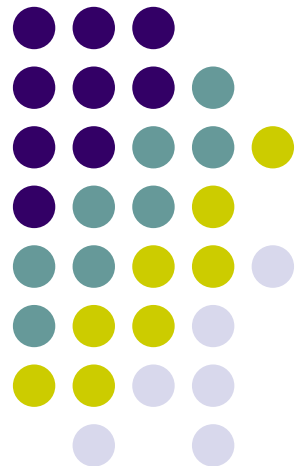
Quality Issues Related to DDGS

Dr. Jerry Shurson
Dept. of Animal Science
University of Minnesota



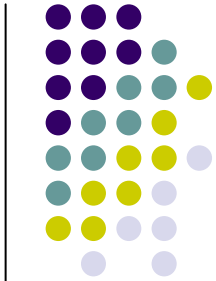
Problem 1 – Variability in Nutrient Content and Digestibility

DDGS Varies in Nutrient Content and Digestibility, Color, and Particle Size Among U.S. Sources

Averages, Coefficients of Variation, and Ranges of Selected Nutrients Among 32 U.S. DDGS Sources (100% Dry Matter Basis)

Nutrient	Average	Range
Dry matter, %	89.3	87.3 – 92.4
Crude protein, %	30.9 (4.7)	28.7 – 32.9
Crude fat, %	10.7 (16.4)	8.8 – 12.4
Crude fiber, %	7.2 (18.0)	5.4 – 10.4
Ash, %	6.0 (26.6)	3.0 – 9.8
Swine ME, kcal/kg	3810 (3.5)	3504 – 4048
Lysine, %	0.90 (11.4)	0.61 – 1.06
Phosphorus, %	0.75 (19.4)	0.42 – 0.99

Variability – Possible Solutions



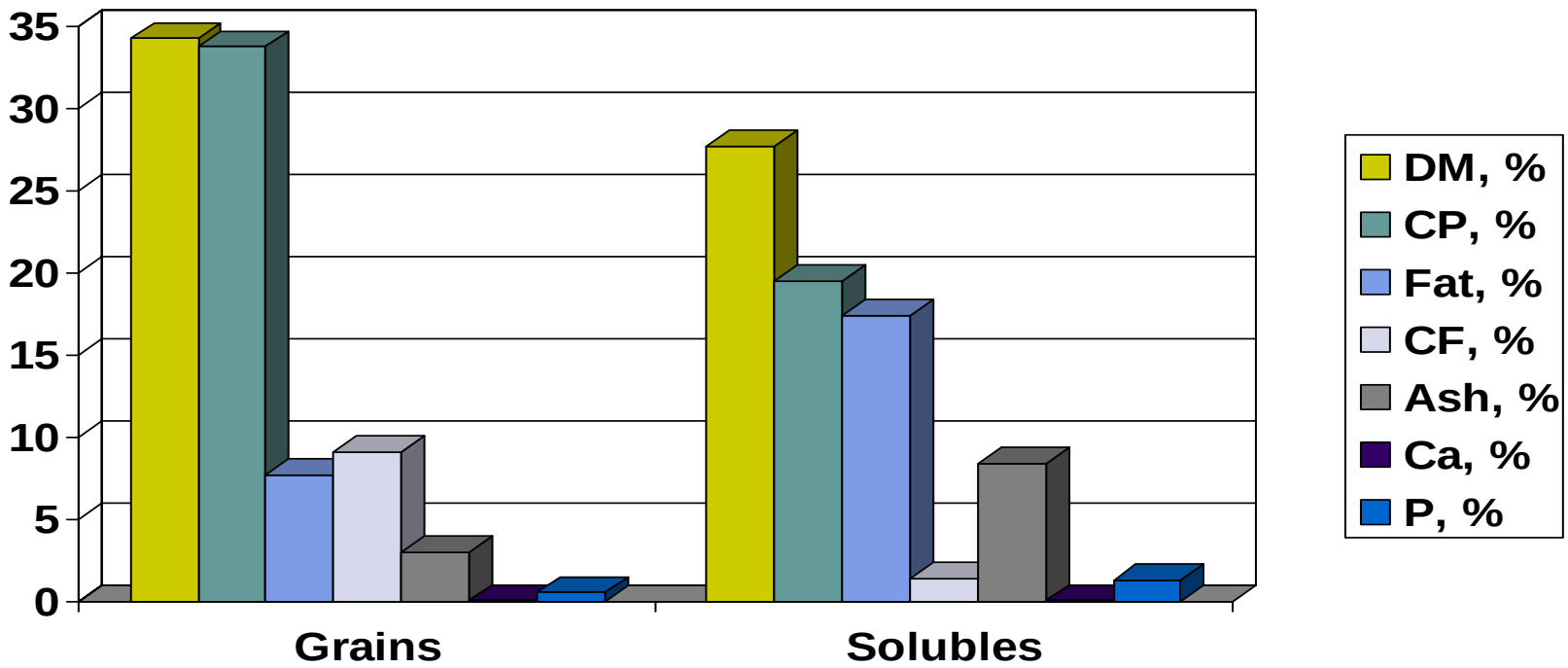
- Use defined quality criteria for screening corn
- Minimize the number of corn varieties used
- Blend a consistent amount of solubles with grains
- Minimize excessive drying/heating
  - Dryer temperatures range from 260°F to 1100°F
  - Reduces amino acid digestibility
- Develop and implement standardized production procedures for all plants within the company

Effect of Acid Detergent Insoluble Nitrogen (ADIN) and Color Score on Growth Performance of Pigs fed Three Blended Sources of DDGS.

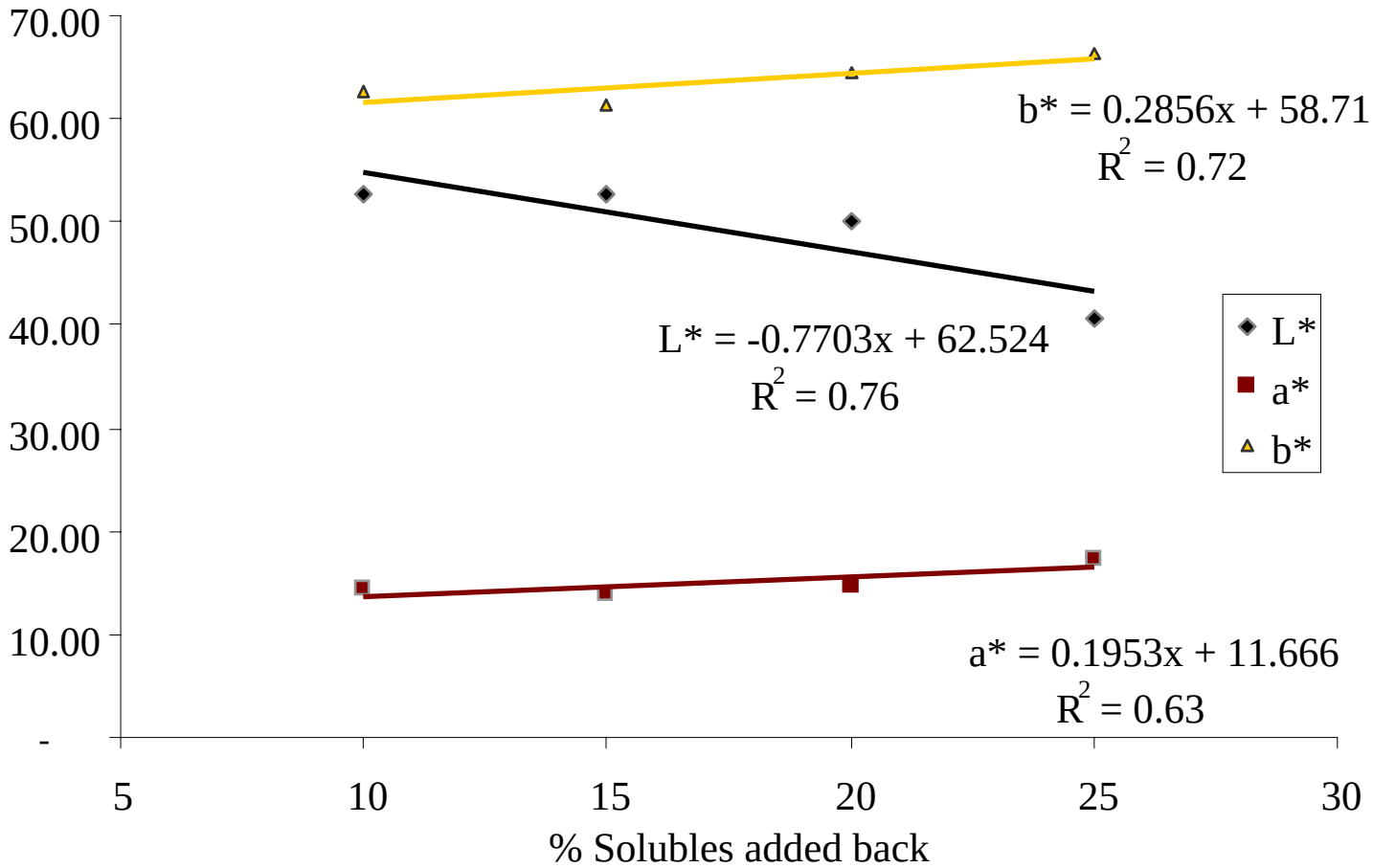
Source	Hunter Lab Color[3]			ADIN%	ADG g[2]	ADFI, g[2]	F/G[2]
	L*	a*	b*				
A	29.0	6.5	12.7	27.1	218	1,103	5.05
E	31.1	6.1	13.1	36.9			
G	38.8	6.8	16.5	16.0	291	1,312	4.52
I	41.8	6.5	18.8	26.4			
B	53.2	4.7	21.8	8.8	390	1,416	3.61
D	51.7	7.1	24.1	12.0			

[1] Modifed form Cromwell *et al.,* 1993.
[2] Difference among diets (P < 0.01)
[3] L=lightness 0=black; 100=white; The higher the a* and b* values, the greater degree of redness and yellowness, respectively.

Comparison of the Nutrient Content of Corn Distiller's Grains and Corn Condensed Distiller's Solubles



Effect of Solubles Addition to Distillers Grains on Color of DDGS (Ganesan *et al.*, 2005)

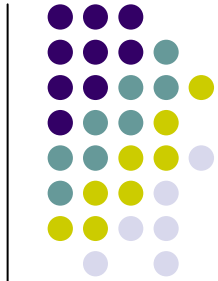


Problem 2 - Flowability

Flowability of DDGS

- Some sources of DDGS do not consistently flow through transport and feed handling systems
- Problem worse in summer
- Problem worse with higher moisture DDGS

Factors That May Affect Flowability of DDGS



- Moisture (humidity)
- Temperature
  - Related to moisture content
  - Above freezing not a real issue
- Pressure (compaction)
- Fat content
- Particle size
- Bulk density

Source: Ganesan et al. 2005

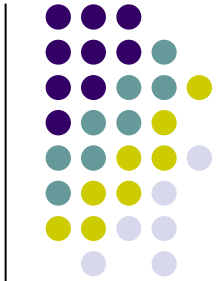
Physical Characteristics of DDGS

- Bulk density
  - 35.7± 2.79 lbs/ft^3
  - Range 30.8 to 39.3 lbs/ft^3
- Particle size
  - 1282± 305 microns
  - Range 612 to 2125 microns

Possible Solutions

- Dry the product more
  - Cost?
  - Regain moisture?
  - Packaging?
- Change the particle size
- Change solubles addition
- Add flow agents
  - Which ones?
  - How much?

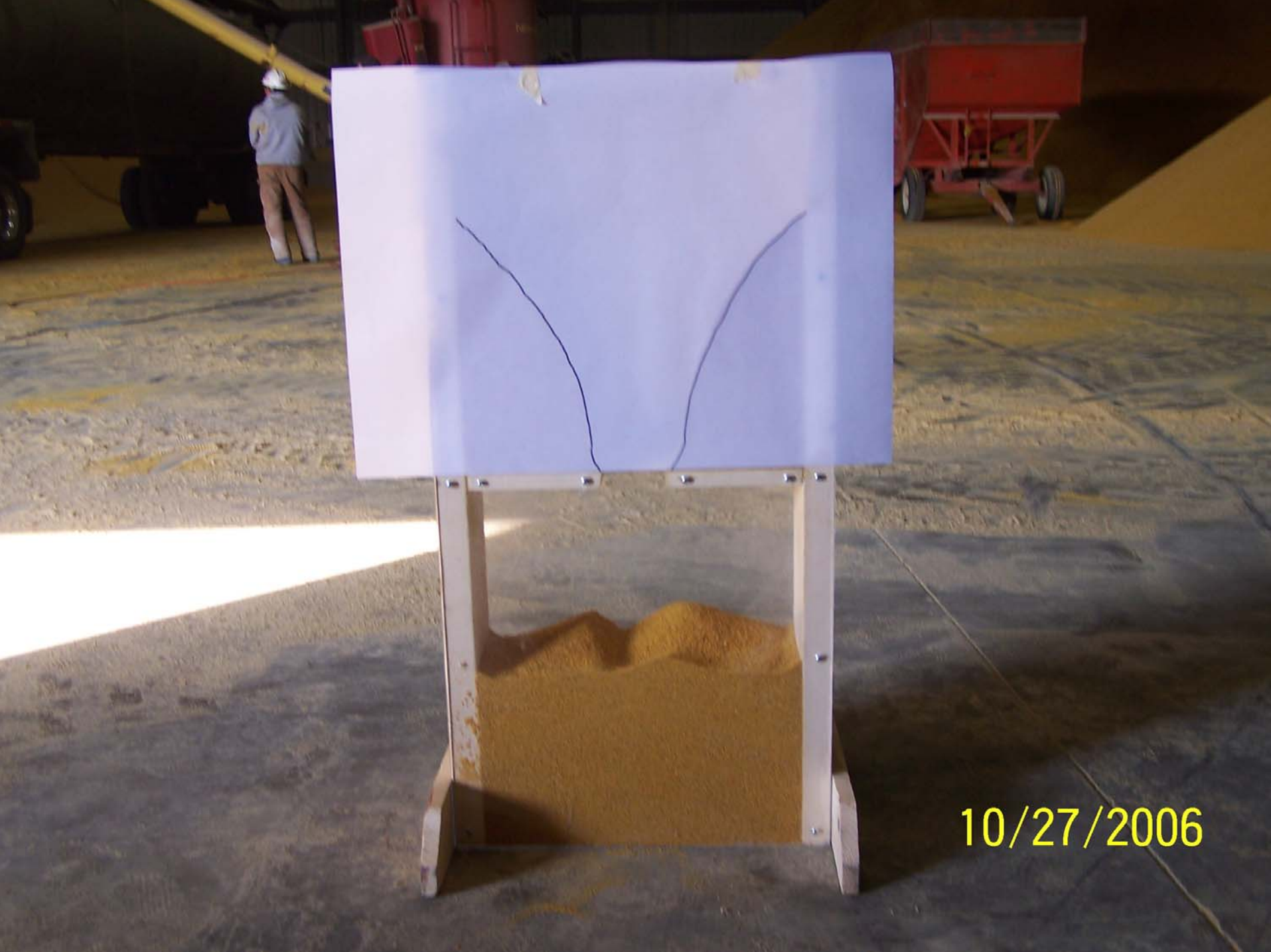
U of M Flowability Research Study



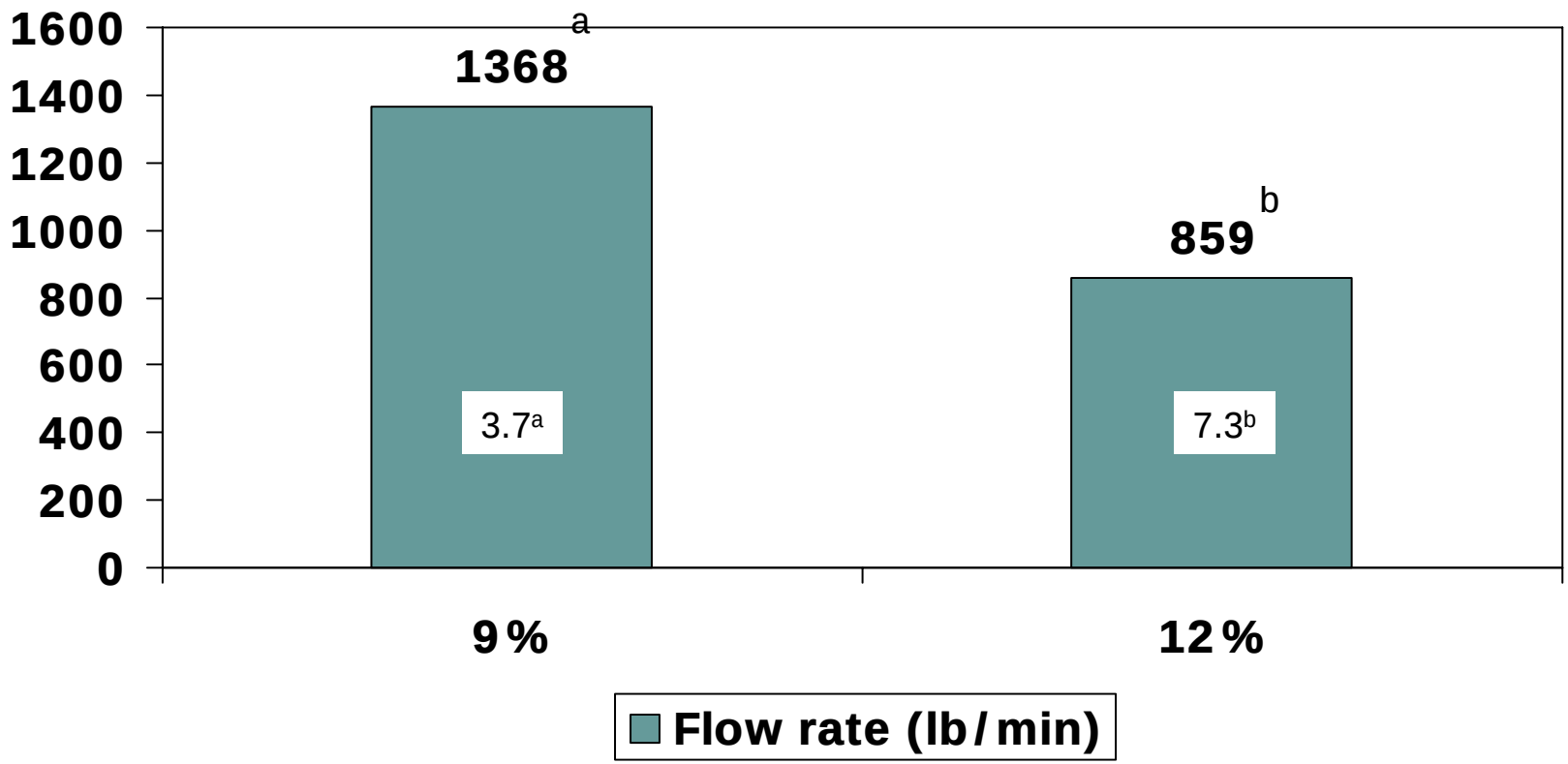
- Treatments
  - Moisture level of DDGS:
    - 9% moisture
    - 12% moisture
  - Flowability agents:
    - Control
    - 5 lbs/ton DMX-7 (Delst, Inc.)
    - 2% Calcium carbonate (Unical-P, ILC Resources)
    - 1.25% zeolite (St. Cloud Mining, NM)


10/27/2006


10/27/2006

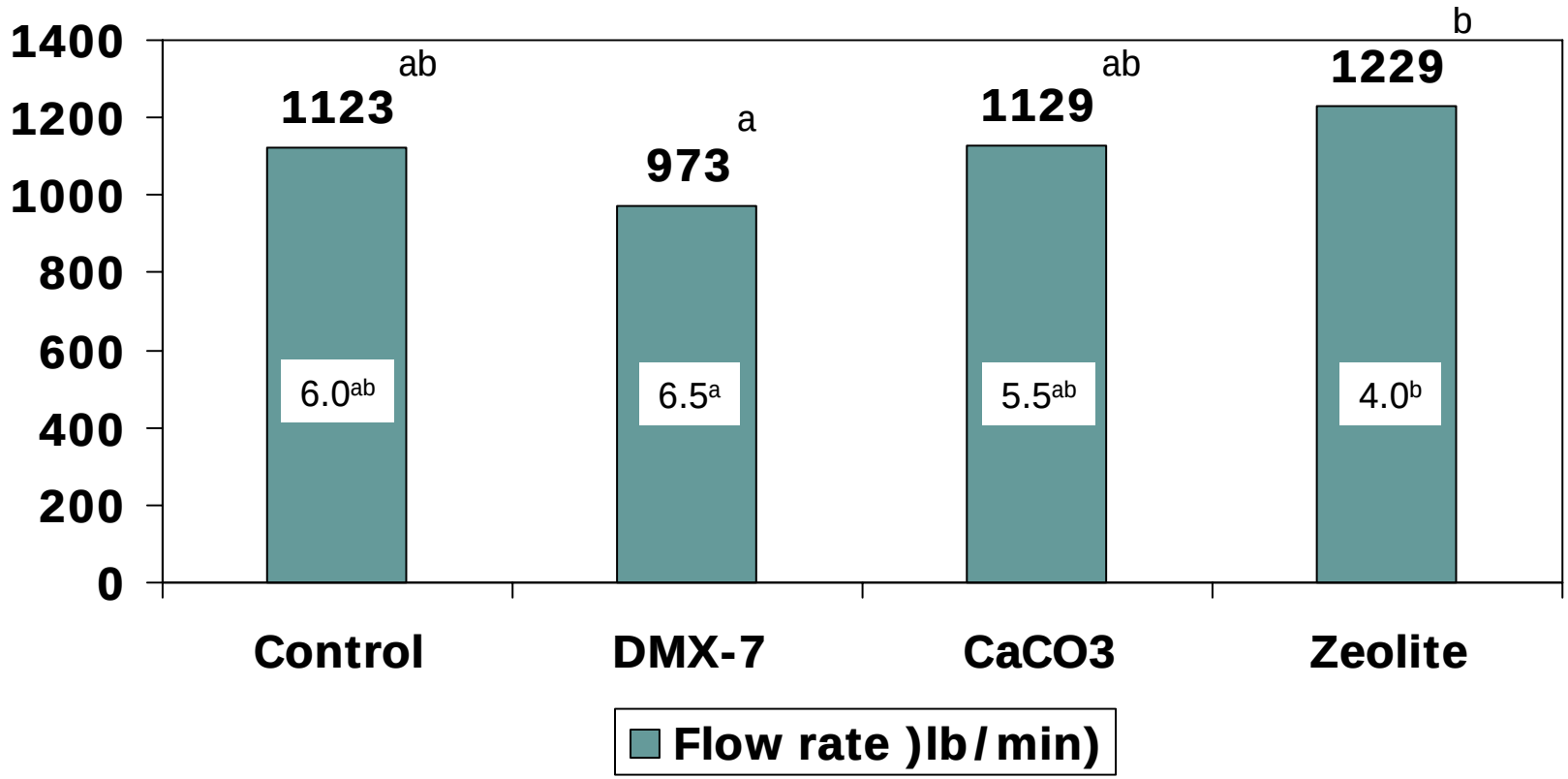

10/27/2006

Effect of DDGS Moisture Level on Flow Rate and Discharge Score



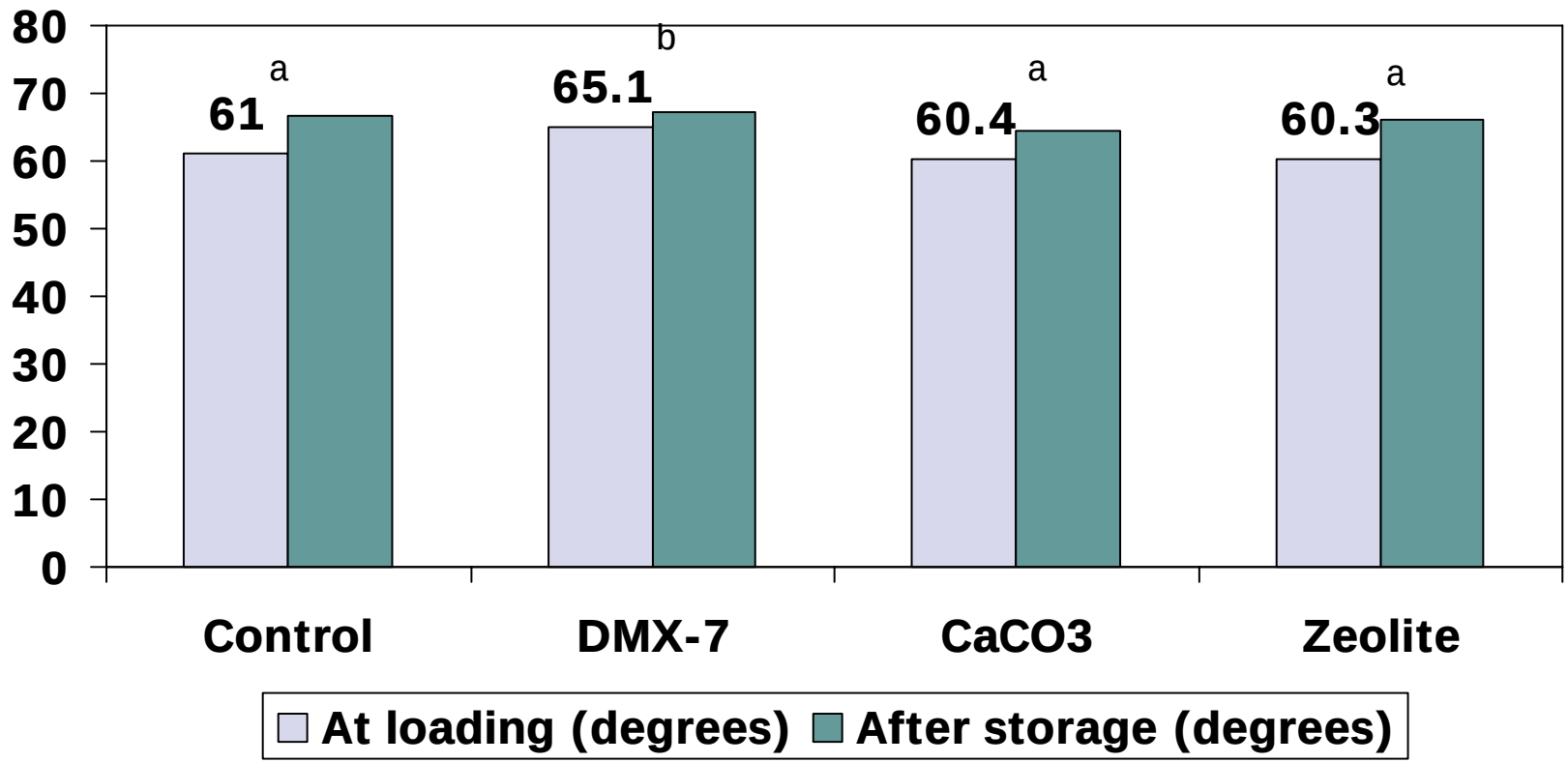
ab(P < 0.05)

Effect of Adding Flowability Agents on Flow Rate and Discharge Score



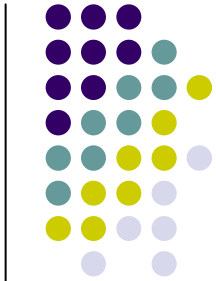
ab(P < 0.05)

Effect of Adding Flowability Agents on Drained Angle of Repose



[ab](P < 0.05)

Problem 3 – Antimicrobial Residues??



- Antimicrobials in ethanol production
  - Used to control bacterial (lactobacillus) contamination
  - Can increase ethanol yield by as much as 25%
  - Which ones are used?
    - Virginiamycin (0.25 to 2.0 ppm)
    - Penicillin (1 g/1000 liters)
  - Unique compared to forms used in animal feeds

Virginiamycin

- Does not affect yeast productivity
- Does not remain in ethanol after distillation
- Is destroyed at temperatures > 93° C
- Dryer temperatures range from 93 to 232° C
- Is destroyed and there are no detectable residues in DDGS

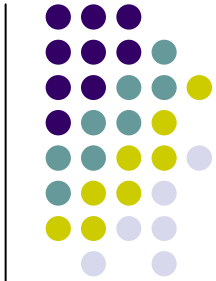
Penicillin

- Most stable at pH 6.0 to 6.4
- Half life of 14 days when in solution at 24° C
- Easily inactivated by primary alcohols and some sugars
- At pH of 4.5 or 9.0, rate of inactivation increases 10-fold
- At pH 3.2 or 10.5, rate of inactivation increases 100-fold
- Completely degraded at pH 3 and a temperature of 37° C for 30 min.
- No residues in DDGS

Possible Solutions

- Conduct a well designed, objective scientific study and publish the results in the public sector, demonstrating that no detectable or biologically active antimicrobial residues are present in distiller’s by-products.

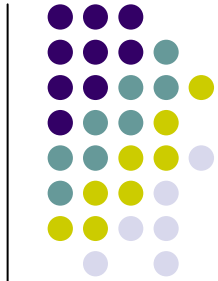
Problem 4 - Mycotoxins



- Main concerns
  - Aflatoxins – carcinogenic, regulated by FDA
  - Vomitoxin (DON) – feed refusal
  - Fumonisin - carcinogenic
  - Zearalenone – reproductive problems

- If contaminated corn is used, mycotoxins are concentrated 3x in DDGS
  - ELISA tests for mycotoxins may give false positive results
  - Use HPLC/TLC for accurate quantification

Possible Solutions

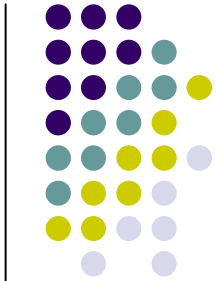


- Adopt a rigorous mycotoxin screening quality assurance program for incoming corn
- Reject corn loads that exceed QA standards
- Test and monitor prevalence and/or level of mycotoxins in DDGS

Problem 5 – Sulfur Content

- Sulfur levels
  - Range from 0.31 to 1.93%
  - Variation partially due to use of sulfuric acid to clean fermenters
  - High levels of sulfur in DDGS with high dietary inclusion rate, high S forages/water → polioencephalmalacia in cattle
  - Affect on feed intake and palatability of DDGS for swine at high levels??????????

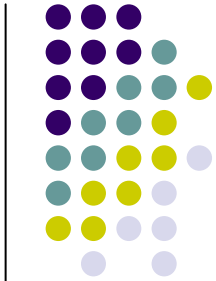
Problem 6 – Sodium Content



- Na content - 0.01 to 0.52%
- Primarily an issue for poultry
- High levels may cause wet litter and dirty eggs if diet adjustments for salt are not made

Some of the Nutrient Variability Among DDGS Sources is Due to the Use of Different Laboratory Testing Procedures

Comparison of AOAC Approved Moisture Testing Methods



- 130-135° C for 1 hour
- 100-105° C for 3 hours
- 100-105° C for 4 hours
- 60-70° C for 24 hours

Variability of Laboratory Results from the Same DDGS Sample Sent to 5 Different Commercial Laboratories

	Moisture	Fat	Protein
Lab 1	12.69	13.73	26.00
Lab 2	10.48	10.01	26.30
Lab 3	10.09	10.04	27.02
Lab 4	10.64	8.73	26.13
Lab 5	13.30	10.15	26.29
NIR	12.60	9.40	25.00

U of M DDGS Web Site www.ddgs.umn.edu

We have developed a DDGS web site featuring:

* nutrient profiles and photos of DDGS samples
* research summaries
    - swine, poultry, dairy, & beef
    - DDGS quality
* presentations given
* links to other DDGS related web sites
* international audiences