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DG:Solubles Ratio Performance

	WDG:Solubles Ratio				Linear	Quadratic
	100:0	85:15	70:30	SEM	*P-Value*	*P-Value*
HCW, kg	400	398	403	3	0.28	0.24
Fat depth, mm	15.2	14.4	15.5	0.7	0.01	0.63
Marbling[a]	545	541	560	13	0.30	0.36
LM area, cm^2	89.0	91.0	89.7	1.2	0.87	0.15
YG[b]	3.41	3.25	3.46	0.10	0.60	0.03

[a] Marbling score = 400 = slight^{00}, 500 = small^{00}, etc.
[b] Calculated YG = 2.5 + (fat depth*2.5) + (0.0038*HCW) – (0.32*LMA)+(0.2*KPH)

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Corn oil extraction in distillers grains and condensed distillers solubles

M. L. Jolly, B.L. Nuttelman, C. J. Schneider, A. L. Shreck, J. L. Harding, D. Burken, G.E. Erickson, T. J. Klopfenstein

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Objective

- Evaluate with and without fat removal in condensed distillers solubles in forage diets on growing performance

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Materials and methods

- 84 d, 60 crossbred steers
- Individually fed using the Calan gate system
- Based on initial BW, steers were stratified and randomly assigned to treatments

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Materials and methods

- Treatments (7)
  - 2x2+1 factorial: Comparing level of CDS by fat
    - Fat: De-oiled (6.3%) and Normal (20.1) fat
    - Level: 0 (Control), 20 and 40%
  - 2x2 factorial: Comparing forage by fat
    - Fat: De-oiled and Normal fat
    - Forage: 40% Grass, 40% Wheat Straw

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Growing Diets

	Control	De-oiled CDS		Normal Fat CDS		De-oiled WS[2]	Normal Fat WS[2]
Ingredient, % DM	0	20	40	20	40	40	40
Brome Hay	77.1	59.6	42.2	59.6	42.2	-	-
Sorghum Silage	19.3	14.9	10.5	14.9	10.5	-	-
Wheat Straw	-	-	-	-	-	55.2	55.2
CDS: De-oiled	-	20	40	-	-	40	-
CDS: Normal Fat	-	-	-	20	40	-	40
Supplement	3.7	5.5	7.3	5.5	7.3	4.8	4.8

[1]Formulated to provide 200 mg/hd/d Monensin
[2]WS = Wheat Straw

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Ingredient Nutrient Analysis

	De-Oiled CDS	Normal Fat CDS
Fat, %	6.3	20.1
CP, %	28.0	26.4
Sulfur	0.99	0.83
DM, %	27.0	27.5

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Dietary Nutrient Analysis

	Control	De-Oiled CDS		Normal CDS		De-Oiled WS	Normal WS
CDS Inclusion, %	0	20	40	20	40	40	40
Dietary Fat, %	1.47	2.39	5.15	3.23	8.83	2.91	8.42

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Results: Level*Fat

Grass Hay and Silage

		De-oiled (6.3%)		Normal Fat (20.1%)			De-oiled	Normal
	0	20	40	20	40	Fat[1]	Lin	Lin
IBW	530	532	527	531	528	0.99	0.98	0.78
EBW	637	702	770	712	783	0.54	<0.01	<0.01
DMI	12.5	15.3	16.5	14.3	17.2	0.85	<0.01	<0.01
ADG	1.27	2.01	2.88	2.15	3.03	0.21	<0.01	<0.01
F:G	9.80	7.58	5.71	6.67	5.65	0.07	<0.01	<0.01

[1]Effect of fat type
No level*fat interaction observed, $P > 0.14$
Low and high fat quadratic response, $P > 0.10$

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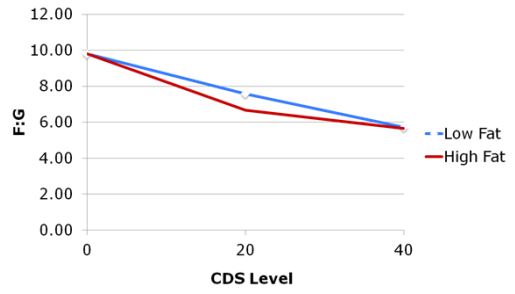
F:G



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Results: Forage*Fat Type

	Grass:Silage[1]		Wheat Straw		*P*-value		
	De-Oiled	Normal	De-Oiled	Normal	F*F[2]	Fat[3]	Forage[4]
IBW	527	528	527	529	0.94	0.89	0.97
EBW	770	783	686	674	0.43	0.97	<0.01
DMI	16.4[a]	17.1[a]	13.4[b]	11.5[c]	0.06	0.41	<0.01
ADG	2.88	3.03	1.89	1.72	0.13	0.92	<0.01
F:G	5.71	5.65	6.99	6.76	0.84	0.50	<0.01

[a,b,c] Within a row, means without a common superscript differ ($P < 0.05$)
[1]Grass Hay 80%, Sorghum Silage 20%
[2]F*F = Forage by fat interaction term
[3]Effect of fat type
[4]Effect of forage type

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Oil Extraction in MDGS and CDS on Feedlot Performance

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Objective

- Evaluate MDGS and CDS with and without corn oil removal on feedlot performance and carcass characteristics

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Materials and Methods

- 225 Calf fed steers
- 25 pens (9 head per pen)
  - Blocked by BW and assigned randomly to treatment
- Implanted with Rev-IS (d 1) and Rev-S (d 83)
- 179 DOF
- Samples were taken from by-products directly from truck and analyzed as well as weekly samples
- All modified distillers grains plus solubles prior to experiment; same plant, different week
- All CDS from same plant, about every 3 weeks

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Materials and Methods

- Treatments
  - 2x2+1 factorial arrangement
  - Level: De-oiled and Normal fat
    - De-oiled CDS = 6.0%
    - Normal fat CDS = 21.1%
    - De-oiled MDGS = 9.2%
    - Normal fat MDGS = 11.8%
  - Inclusions: 27% CDS or 40% MDGS

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Finishing Diets

	Control	27% CDS		40% MDGS	
		De-Oiled	Normal	De-Oiled	Normal
HMC	43.75	30.25	30.25	23.75	23.75
DRC	43.75	30.25	30.2	23.75	23.75
MDGS: De-oiled	-	-	-	40	-
MDGS: Normal	-	-	-	-	40
CDS: De-oiled	-	27	-	-	-
CDS: Normal	-	-	27	-	-
Sorghum Silage	7.5	7.5	7.5	7.5	7.5
Supplement	5	5	5	5	5

Diets formulated to contain 345 mg/steer Monensin and 90 mg/steer Tylan daily

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Ingredient Nutrient Analysis

	27% CDS		40% MDGS	
	De-Oiled	Normal	De-Oiled	Normal
Fat, %	6.0	21.1	9.2	11.8
CP, %	29.6	27.0	33.7	33.0
Sulfur	1.26	0.78	0.65	0.56
DM, %	27.0	27.5	46.0	46.5

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Dietary Nutrient Analysis

	Control	27% CDS		40% MDGS	
		De-Oiled	Normal	De-Oiled	Normal
Dietary Fat, %	4.43	4.72	8.80	6.12	7.19

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Performance

	Control	De-oiled CDS	Normal CDS	De-oiled MDGS	Normal MDGS	F-Test	CDS	MDGS
Initial BW, lb	662	661	663	662	661	0.39	0.07	0.68
Final BW, lb	1248^{a}	1293^{b,c}	1277^{a,b}	1308^{b,c}	1318^{c}	0.01	0.43	0.61
DMI, lb/d	20.8^{a}	19.4^{b}	19.4^{b}	20.5^{a}	20.8^{a}	0.01	0.97	0.58
ADG, lb	3.28^{a}	3.53^{b,c}	3.43^{a,b}	3.61^{b,c}	3.67^{c}	0.02	0.36	0.60
F:G	6.36^{a}	5.49^{b}	5.66^{b}	5.69^{b}	5.67^{b}	<0.01	0.29	0.80

^{a,b,c} Within a row, means without a common superscript differ ($P < 0.05$)

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Carcass Characteristics

	Control	De-oiled CDS	Normal CDS	De-oiled MDGS	Normal MDGS	F-Test	CDS	MDGS
HCW, lb	786^{a}	814^{b,c}	805^{a,b}	824^{b,c}	830^{b,c}	0.01	0.43	0.61
LM area,in	12.56	13.19	12.81	12.80	12.65	0.38	0.25	0.66
12th rib fat, in	.50	.50	0.47	0.53	0.56	0.28	0.47	0.47
YG	3.21	3.11	3.15	3.37	3.49	0.13	0.81	0.44
Marbling Score[1]	570	579	575	594	599	0.50	0.85	0.77

^{a,b,c} Within a row, means without a common superscript differ ($P < 0.05$)
[1]Marbling score: 500 = Small 00

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Conclusion

- Growing Cattle
  - 20% inclusion of CDS: High fat CDS tended to have improved feed efficiency compared to low fat but low fat CDS still has improved feed efficiency compared to controls
  - 40% inclusion of CDS: Both low and high fat had similar performance

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Conclusion

- Finishing Cattle
  - Cattle fed CDS or MDGS, regardless of fat content, had greater final BW, ADG, and HCW compared to controls
  - Feed conversion, regardless of fat content, was greatly improved for CDS or MDGS compared to controls
  - Data suggests that cattle fed de-oiled distillers or solubles have comparable performances to normal fat using the centrifugation process of removing oil from solubles

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