Does removing nutrient components from distillers grains affect the feeding value for beef cattle

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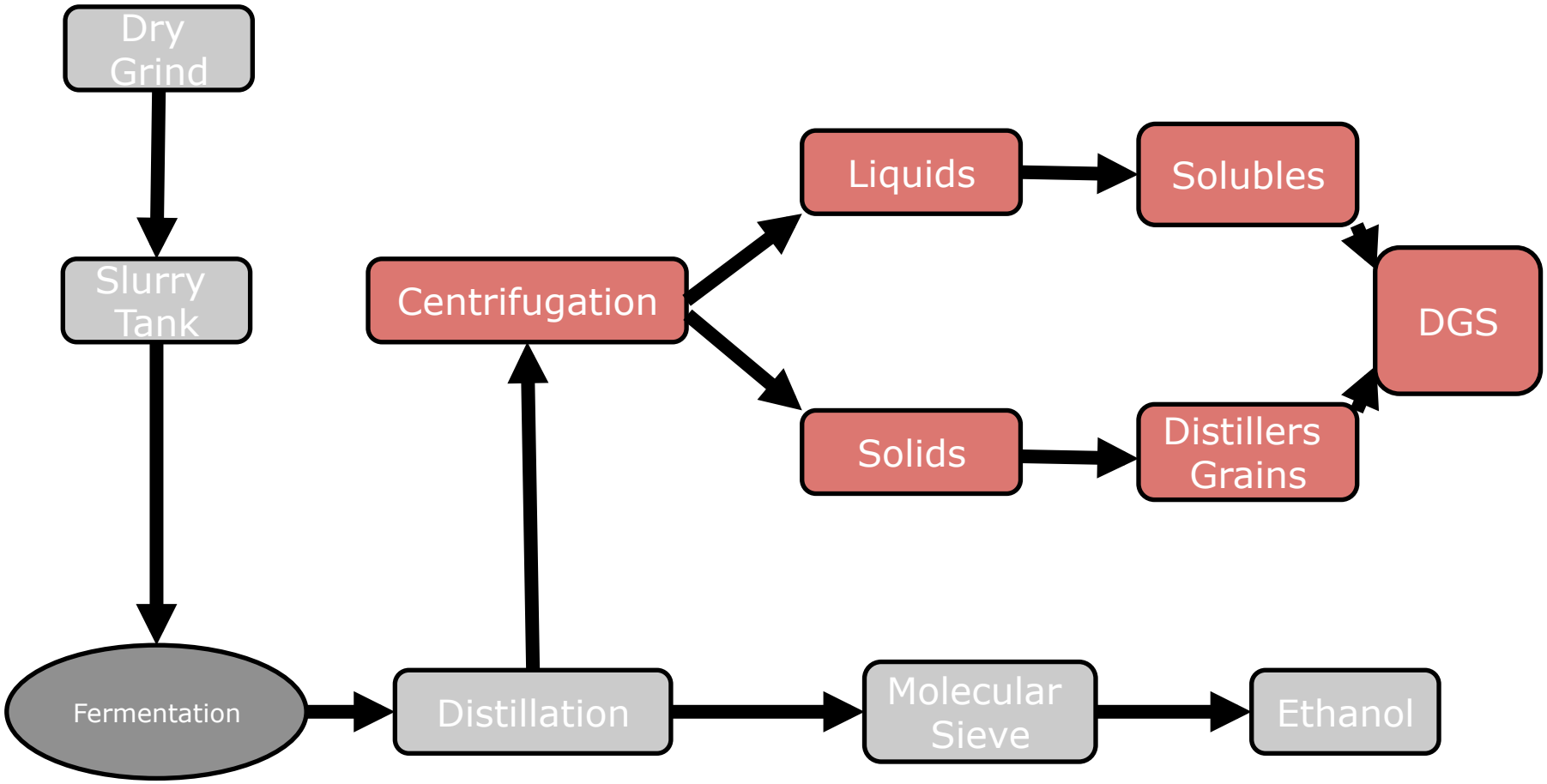
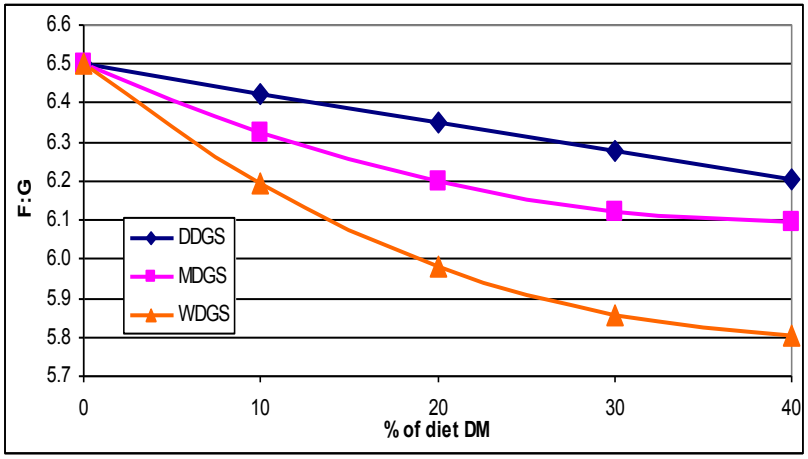
Ethanol Production



Drying Impact - performance



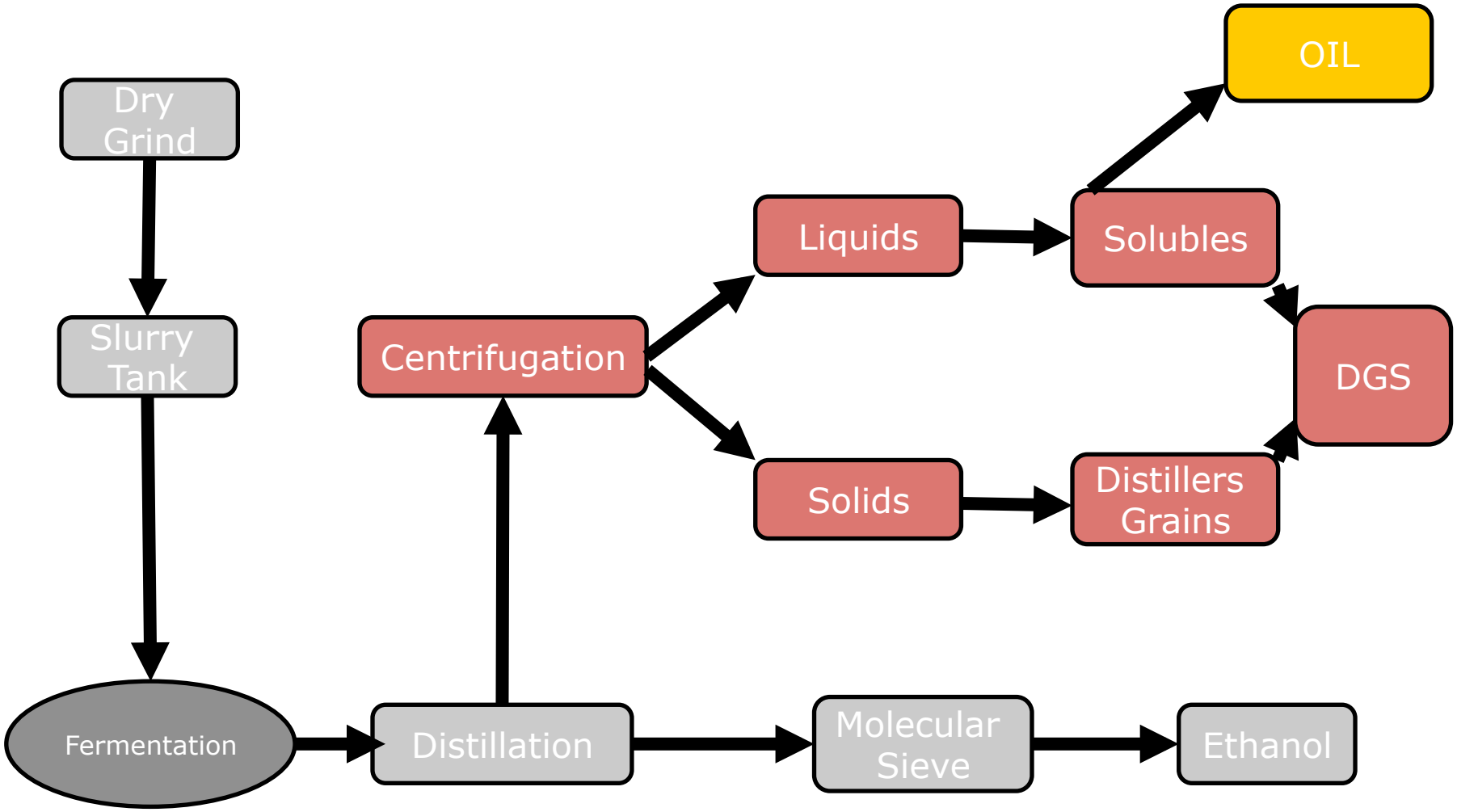
Value of DGS, relative to corn

	10	20	30	40
WDGS	150	143	136	130
MDGS	128	124	120	117
DDGS	112	112	112	112

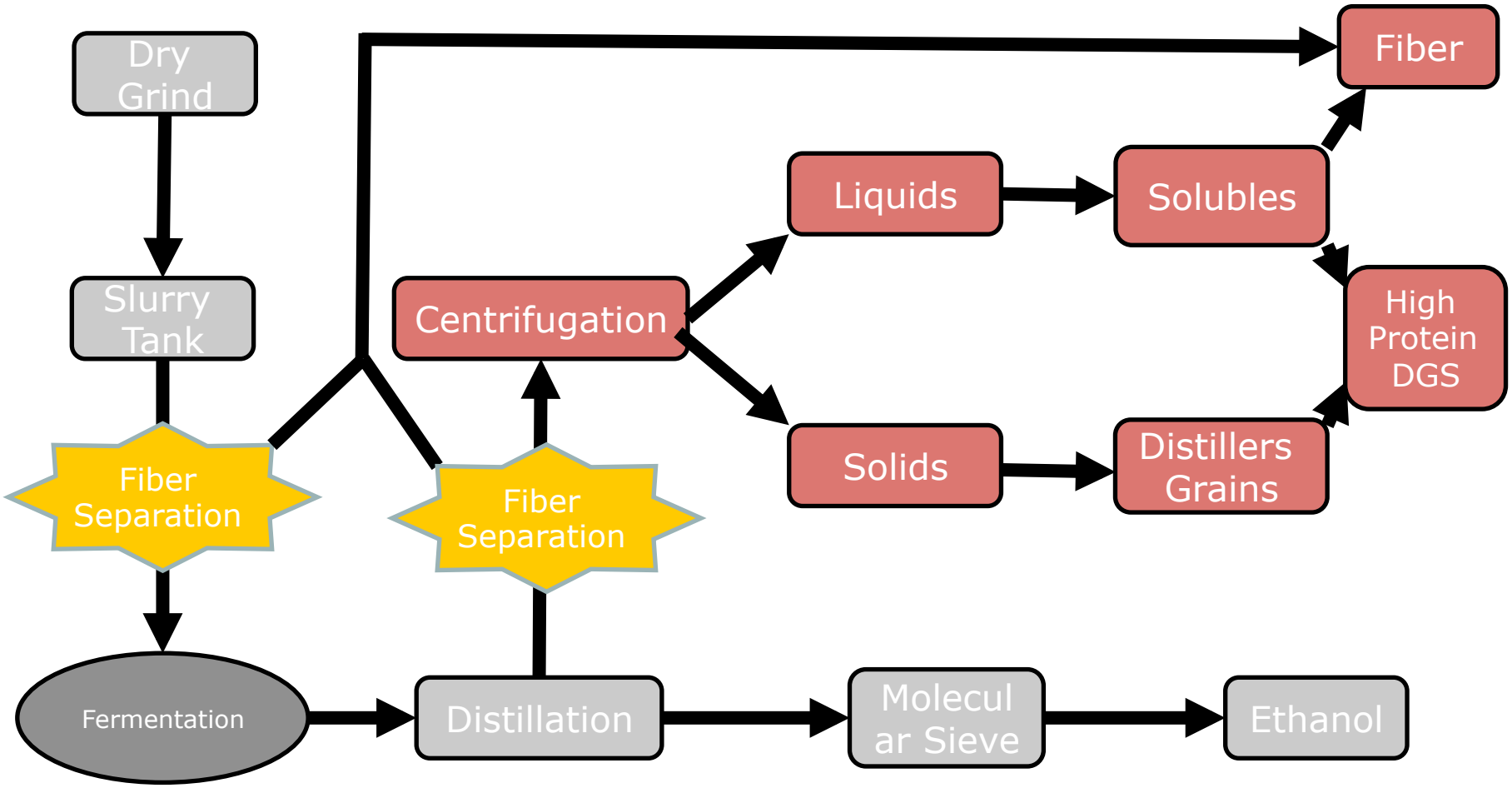
- WDGS
  (20 Exp, 3,365 steers, 350 pens)
- DDGS
  (4 Exp, 581 steers, 66 pens)
- MDGS
  (4 Exp, 680 steers, 85 pens)

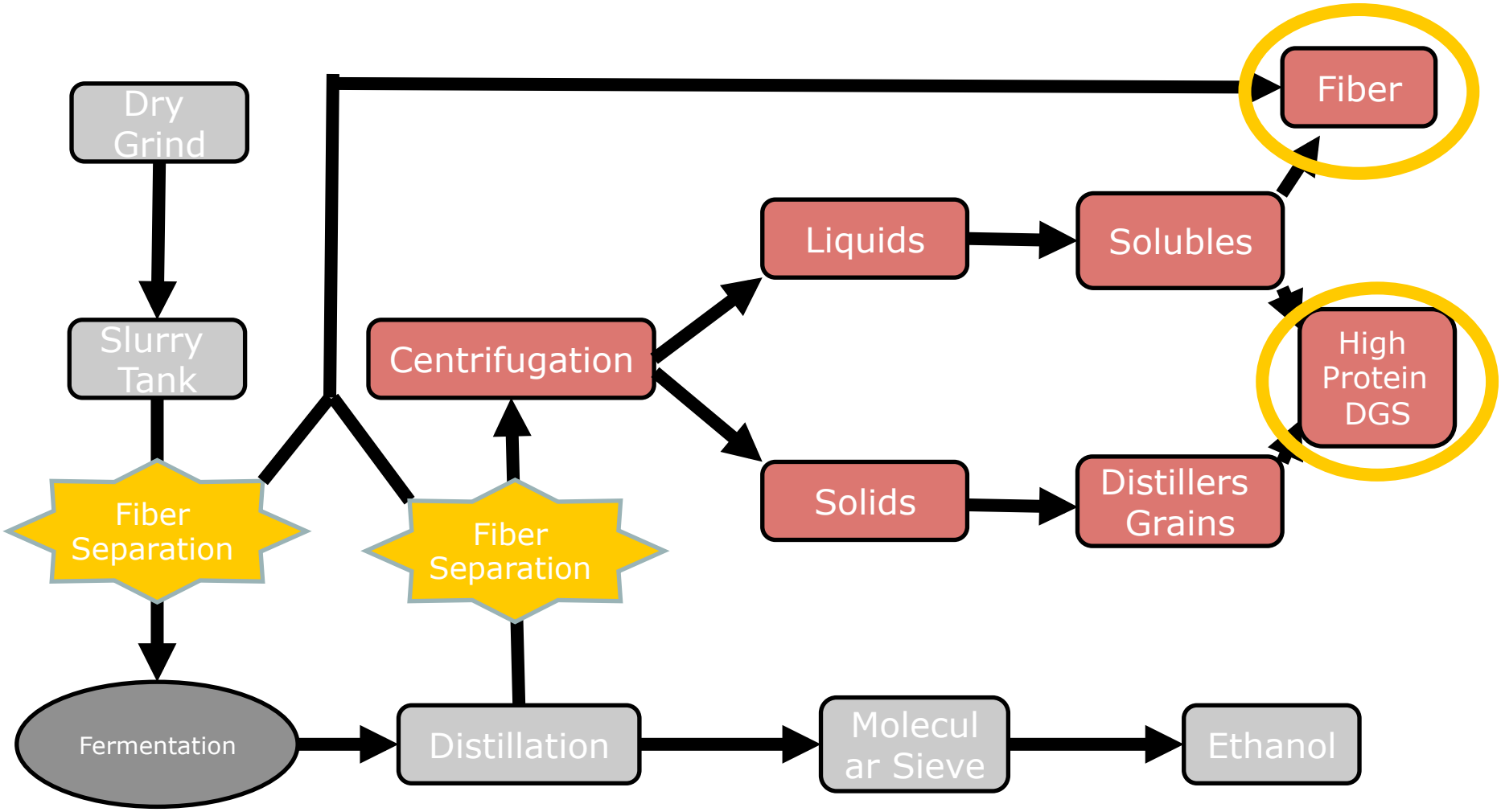
Bremer et al., 2011 Prof. Anim. Scient.

OIL Removal


Dry Grind
Slurry Tank
Fermentation
Distillation
Centrifugation
Liquids
Solids
Solubles
Distillers Grains
OIL
DGS
Molecular Sieve
Ethanol

Fiber Removal



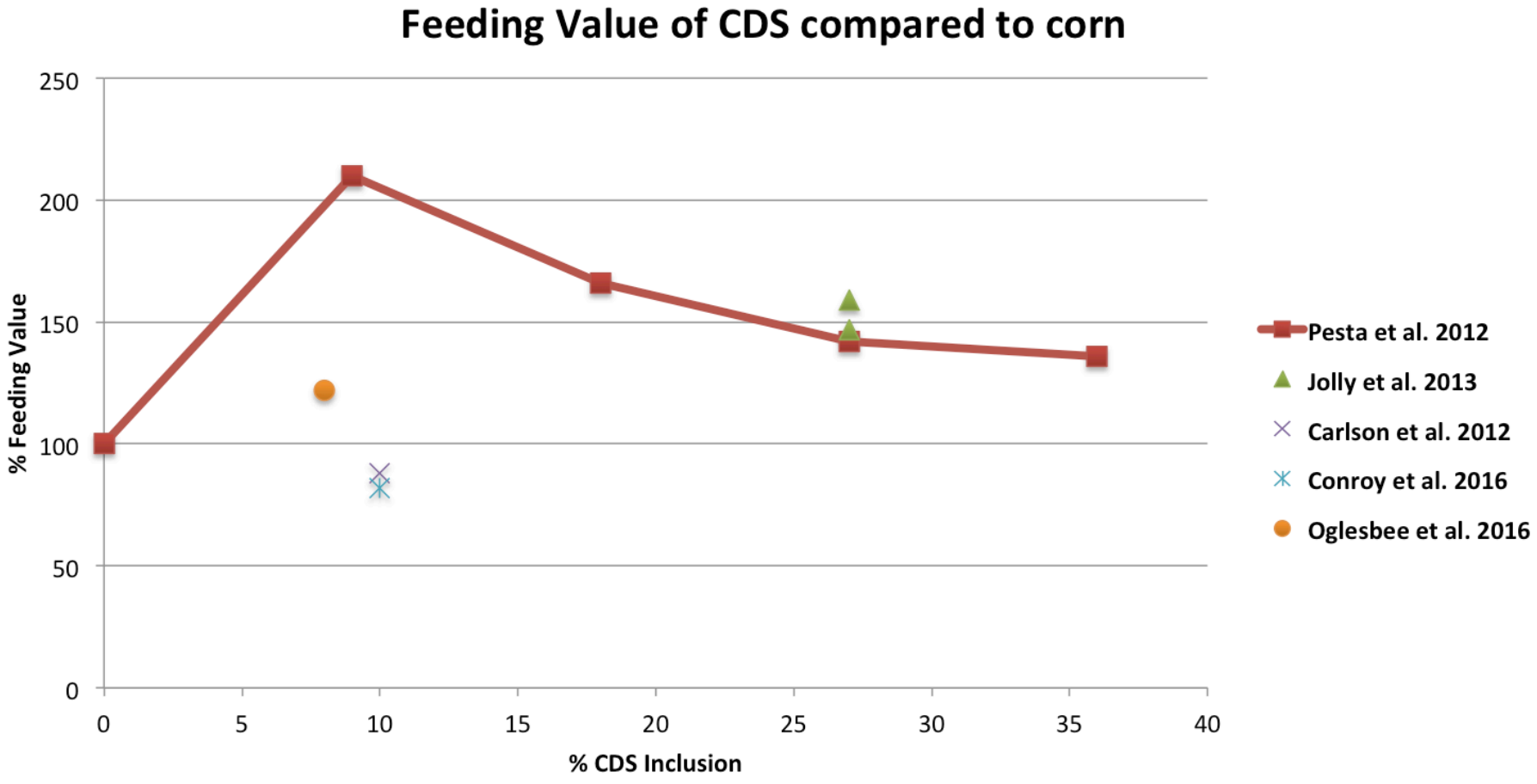

Dry Grind
Slurry Tank
Fiber Separation
Fermentation
Fiber Separation
Distillation
Centrifugation
Liquids
Solids
Solubles
Distillers Grains
Fiber
High Protein DGS
Molecular Sieve
Ethanol

Nutrient profiles of corn and various sources of distillers grains

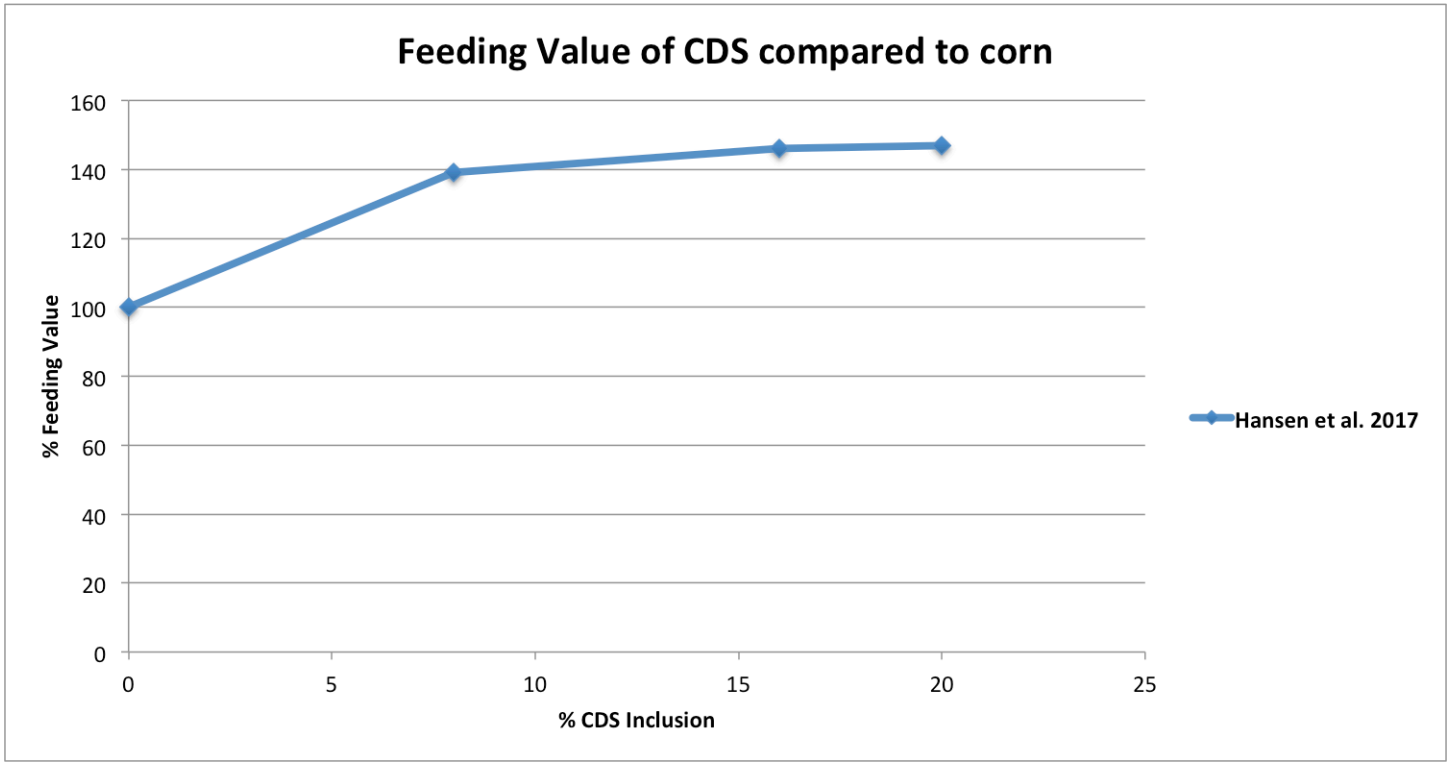
Item	Corn[1]	Traditional DGS[2]	Low-fat DGS[3]	Low-fat high-protein DGS[4]
CP	8.79	31.0	33.5	45.6
Fat	3.81	11.9	7.67	4.81
NDF	9.72	30.1	32.2	33.6
Phosphorus	0.29	0.83	1.03	0.63
Sulfur	0.11	0.77	0.61	0.42

[1]NAEMS, 2016.
[2]Buckner et al., 2011.
[3]Compiled from Bremer, 2014; Carlson et al. 2015; Diaz-Royon et al., 2012; Jolly et al., 2013; Jolly et al., 2014.
[4]Compiled from Carlson et al. 2015; Diaz-Royon et al., 2012.

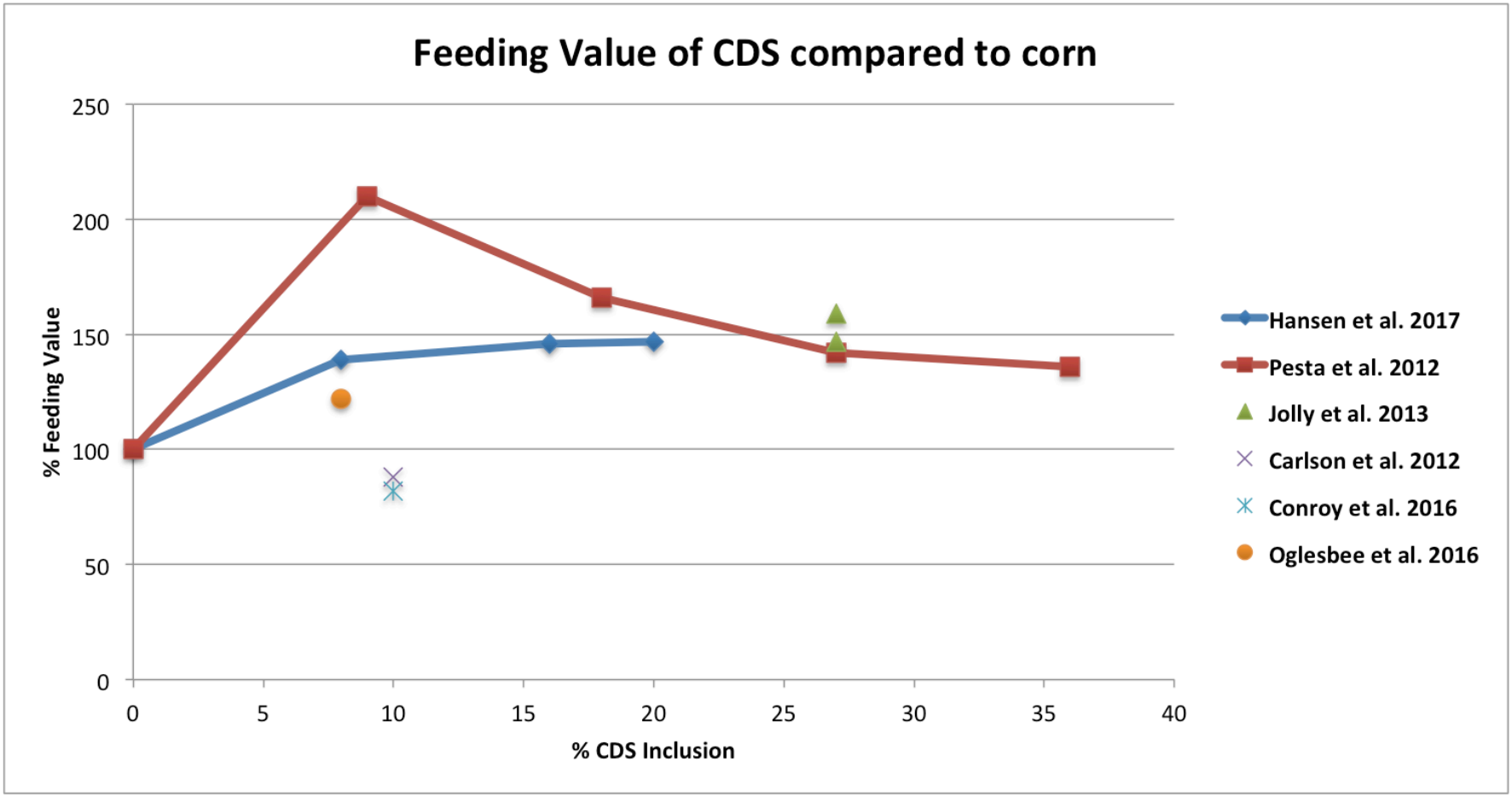
Oil
Fiber
Fiber + Solubles
Protein



Hansen et al., 2018



Hansen et al., 2018



Hansen et al., 2018

Value of fat in distillers

	CON	FF MDGS	DO MDGS	MDGS + OIL
DRC	42.50	23.75	23.75	23.75
HMC	42.50	23.75	23.75	23.75
FF-MDGS	-	40.00	-	-
DO-MDGS	-	-	40.0	38.0
Oil	-	-	-	2.0
Alfalfa	3.50	3.50	3.50	3.50
Sorghum Silage	4.00	4.00	4.00	4.00
Supplement	7.50*	5.00	5.00	5.00

Empyreal fed at 2% for 50 days; then 1% until day 85

320 steers; 32 pens; 8 reps

Burhoop et al., 2017

Value of fat in distillers

	CON	FF MDGS	DO MDGS	MDGS + OIL
OM, %	95.95	95.19	93.30	95.28
NDF, %	11.03	22.64	22.69	21.97
DE, Mcal/lb	1.59	1.66	1.63	1.51
Fat, %	4.16	7.09	6.04	7.86

Burhoop et al., 2017

Value of fat in distillers

	CON	FF MDGS	DO MDGS	MDGS + OIL	SEM	F-test
Initial BW, lb	924	926	926	925	1.0	0.43
Final BW, lb	1375^{b}	1402^{ab}	1422^{a}	1412^{a}	12	0.04
DMI, lb/d	22.7^{b}	22.4^{b}	23.7^{a}	22.1^{b}	0.34	0.01
ADG, lb	3.36^{b}	3.55^{ab}	3.71^{a}	3.63^{a}	0.09	0.06
F:G	6.76^{c}	6.29^{ab}	6.37^{b}	6.06^{a}	-	0.003
HCW, lb	866^{b}	883^{ab}	896^{a}	890^{a}	8	0.05
12th rib fat	0.47^{b}	0.55^{a}	0.56^{a}	0.54^{a}	0.02	0.01
Marbling*	463	467	458	446	13	0.64
LM Area, in^{2}	13.6	13.4	13.7	13.7	0.2	0.52

*400 = Small^{00}

Burhoop et al., 2017

Value of fat in distillers

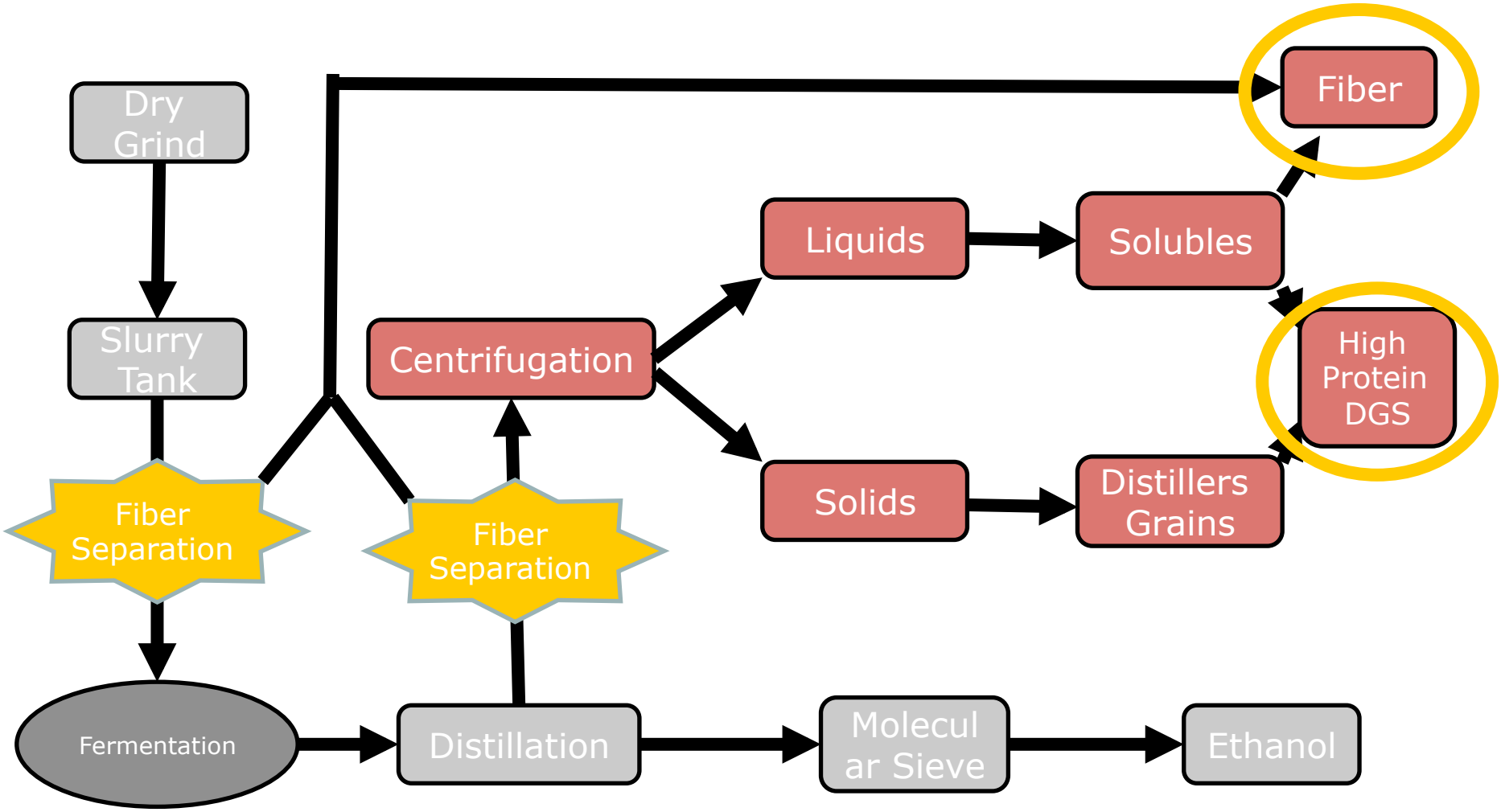
	CON	FF MDGS	DO MDGS	MDGS + OIL	SEM	F-test
Initial BW, kg	419	420	420	420	0.5	0.43
Final BW, kg	624^{b}	636^{ab}	645^{a}	640^{a}	5.6	0.04
DMI, kg/d	10.3^{b}	10.2^{b}	10.8^{a}	10.0^{b}	0.15	0.01
ADG, lb	1.52^{b}	1.61^{ab}	1.68^{a}	1.65^{a}	0.04	0.06
F:G	0.148^{c}	0.159^{ab}	0.157^{b}	0.165^{a}	0.003	0.003

Burhoop et al., 2017

Comparison of feed efficiency from traditional and de-oiled distillers grains relative to corn control diets.

Reference	Item	Inclusion	Corn Control	Traditional Distillers	De-oiled Distillers	Trial SEM	% reduction
Jolly et al., 2013	DRC	40%	0.157[a]	0.176[b]	0.175[b]	0.004	0.5
Jolly et al., 2014	DRC	50%	0.155[a]	0.167[b]	0.163[b]	0.002	2.4
Bremer et al., 2014	Exp. 1 DRC	30%	0.140[a]	0.152[b]	0.147[b]	0.002	3.2
Bremer et al., 2014	Exp. 2 DRC	35%	0.127[a]	0.148[b]	0.144[b]	0.004	2.7
Bremer et al., 2014	Exp. 2 SFC	35%	0.140[a]	0.155[b]	0.147[b]	0.004	5.2
Burhoop et al., 2017	DRC	40%	0.148[a]	0.159[b]	0.157[b]	0.003	1.2
Average	-	38%	0.145	0.160	0.156	0.003	2.5

Oil removal reduced the value of distillers grains by **6.6%**


Dry Grind
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Fiber Separation
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Liquids
Solids
Solubles
Distillers Grains
Fiber
High Protein DGS
Molecular Sieve
Ethanol

Value of fiber in distillers

	CON	20MDGS	40MDGS	20FIB	40FIB
DRC	68.5	51.5	31.5	60.0	51.5
HMC	12.0	12.0	12.0	12.0	12.0
MDGS	-	20.0	40.0	-	-
SEM	-	-	-	1.5	3.0
Wet Corn Bran	-	-	-	7.0	14.0
Corn Silage	8.0	8.0	8.0	8.0	8.0
Alfalfa	3.5	3.5	3.5	3.5	3.5
SBM	3.0	-	-	3.0	3.0
Supplement	5.0	5.0	5.0	5.0	5.0

Burhoop et al., 2017

Value of fiber in distillers

	CON	20MDGS	40MDGS	20FIB	40FIB
CP	14.1	15.1	19.8	14.1	13.3
NDF	11.0	16.7	22.0	16.6	22.2
ADF	4.5	6.6	8.6	6.0	7.5
Lignin	1.7	2.3	2.9	1.9	2.2

Burhoop et al., 2017

Value of fiber in distillers

	CON	20MDGS	40MDGS	20FIB	40FIB	SEM	F-test
Initial BW, lb	915	916	916	915	915	0.9	0.63
Final BW, lb	1439^{b}	1473^{a}	1472^{a}	1428^{b}	1429^{b}	5.5	<0.01
DMI, lb/d	25.7^{c}	26.9^{a}	26.4^{b}	26.0^{bc}	26.3^{b}	0.2	<0.01
ADG, lb	3.81^{b}	4.05^{a}	4.04^{a}	3.73^{b}	3.74^{b}	0.04	<0.01
F:G	6.75^{b}	6.64^{ab}	6.53^{a}	6.97^{c}	7.03^{c}	-	<0.01
HCW, lb	907^{b}	928^{a}	928^{a}	900^{b}	901^{b}	3.5	<0.01
12th rib fat	0.53^{b}	0.58^{a}	0.59^{a}	0.52^{b}	0.55^{b}	0.01	<0.01
Marbling*	477^{b}	496^{a}	476^{b}	465^{b}	476^{b}	6.0	<0.01
LM Area, in^{2}	13.7	13.7	13.5	13.6	13.6	0.	

*400 = Small^{00}

Burhoop et al., 2017

Fiber-Removed Diets

	Control	WDGS	DDGS	HiPro DDGS	Bran+Sol
HMC	39.5	20.5	20.5	20.5	20.5
DRC	39.5	20.5	20.5	20.5	20.5
Corn Silage	15.0	15.0	15.0	15.0	15.0
HiPro DDGS	-	-	-	40.0	-
DDGS	-	-	40.0	-	-
WDGS	-	40.0	-	-	-
Bran+Sol	-	-	-	-	40.0
Supplement	6.5	4.0	4.0	4.0	4.0

WDGS

DDGS

HiPro DDG

Bran + Solubles

	Control	WDGS	DDGS	HiPro DDGS	Bran+Sol	*P* -Value
Initial BW	604	604	604	602	605	0.7
Final BW	1316^{b}	1314^{b}	1347^{ab}	1365^{a}	1385^{a}	0.03
DMI	21.6	21	21.4	21.2	21.3	0.62
ADG	3.76^{c}	3.75^{c}	3.93^{abc}	4.03^{ab}	4.11^{a}	0.02
F:G	5.71^{c}	5.59^{c}	5.46^{abc}	5.26^{ab}	5.18^{a}	0.02
HCW	829^{c}	828^{b}	849^{ab}	860^{ab}	872^{a}	0.03
LM Area	13.2	13.3	13.5	13.3	13.6	0.84
Marbling	463	453	480	461	454	0.69
Fat Depth	0.5	0.48	0.51	0.5	0.5	0.92
Calc. YG	3.2	3.1	3.2	3.3	3.2	0.86

Feeding Value	106%	111%	121%	126%

Garland et al., 2018

	CON[1]	20BRAN+SOL[2]	40BRAN+SOL[3]	20WDG[4]	40WDG[5]
Ingredients					
HMC	44	34	24	34	24
DRC	44	34	24	34	24
Grass Hay	7	7	7	7	7
WDGS	-	-	-	20	40
Bran + Sol	-	20	40	-	-
Supplement	5	5	5	5	5

[1]CON: Corn-based control diet with 50:50 blend of high-moisture and dry-rolled corn
[2]20BRAN+SOL: Bran + Solubles fed at 20% diet DM
[3]40BRAN+SOL: Bran + Solubles fed at 40% diet DM
[4]20WDG: Wet distillers grains fed at 20% diet DM
[5]40WDG: Wet distillers grains fed at 40% diet DM

Bran + Solubles

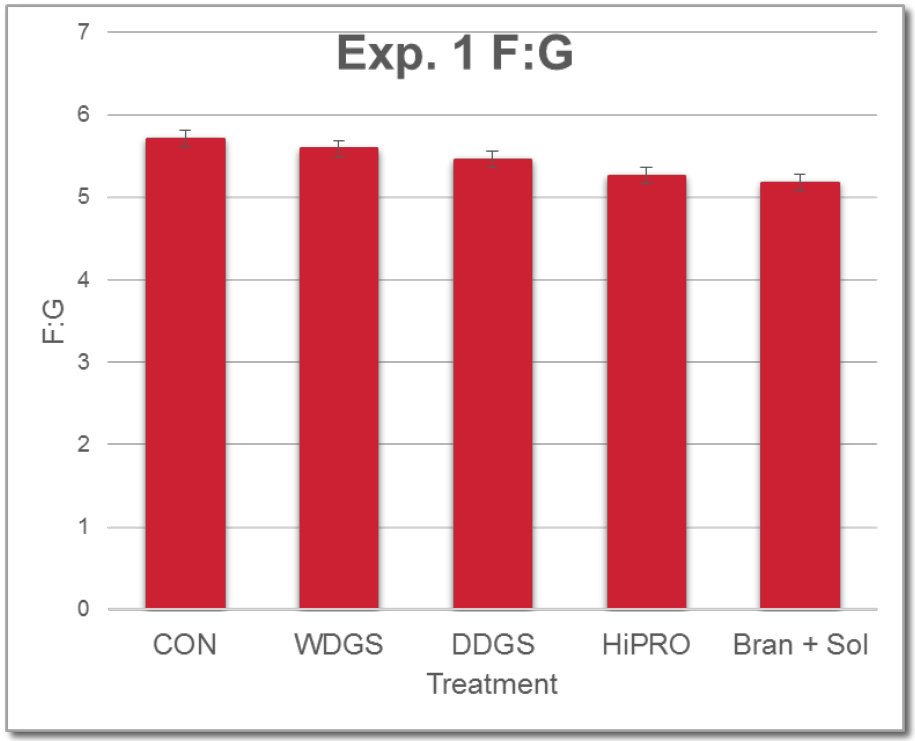
WDGS

	CON	20BRAN+ SOL	40BRAN+ SOL	20WDG	40WDG	SEM	F-test
Performance							
Initial BW, lb	915	914	913	917	914	1.4	0.34
Final BW, lb	1362^{b}	1420^{a}	1428^{a}	1428^{a}	1434^{a}	12.1	<0.01
DMI, lb/d	27.0^{c}	29.0^{ab}	29.4^{ab}	29.8^{a}	28.4^{b}	0.36	<0.01
ADG, lb	3.73^{b}	4.22^{a}	4.29^{a}	4.26^{a}	4.33^{a}	0.100	<0.01
Feed:Gain	7.21^{b}	6.86^{ab}	6.83^{ab}	6.96^{b}	6.55^{a}	<0.01	0.07
Carcass characteristics							
HCW, lb	862^{b}	895^{a}	907^{a}	903^{a}	907^{a}	7.9	<0.01
LM area, in^{2}	12.9	12.7	13.1	12.6	12.9	0.19	0.36
Marbling [1]	507^{ab}	524^{ab}	499^{b}	489^{b}	535^{a}	12.4	0.09
Fat depth, in	0.50^{b}	0.55^{ab}	0.55^{ab}	0.59^{a}	0.58^{a}	0.017	0.07
Calc YG [2]	3.27^{c}	3.58^{ab}	3.51^{b}	3.73^{a}	3.64^{ab}	0.078	<0.01

Values within rows with unique superscripts are different ($P \leq 0.05$)

[1]300 = Slight, 400 = Small, 500 = Modest

[2]Calculated as 2.5 + (2.5 x 12th rib fat, in) + (0.2 x 2.5(KPH, %)) – (0.32 x REA, in2) + (0.0038 x HCW, lb)


Exp. 1 F:G
F:G
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1
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4
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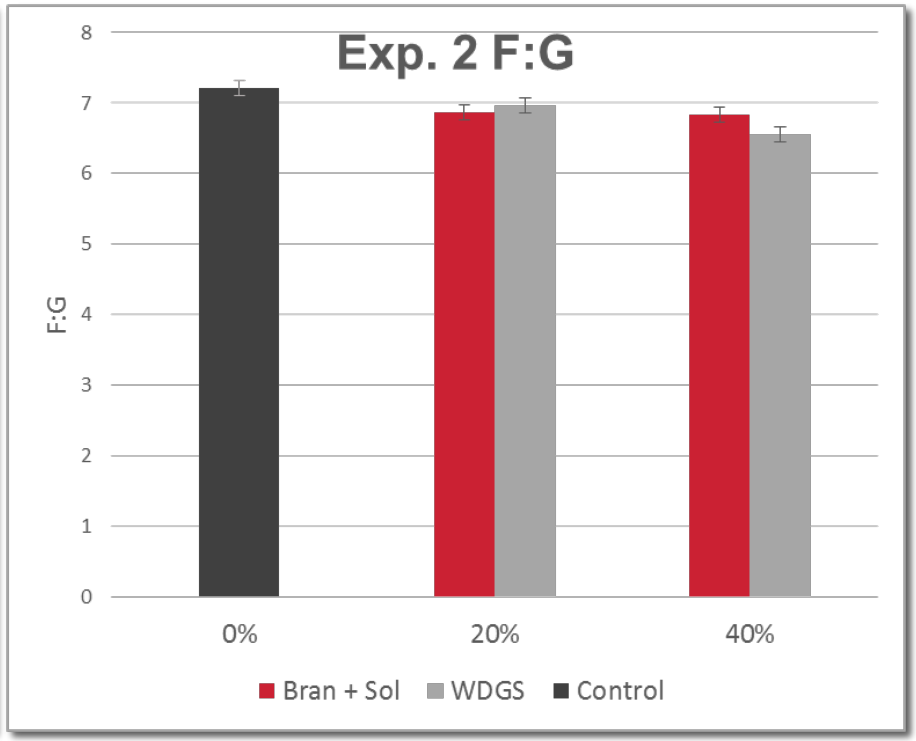
6
7
CON
WDGS
DDGS
HiPRO
Bran + Sol
Treatment


Exp. 2 F:G
F:G
0
1
2
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0%
20%
40%
Bran + Sol
WDGS
Control

Isolated components of distillers grains - growing

Item	CON	40 MDGS	SOL	PROT	FIBER	COMBO
Grass Hay	50.0	50.0	50.0	50.0	50.0	50.0
DRC	40.0	-	25.0	20.0	20.0	5.0
MDGS	-	40.0	-	-	-	-
CCDS	-	-	15.0	-	-	15.0
CGM	-	-	-	20.0	-	-
Corn bran	-	-	-	-	16.4	16.4
Germ	-	-	-	-	3.6	3.6
Soy Pass	5.0	5.0	5.0	5.0	5.0	5.0
Urea	1.05	-	0.49	-	0.79	0.25
Suppl.	3.95	5.0	4.51	5.0	4.21	4.75

Isolated components of distillers grains - growing

Item	CON	40 MDGS	SOL	PROT	FIBER	COMBO
CP	12.5	17.7	12.5	22.7	12.5	12.5
NDF	32.6	43.9	31.2	33.0	39.5	40.5
Fat	2.4	5.1	3.0	2.2	2.6	4.0

Isolated components of distillers grains - growing

Item	CON	40 MDGS	SOL	PROT	FIBER	COMBO	SEM
Initial BW	668	668	669	669	669	668	1
Ending BW	937^{c}	959^{a}	940^{bc}	950^{ab}	933^{c}	944^{bc}	6
DMI	21.6^{ab}	21.7^{a}	22.0^{a}	21.2^{ab}	20.8^{b}	22.0^{a}	0.4
ADG	3.32^{cd}	3.58^{a}	3.34^{bcd}	3.47^{ab}	3.26^{d}	3.40^{bc}	0.07
F:G	6.48^{b}	6.04^{a}	6.55^{b}	6.07^{a}	6.35^{ab}	6.41^{b}	-
Feeding Value	-	118%	93%	134%	110%	103%	-

Oil - oil removal reduces the value of distillers grains by approximately 6.6%

Fiber – Feeding fiber (bran) alone reduces performance compared to corn

Fiber + Solubles – Appears to have feeding value equal to distillers grains

Protein – Bypass protein significantly contributes to energy value of distillers grains

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