NUTRIENT COMPOSITION OF DISTILLERS GRAINS WITH ADDED SOLUBLES

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Previous DDGS research has shown:

- **Little relationship between ADIP and N digestibility (r = .24) in non-forage proteins** ***Nakamura et al., 1994***

- **Color was related to ADIP (r = .79) and lysine (r = .67) concentrations** ***Cromwell et al., 1993***

OBJECTIVES

- To assess the variation in the nutrient content of distillers dried grains with added solubles (DDGS) across and within ethanol production facilities.

- To study the relationship between protein quality, other chemical components and physical characteristics of DDGS.

MATERIALS AND METHODS

Sample collection

Measurements

Statistical analysis

Sample collection:

- Eight ethanol production facilities were sampled
  - Location: MN (5), SD (2), and NE (1).
- Samples from each facility were collected on the first and third Tuesday of each month over a 6-month period (Dec. 96 to May 97)

Measurements:

- **Nutrient content**
  - **DM, CP, NDF, ADF, Fat, and Ash**
- **Particle size**
  - **Screens: > 2 mm and < 1 mm**
- **Color score**
  - **L (lightness: black to white)**
  - **a (redness)**
  - **b (yellowness)**

Measurements:

- **CP fractions**
  - **Soluble protein (SP)**
  - **Acid detergent insoluble protein (ADIP)**
  - **Rumen degradable protein (RDP)**
  - **Intestinal available rumen undegradable protein (IARUP)**

Statistical analysis:

- GLM procedure of SAS

Model Y = P + M(P)

Y	=	observed measurement
P	=	effect of ethanol production facility (fixed effect)
M (P)	=	effect of month of sampling nested within production facility (random effect)

RESULTS

- Nutrient content
- Production facilities
- Color and protein availability

ACROSS ETHANOL PLANT VARIATION IN NON-PROTEIN COMPONENTS OF DDGS[1]

Item	Mean	C.V.	*P*
DM, %	92.7	1.7	<.01
	---------- % of DM ----------		
NDF	48.8	7.2	<.01
ADF	15.5	16.9	.04
Fat	10.5	16.0	<.01
Ash	4.3	12.4	<.01

[1] Distillers dried grains with solubles.

ACROSS ETHANOL PLANT VARIATION IN PROTEIN COMPONENTS OF DDGS[1]

Item	Mean	C.V.	*P*
CP, % of DM	30.1	3.7	<.01
	---------- % of CP ----------		
Soluble CP	9.7	28.9	<.01
ADIP	8.0	36.1	<.01
RDP	46.5	7.7	<.01
	---------- % of RUP ----------		
IARUP	82.2	4.4	<.01

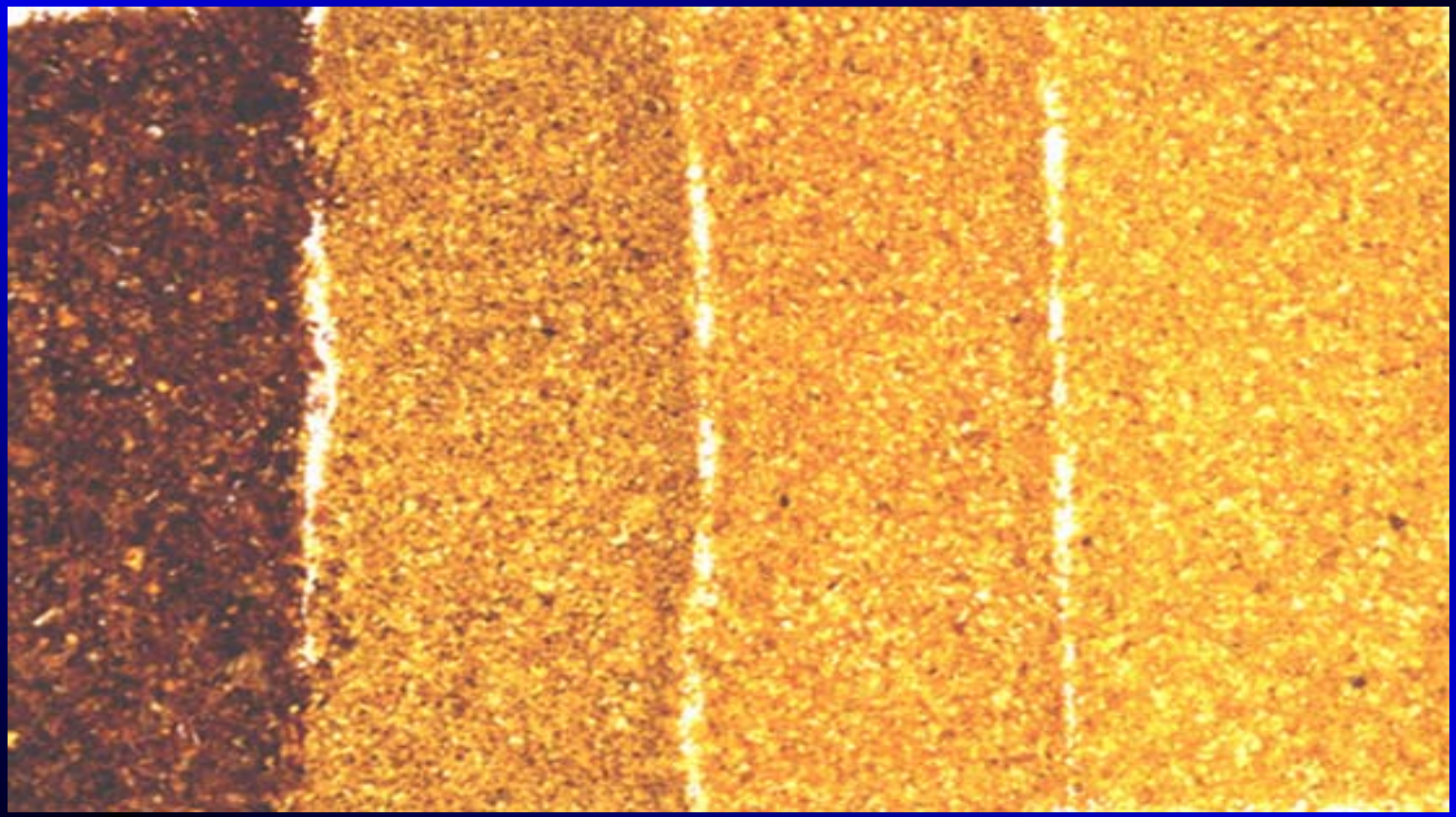
[1] Distillers dried grains with solubles.

ACROSS ETHANOL PLANT VARIATION IN PHYSICAL CHARACTERISTICS OF DDGS[1]

Item	Mean	C.V.	*P*
Particle size			
> 2 mm, %	10.2	22.3	<.01
< 1 mm, %	58.4	20.7	<.01
Color score			
L (lightness)	51.0	4.6	<.01
a (redness)	5.5	9.6	<.01
b (yellowness)	22.5	14.2	<.01

[1] Distillers dried grains with solubles.

DDGS Color Variation



Dark → Light

VARIATION IN DDGS[1] COMPOSITION WITHIN ETHANOL PRODUCTION FACILITIES

Items with relatively low variability	C.V. range
DM, %	.56 - 3.69
NDF, % of DM	3.99 - 10.29
CP, % of DM	2.04 - 5.85
RDP, % of CP	6.72 - 15.12
IARUP, % of RUP	4.06 - 7.01
Color score L	2.14 - 6.96

[1] Distillers dried grains with solubles.

VARIATION IN DDGS[1] COMPOSITION WITHIN ETHANOL PRODUCTION FACILITIES

Items with relatively high variability	C.V. range
ADF, % of DM	12.9 - 28.1
Ether extract, % of DM	12.9 - 38.5
Ash, % of DM	6.7 - 19.7
Soluble protein, % of CP	11.4 - 61.2
ADIP, % of CP	34.5 - 61.3
Color scores a and b	8.3 - 68.4

[1] Distillers dried grains with solubles.

CORRELATION OF PROTEIN FRACTIONS WITH ADIP AND COLOR OF DDGS[1]

Item	SP	ADIP	RDP	IARUP
	---------- % of CP ----------			% RUP
ADIP	-.06	----	.04	-.28**
Color[2]				
L	-.19	-.27**	-.03	.17
a	.38**	-.16	.33**	.11
b	-.10	-.23	.02	.09

[1] Distillers dried grains with solubles.

[2] L = lightness; a = redness; b = yellowness.

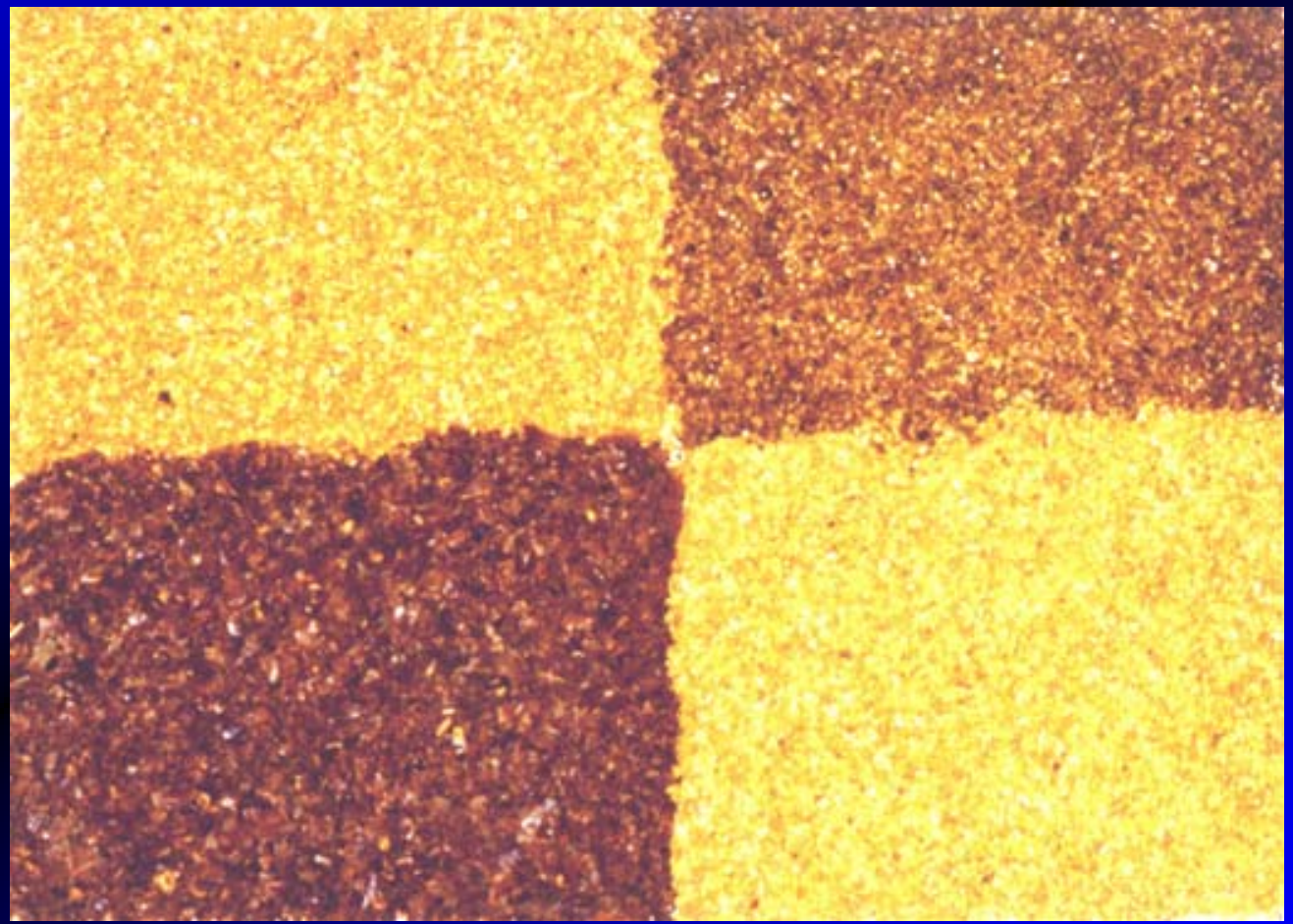
* Correlation significant at $P < .05$.

** Correlation significant at $P < .01$.

ADIP and Color Variation

Low ADIP

High ADIP



CORRELATION BETWEEN ADIP AND LIGHTNESS

<10% ADIP - r = -.28*

10-13% ADIP - r = -.54*

>13% ADIP - r = -.81*

* P < .05.

SUMMARY

- Production facility had a significant effect on all nutrient values of DDGS.
- Within production facility, a low variation in NDF, CP, RDP, IARUP, and the L color score existed across months.

CONCLUSIONS

DDGS is a good source of RDP and intestinally available RUP for ruminants, but

- **Variation within and across production facilities indicates routine sampling and analysis of DDGS is needed.**
- **Sample darkness associated with ADIP values >13% of CP is a good indication of heat damage and low availability of protein.**
- **Further investigations should determine individual amino acid availability.**

NUTRIENT CONTENT OF DDGS[1]

Item	Mean	Range
DM, %	92.7	81.9 - 96.9
	---------- % of DM ----------	
NDF	48.8	38.9 - 61.5
ADF	15.5	5.4 - 23.1
Fat	10.5	4.3 - 18.7
Ash	4.3	2.0 - 6.7

[1] Distillers dried grains with solubles.

PROTEIN FRACTIONS IN DDGS[1]

Item	Mean	Range
CP, % of DM	30.1	25.9 - 36.3
	---------- % of CP ----------	
Soluble CP	9.7	1.1 - 21.8
ADIP	8.0	.8 - 18.5
RDP	46.5	31.5 - 59.8
	---------- % of RUP ----------	
IARUP	82.2	71.5 - 93.8

[1] Distillers dried grains with solubles.