Use of By-Products in Growing and Stocker Diets

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By-Product Use

- Formulated in diets to replace:
  - Grain (corn)
  - Roughage (alfalfa hay)
  - Combination of grain and roughage
  - Proteins (SBM)
- Commonly used by-products originate:
  - Grain Milling Industries
  - Oil seed processing industries
  - Sugar and Dairy industries

Common By-Products

- Grain Milling:[a]
  - Corn Gluten Feed (wet or dry)
  - Distillers Grains (wet or dry)
  - Wheat Middlings
  - Food Processing & Industrial
- Oil Seed Processing
  - Soybean Hulls
  - Cotton by-products

[a] Includes grain processed for fuel ethanol.

Characteristics (Grain Milling)

- Compared to grain (corn):
  1. Contain little starch
  2. Higher in protein
     a) May be native grain protein or other
  3. Higher in NDF, ADF and crude fiber
     a. Highly digestible
  4. May or may not contain oil (fat)
  5. Large differences in moisture content
  6. Higher mineral content
     a. Phosphorus and sulfur

Characteristics (Oil Seed Processing)

- Compared to parent seeds:
  1. Normally contain little oil (fat)
  2. Higher in NDF, ADF and crude fiber
     a. Digestibility variable
  3. Normally in dry form
  4. Do not require further processing

Soybean Hulls

Soyhulls versus Corn in Low Energy Growing Diets

		% Corn			% Soyhulls		
Item	Cont	13	25	50	13	25	50
DMI, lb/d	13.8	13.3	15.0	16.5	15.0	15.4	16.5
ADG, lb [a]	1.05	1.46	1.68	2.16	1.50	1.72	1.98
Feed/gain[a]	13.4	9.2	8.7	7.62	9.97	8.9	8.3

[a] Quadratic effect of level (P < .05).

Control Diet: equal proportions of corn stalklage, brome hay and corn cobs.

Soyhulls versus Corn in High Energy Growing Diets

	Treatment [a]				
Item	R	C1.5	C2.25	SH1.5	SH2.25
DMI, lb/d	17.2	8.7	14.2	8.6	13.4
ADG, lb [b]	1.81	1.16	2.36	.79	1.63
Feed/gain[b]	9.62	7.46	5.99	10.64	8.20

[a] R= roughage based diet fed at 2.75% BW; C1.5 and C2.25= corn-based diet (77%) fed at 1.5 and 2.25% BW, respectively; SH1.5 and SH2.25= soyhull diet (91%) fed at 1.5 and 2.25% BW, respectively.

[b] Corn versus soyhulls (P < .05).

Löest et al., 2001

Soyhulls in Finishing Diets

	Soyhulls % of diet DM			
Item	0	20	40	60
DMI, lb/d [a]	21.6	24.0	25.0	24.6
ADG, lb [a]	3.09	3.06	2.87	2.62
Feed/gain[a]	6.81	7.84	8.71	9.39

[a] Linear effect of soyhull inclusion (P < .05).

Ludden et al., 1995

Soyhulls in Growing Diets

- Also used to replace roughage:
  1. Limited data
  2. Roughage value varies
     a. 30 to 70%
  3. Provide energy dilution
  4. Physical roughage ?
     a) Stimulation of rumen function

Soyhull Summary

1) Low energy, forage-based diets
   a) 80 to 90% energy value to corn

2) Medium and high-energy growing diets
   a) 70 to 80% energy value of corn
   b) High inclusion may produce bloat

3) High Grain Diets
   a) Limited use as a replacement for corn (value 65% or less relative to corn)
   b) Used as roughage, but value elusive

Raw Soybeans / SBM / Urea Compared

- Kansas Study
- Raw Soybeans had approx. 80% value of SBM in low urea (.33%) growing diet.
- Raw Soybeans contain urease, which converts urea to ammonia, thus caution should be used when combining them.
- .25 lb. urea can be fed with 2 lbs. of raw soybeans effectively.

CSHulls/CSM vs Alfalfa Hay in Stressed Feeder Calves

	65%/35% CSH/CSM	Alfalfa Hay
ADG	2.64	2.52
DMI	11.8	10.7
Feed:Gain	4.52	4.23

448 lb. Heifers (28 day Trial)
KSU.2001

Beet Pulp vs Corn Silage

Two Trials compared Beet Pulp and Corn Silage (2000, 2001. Nebraska)

ADG was similar in both.

Feed:Gain slightly better for Beet Pulp.

Whey vs Corn in Growing Diet

	control	10% Whey
ADG	2.83	2.81
DMI	17.96	18.95
Feed:Gain	6.35	6.74

- Value of Whey estimated at 50% of Corn (Dry Matter Basis)

California.2002

Wheat Middlings

Wheat Midds in Growing Diets

- **Wheat midds in full-fed silage or limit-fed corn-based diets:**
  - **Sorghum silage diet (full-fed)**
    - **Base diet: 47% DRC, 40% Silage, 11% SBM**
  - **Corn-based diet (limit-fed; 2.4% BW)**
    - **Base diet: 68% corn, 15% AH, 10% SBM**
  - **Midds replaced: 0, 33, 67, 100% replacement of corn and soybean meal in both feeding programs**

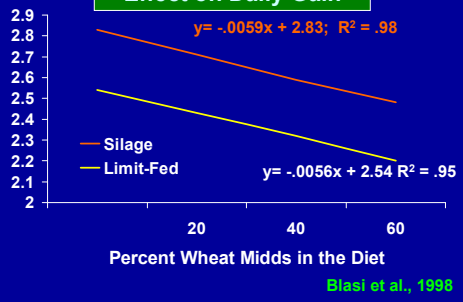
Blasi et al., 1998

Corn, DDG, Wheat Middlings compared in receiving diets

	Corn	DDGs	Midds
ADG	2.64	2.72	2.33
DMI	11.4	11.9	11.5
Feed:Gain	4.38	4.48	5.00

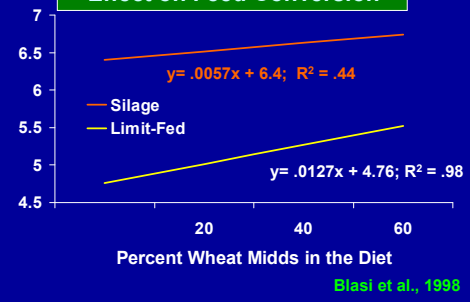
KSU.1999

Wheat Midds in Growing Diets



Blasi et al., 1998

Wheat Midds in Growing Diets



Blasi et al., 1998

Wheat Middlings Summary

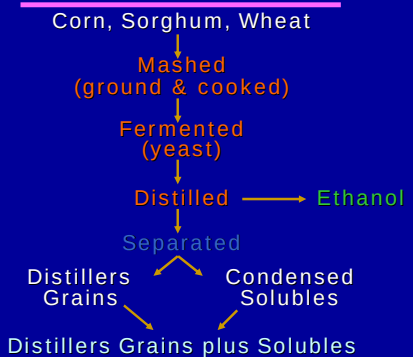
1) Work well in growing diets
   a) Energy value relative to corn (70 to 85%)
   b) Energy value influenced by feeding program and level fed
   c) Higher in silage-based full-fed diets compared with limit-fed high-energy diets

Wheat Middlings Summary

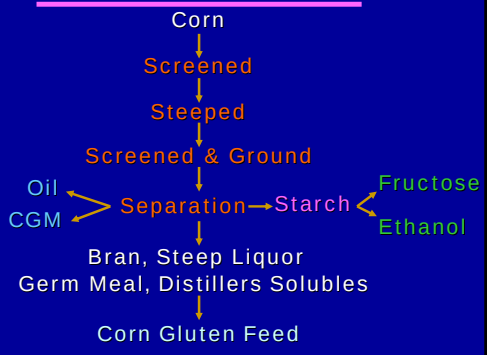
1) Corn-based diets
   a) Energy value relative to corn varies:
      i. Up to 5% - similar to DRC
      ii. 5 to 10% - 75 to 80% of DRC
      iii. Greater than 10% - 40 to 50% of DRC
   b) Used to replace roughage
      i. Up to 33% of the hay in DRC diets
      ii. Value in highly processed diets ?

Corn Milling By-Products

Dry Milling Procedures



Wet Milling Procedures



Protein Content of Corn Steep and SBM compared in Growing Diets

	Urea Control	1 lb. SBM	1.5 lb. C.Steep
ADG	1.60	2.25	2.25

* .5 lb of Natural Protein from SBM or C.Steep responded equally.

Neb.2001

Supplementation of Corn Gluten Feed on Wheat Pasture

	Control	+4 lbs CGF
ADG	1.70	2.48

- Wheat pasture was limited in 2 of 3 yrs and CGF Pellets allowed for longer grazing period.

Oklahoma. 2005,2006,2007.

WCGF on calves grazing corn residue

	2 lb. Sunmeal	WCGF			
	Control	2 lbs	4 lbs	6 lbs	8lbs
ADG	.91	1.28	1.59	1.88	1.90

* Supplementing WCGF above 1% Body Wt. does not appear to improve gain.

Wet Corn Gluten Feed vs DDGs in Growing Calf Diets

600 lb steers: 82 day Trial

Base Diet: Brome Grass & Alfalfa Haylage

	Control	15% WCGF	15% DDGs
ADG	2.10	2.26	2.40
DMI	19.0	19.3	19.2
Feed:Gain	9.04	8.54	8.04

Dry Milling: Wet and Dry Distillers Grains

WDG/Wheat Hay supplement on Native Grasses

	Control	+4 lbs. WDG/Hay Mix
ADG	1.50	2.23

Kansas. 2005,2006,2007.

Summary of 8 Grazing Studies (Kansas & Nebraska)

		ADG		
	InWt.	Control	4 lbs DDG	7.5 lbs DDG
Av.	638	1.60	2.13	2.49

* Each 1.0 lb. DDG fed decreased Forage Intake by .5 lb.

Supplementing DDG, WDG, or WDG/Wheat Straw Mix on Grower

590 lb. Steers: Nebraska, 2008
Base Diet: 60% S. Silage / 40% Alfalfa Hay
Mix Contained 2/3 WDG / 1/3 Wheat Straw

ADG	Ctrl	2	4
DDG:	1.58	2.31	2.36
WDG:	1.58	2.29	2.42
Mix:	1.58	1.84	2.28

* Straw supplied fill to limit forage intake.

Distiller's Grain: Sorghum vs Corn

700 lb. steers: High energy diet

	Ctrl	10% WSDG	10% WCDG
ADG	3.32	3.12	3.18
DMI	18.6	18.5	18.1
Feed:Gain	5.6	5.9	5.7

Texas, 2006

DDG vs WDG

Yearling Cattle: High Energy Diets
Control: Corn Flake Base Diet
DDG & WDG fed at 15% diet DMB.

3 Study Averages:

	Ctrl	DDG	WDG
ADG	3.46	3.41	3.45
DMI	21.1	21.8	21.3
F:G	6.11	6.38	6.19

Corn Milling By-product Summary

1) **Offer greatest potential to enhance performance in the wet form**
   a) **Dry vs wet**
   b) **DCGF 75 to 80% the value of corn**

2) **Response may vary with management, level of inclusion and roughage level**

Corn Milling By-product Summary

3) Have a greater energy content than other by-products (midds, soyhulls)

4) Value of WCGF relative to corn is influenced by corn processing method

5) Corn milling by-products most likely will not replace roughage but we may be able to feed lower roughage levels because of reduced starch load.

Corn Milling By-product Summary

6) Purchase considerations:
   a) Reduced ration cost
   b) Improved Profit (loss)
      i. Performance and/or ration cost
   c) Availability
   d) Handling
      i. Shrink
      ii. Increased feed
   e) Excess Nutrients
      i. Nitrogen, Phosphorus, Sulfur, etc.
      ii. Future environmental issues

Issues With Feeding By-Products

Concerns

- Inventory Management
  - Need storage for 2-3 day supply
- Flow through feed mills
  - Wet by-products
  - Bridging of dry products (DDG)
- Moisture Variation
  - Not all wet products are consistent
- Feed Batched and Delivered Increased (10 – 25%)
  - Cattle intake
  - Moisture of wet by-products

Nutrient Concerns With By-products

	Diets			
Nutrient, %	corn: 0GF	corn: 10GF	corn: 20GF	corn: 30GF
CP	9.5	10.8	12.1	13.5
Phosphorus	.29	.38	.47	.56
Sulfur	.15	.20	.24	.28

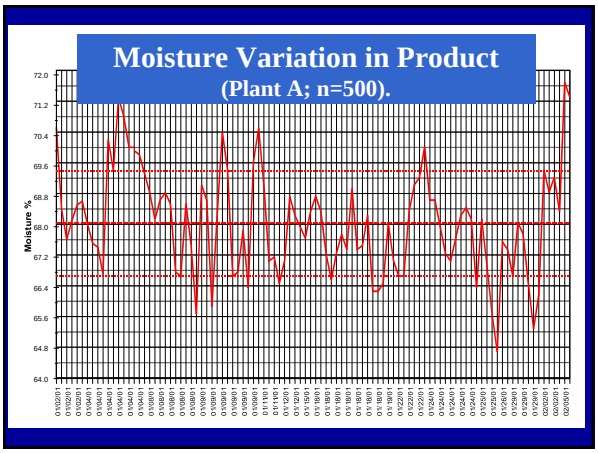
Diets contain 9% alfalfa hay (DM basis) and no other supplemental nutrient.

Typical Nutrient Analysis

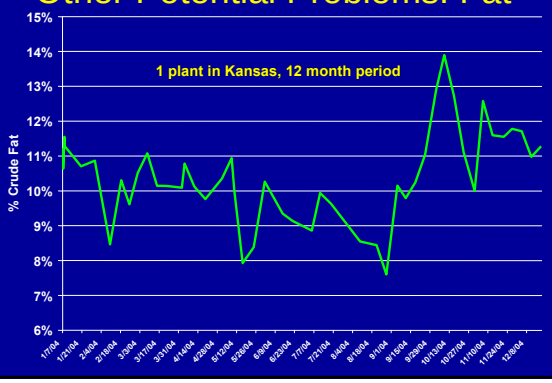
	DDGs	CGF	Soyhulls	Sunmeal
Dry Matter	90.0	88.0	89.0	90.0
C. Protein	30.0	22.0	11.0	30.0
Crude Fat	12.0	4.5	1.0	1.4
ADF%	17.5	11.5	50.0	33.0
NEg(Mcal/lb)	.70	.60	.45	.25
Calcium	.10	.15	.50	.40
Phosphorus	.90	.90	.20	.99
Potassium	1.20	1.20	1.20	1.20
Sodium	.50	.50	.50	.50
Sulfur	.70	.60	.10	.30

Comparison of DDG From Different Plants

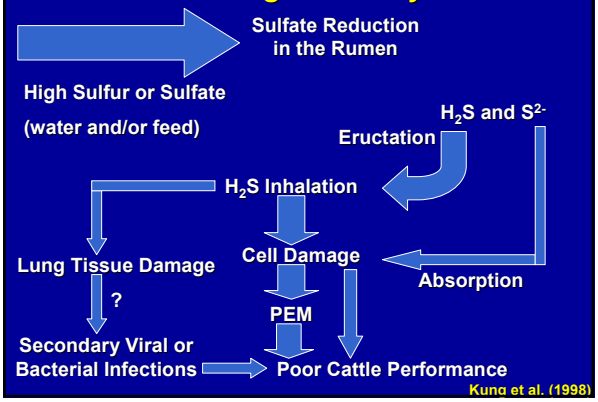
	Plant A	Plant B
Dry Matter	89.0	90.0
C. Protein	29.8	31.4
Crude Fat	14.2	9.3
ADF%	16.2	17.6
NEg(mcal/lb)	.71	.62
Calcium	.10	.30
Phosphorus	.90	.80
Potassium	1.20	1.10
Sodium	.50	.80
Sulfur	.50	1.47



Other Potential Problems: Fat



Effects of High Dietary Sulfur

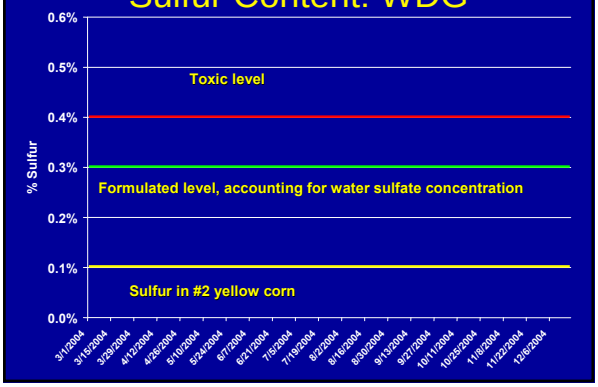


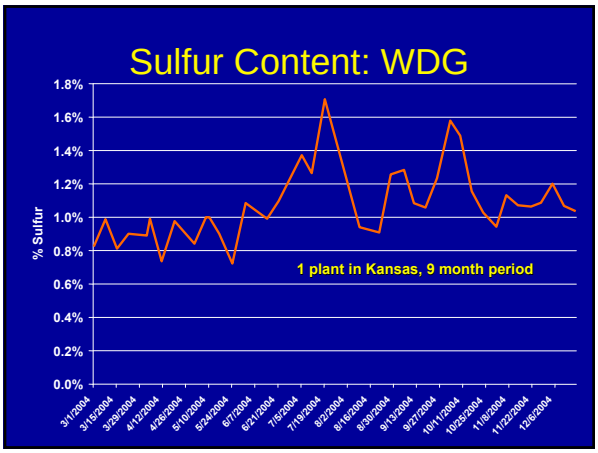
Kung et al. (1998)

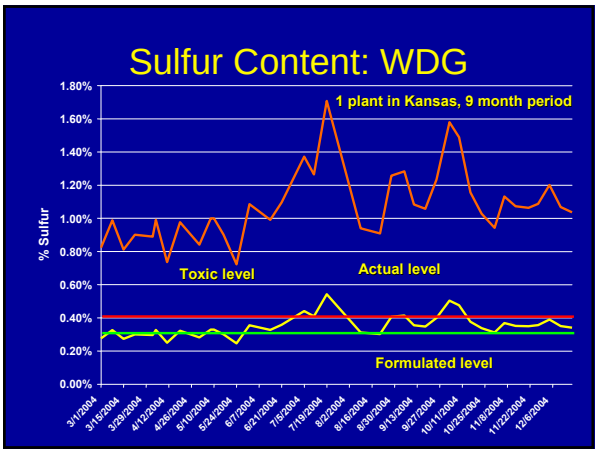
Symptoms of PEM

- **Blindness**
- **Ataxia (uncoordinated)**
- **Seizures**
- **Bloat?**

Sulfur Content: WDG







Managing Sulfur

- Know sulfate concentration of water
- Know sulfur concentration of dietary ingredients
- Formulate diets to contain ≤ 0.3% sulfur on a DM basis
- Use CTC during a PEM outbreak?

By-Products: Friend or Foe?

- Increased demand for corn
  - Dramatic price increase
- Economical
  - Depends on location
  - Tied to corn, protein, or roughage price
- Energy value variable, can be 50-130% of corn
  - Corn processing, good source of protein
  - Carcass quality at high levels
- Environmental concerns
  - N and P
- Cattle Health
  - Watch S levels