Update-Utilization of Feed Byproducts of the Biofuels Industry in Turkey Diets

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Presented at the National Turkey Federation Convention
February 11, 2008

DDGS Update
Corn, Conventional Product

- Research Areas
  - Amino acids (Digestibility & content)
    - Lysine and heat damage
    - Limiting in lys, arg, try
  - Phosphorus availability (Greater than 60%)
  - Inclusion Levels for turkeys
    - 10-20%
  - Energy
    - Batal, 2006- 2820 kcal/kg; Noll, 2004 - 2830 kcal/kg
    - Manangi et al., 2007
      - Correlated with NDF

DDGS Update
Corn, Conventional Product

- Research Areas
  - Nutrient Characteristics & Variability
    - Variability exists (Variation Among Plant > Within Plant)
      - Solubles Addition
      - Type of product

DDGs Nutrient Characteristics*

Content, %	Sample Range	Ave.	NRC, 1994
Protein	25.5-30.8	27.8	27.4
Fat	8.9-11.1	10	9
Fiber	5.4-6.5	5.7	9.1
Ca	.017-.045	.05	.17
P	.62-.88	.75	.72
Na	.05-.17	.12	.48
Cl	.13-.19	.17	.17
K	.87-1.11	.95	.65

*Noll & Parsons, unpublished data

DDGs Nutrient Characteristics

AA, %	Range	Ave.	NRC, 1994
Methionine	.41-.6	.49	.6
Cystine	.42-.67	.53	.4
Lysine	.55-.89	.73	.75
Arginine	.89-1.31	1.1	.98
Tryptophan	.18-.26	.22	.19
Threonine	.85-1.14	.98	.92

*Noll & Parsons, unpublished data

DDGs Nutrient Characteristics*

Amino acid	Digest Coeff (%)	Ave
Methionine	80-90	87
Cystine	66-85	77
Lysine	37-84	68
Arginine	80-90	85
Tryptophan	76-87	83
Threonine	67-81	75

*Noll and Parsons, unpublished data

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Variability in Nutritional Characteristics

- Corn nutrient content
- Processing
  - Drying conditions
  - Solubles addition (amount)

Varying Solubles Addition

- Measure effect on nutritional characteristics of resulting DDGS
- Can rate of addition indirectly effect amino acid digestibility?

Noll & Parsons, 2007

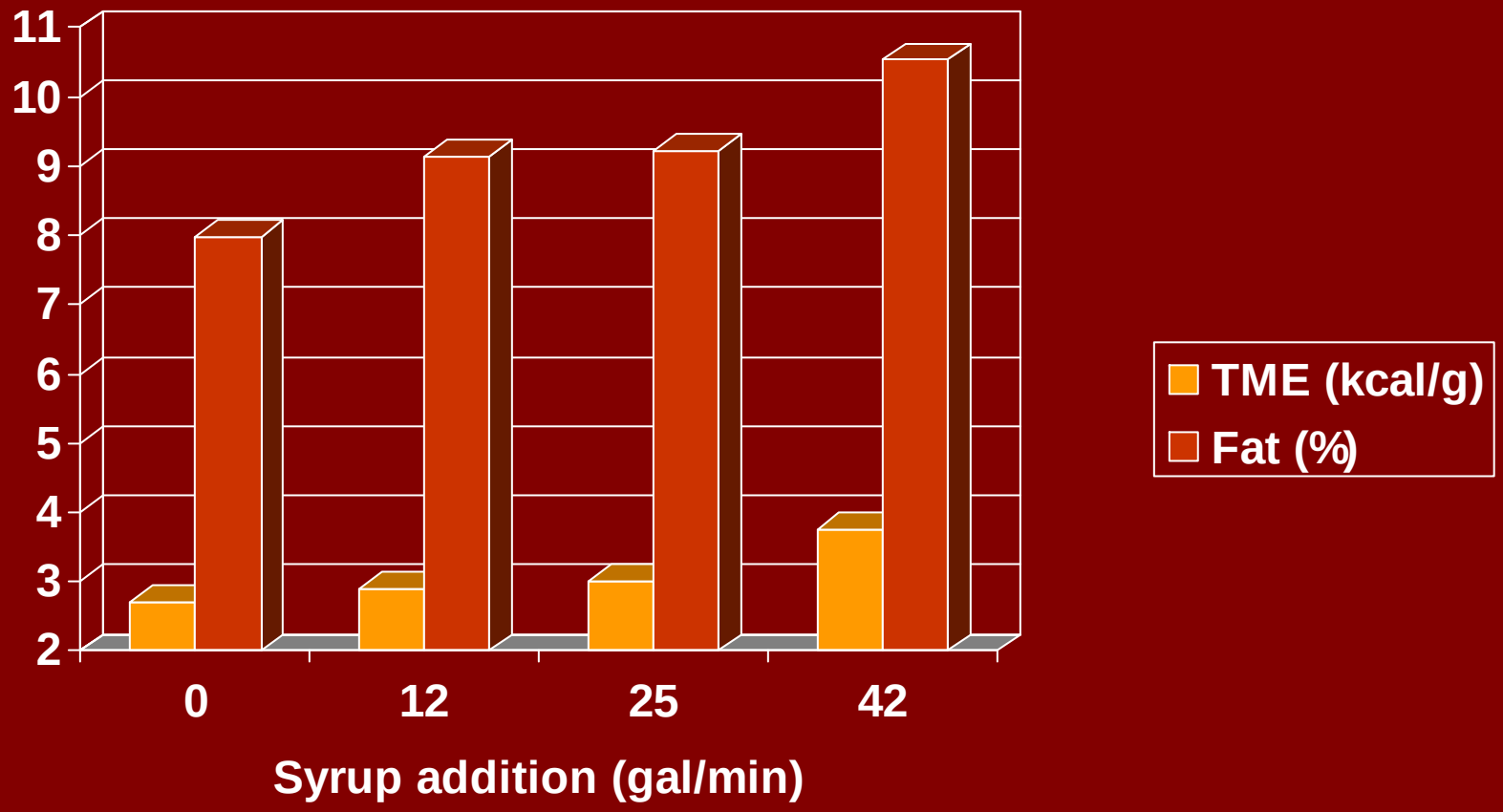
Variable Solubles Addition & DDGS Characteristics-Pilot Study

- Four Syrup Addition Rates
  - 42, 25, 12, 0 gal/min
- DDGS samples taken from each lot
  - Chemical analyses
  - Amino acid digestibility
  - TME
- Pearson Correlations with addition rate

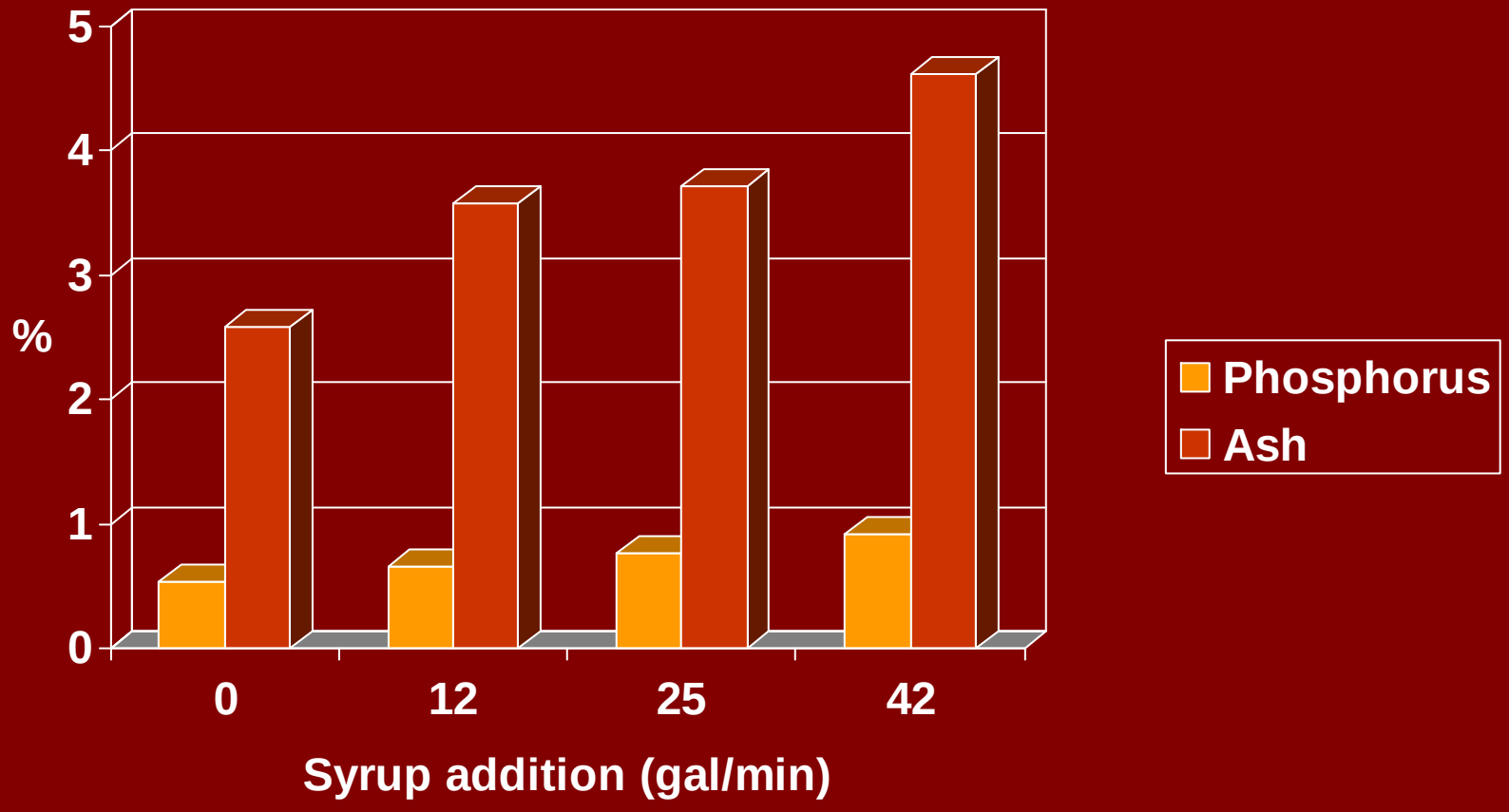
Variable Solubles Addition & DDGS Characteristics

- No effect
  - Protein, amino acids content
  - Amino acid digestibility mostly not affected
- Significant correlation found for:
  - Color
  - Crude fat
  - Ash
  - Minerals
    - P
  - TMEn

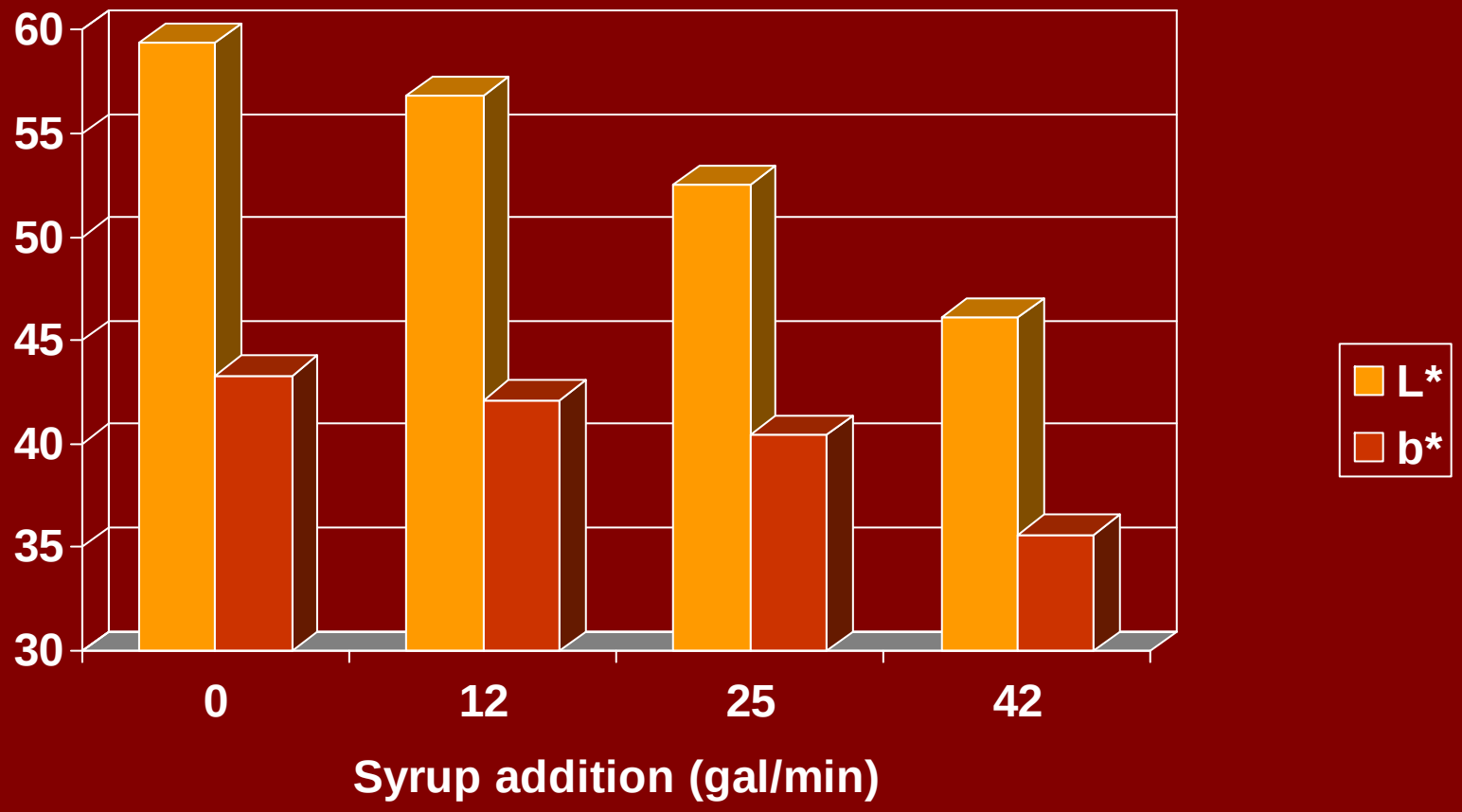
Influence of syrup addition on DDGS fat content and TMEn (DM basis)



Influence of syrup addition on DDGS ash and phosphorus content (DM basis)



Influence of syrup addition on color (L*, b*) of DDGS



Variable Syrup Addition

- Changed composition of resulting DDGS
- Minerals (P), fat, color, and energy changed
- Particle size – “syrup balls” at highest level of solubles addition

Variability – Type of product

- Ethanol processing methods continue to evolve & change to improve production efficiency
  - Corn fractionation
  - Manipulation of DDGS
- Composition very different from conventionally produced DDGS

Nutrient Characteristics of Alternative "DDGS" Products (Batal, 2007)

(%)	Conv. DDGS	HP-DDGS	Dehy. Corn germ
Protein	27	44	15.5
Crude fiber	7	7	4.5
Crude fat	10	3	17
P, total	.77	.35	1.18
P, Avail	60	47	31
Lysine, total	.79	1.03	.83
Lys, Avail	81	72	80

Dietary Inclusion Levels of DDGS Previous Research Results Heavy Tom Grow/Finish Diets

- Up to 10- 20% in heavy tom grow/finish diets possible in corn-soy based diets
  - Growth & Feed/gain similar to Control
- Some slight reduced performance at 20%
  - Reduced intact protein (lower protein diets + supplemental thr) + limited intake (summer)
  - High levels of animal byproduct
    - >8% PBM

Current Study Objectives

- Determine:
  - Maximal inclusion levels of DDGS in corn-soy-meat based diet when started at different ages and effect on:
    - Turkey performance
    - Litter moisture

Methods

- Ingredients (corn, soy, PBM, DDGS)
  - Nutrient analyses plus digestible amino acids
- Diets formulated to 100% NRC digestible lys, TSAA, thr
  - Supplemental lys & met; some thr
  - Three wk feeding periods 2-19 wks of age
- Inclusion level of PBM limited to prevent excess dietary phosphorus
- Diets fed as mash

Methods Continued

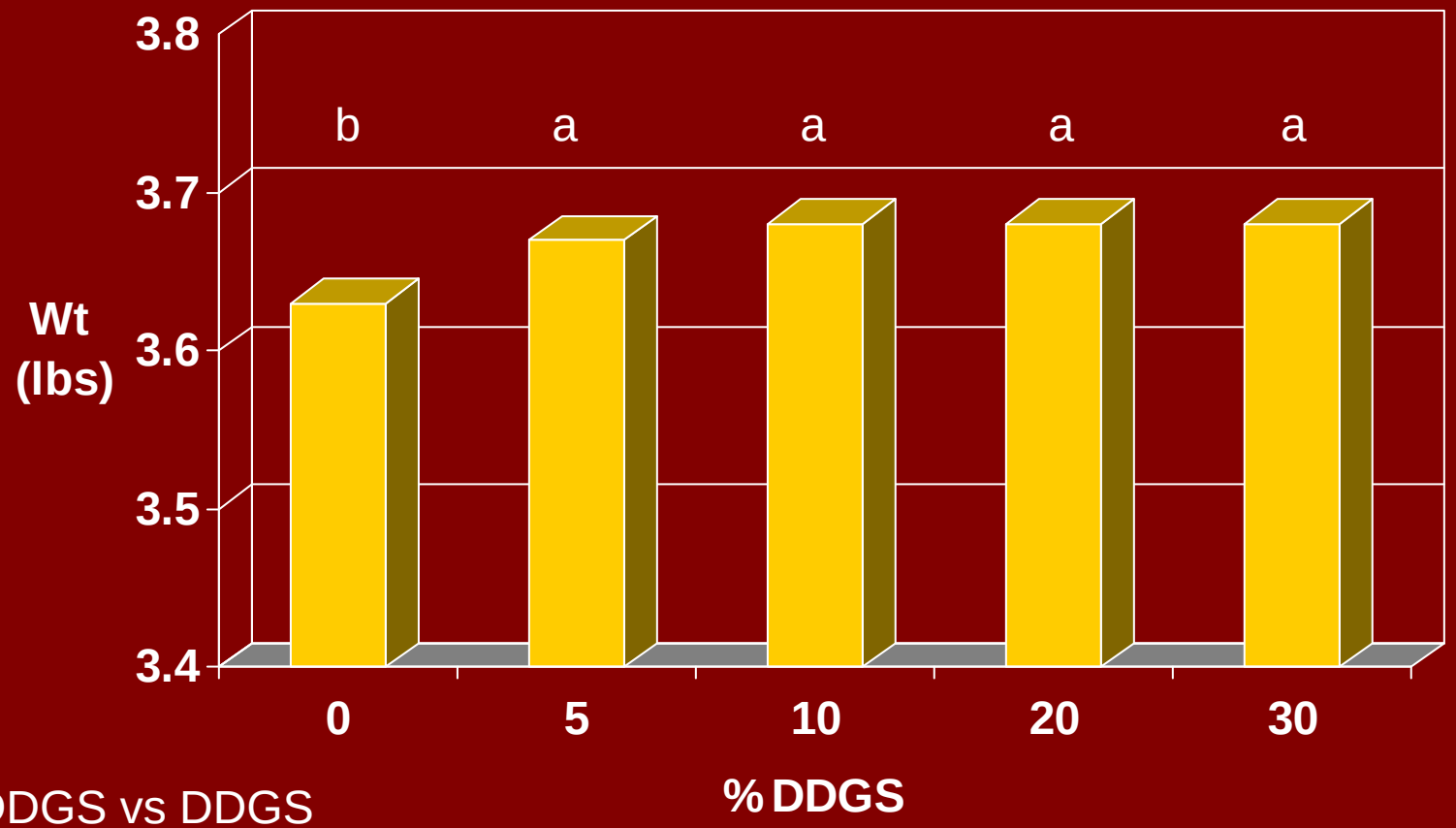
- Each diet fed to 9 replicate pens of toms (Nicholas, 10b/pen) (90 pens total)
- Trial started at 2 wks of age and finished at 19 wks of age
- Individual bird weights and pen feed intake
- Experimental Design – randomized block design
- Statistical analyses – ANOVA, LSD, and contrasts

Treatments - DDGS Inclusion Levels (% of Diet)

Treatment	Age Period (wks)					
	2-5	5-8	8-11	11-14	14-17	17-19
1	0	0	0	0	0	0
2	10	10	10	10	10	10
3	20	20	20	20	20	20
4	30	30	30	30	30	30
5	0	10	10	10	10	10
6	0	20	20	20	20	20
7	0	30	30	30	30	30
8	5	10	20	20	20	20
9	5	10	20	30	30	30
10	5	20	30	40	40	40

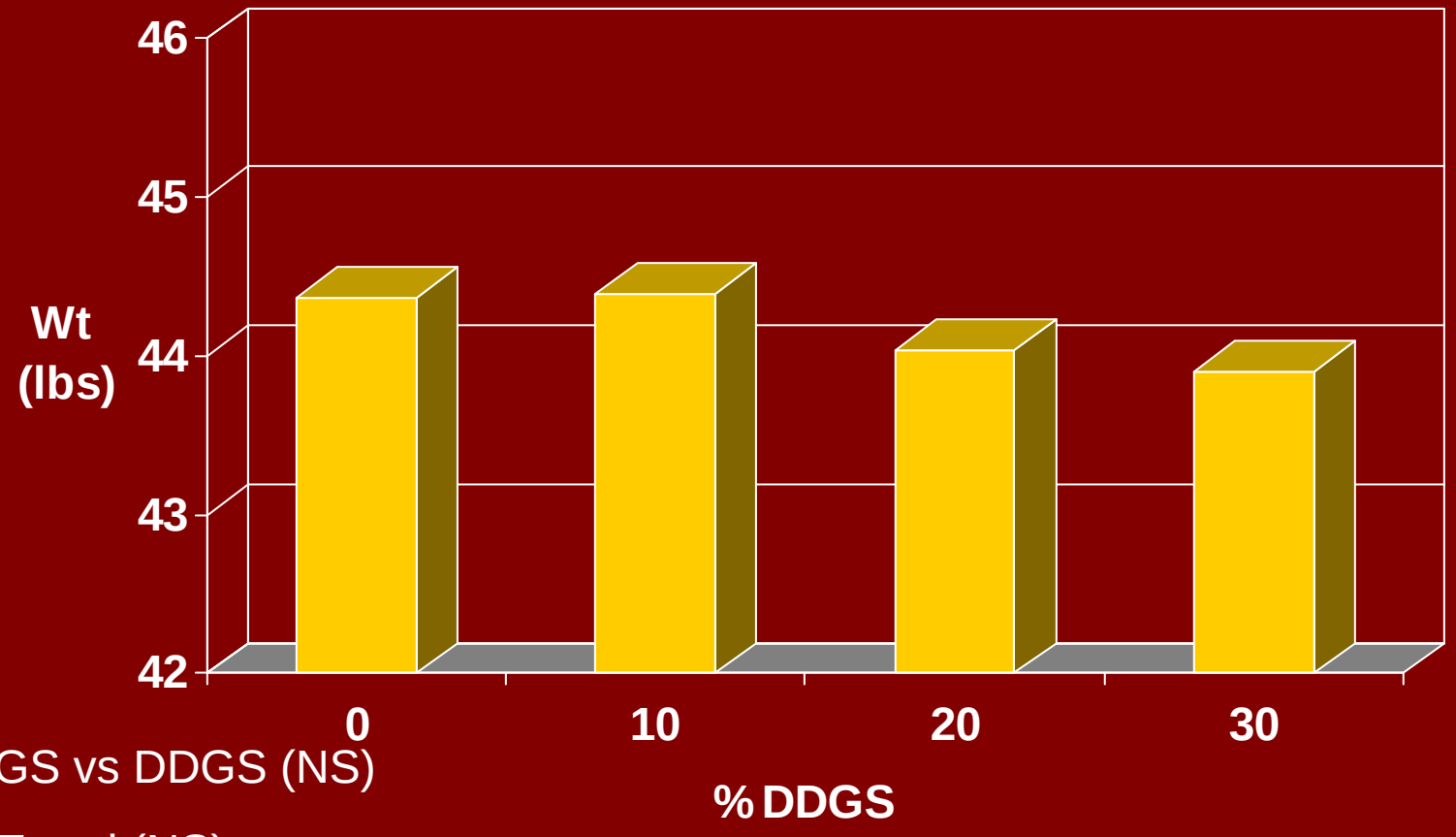
Results

DDGS Level (2-5 wks of age) and Poult Body Weight



No DDGS vs DDGS ($P<.05$)

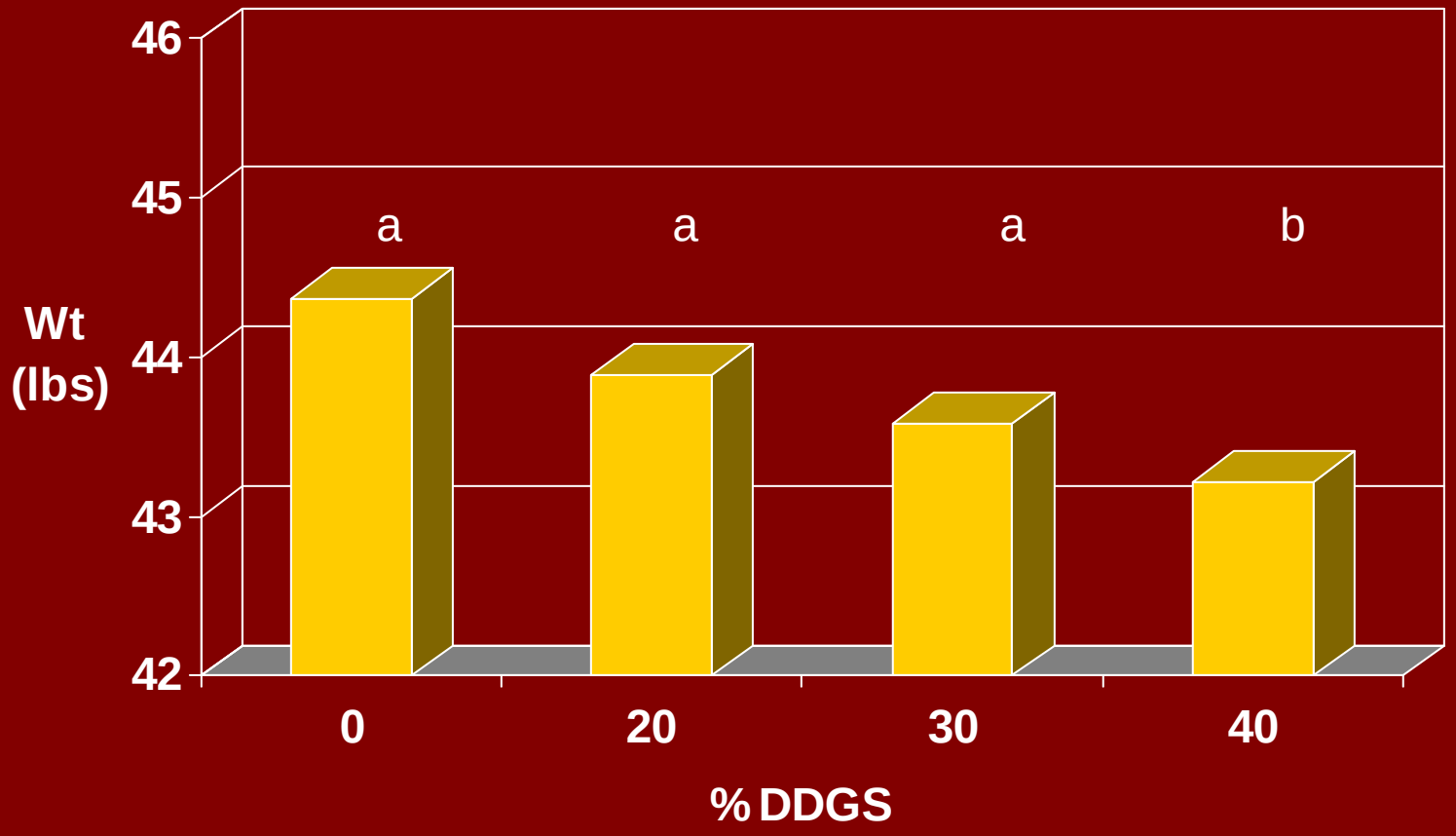
DDGS Level (2-19 wks of age) and 19 wk Tom Weight



No DDGS vs DDGS (NS)

Linear Trend (NS)

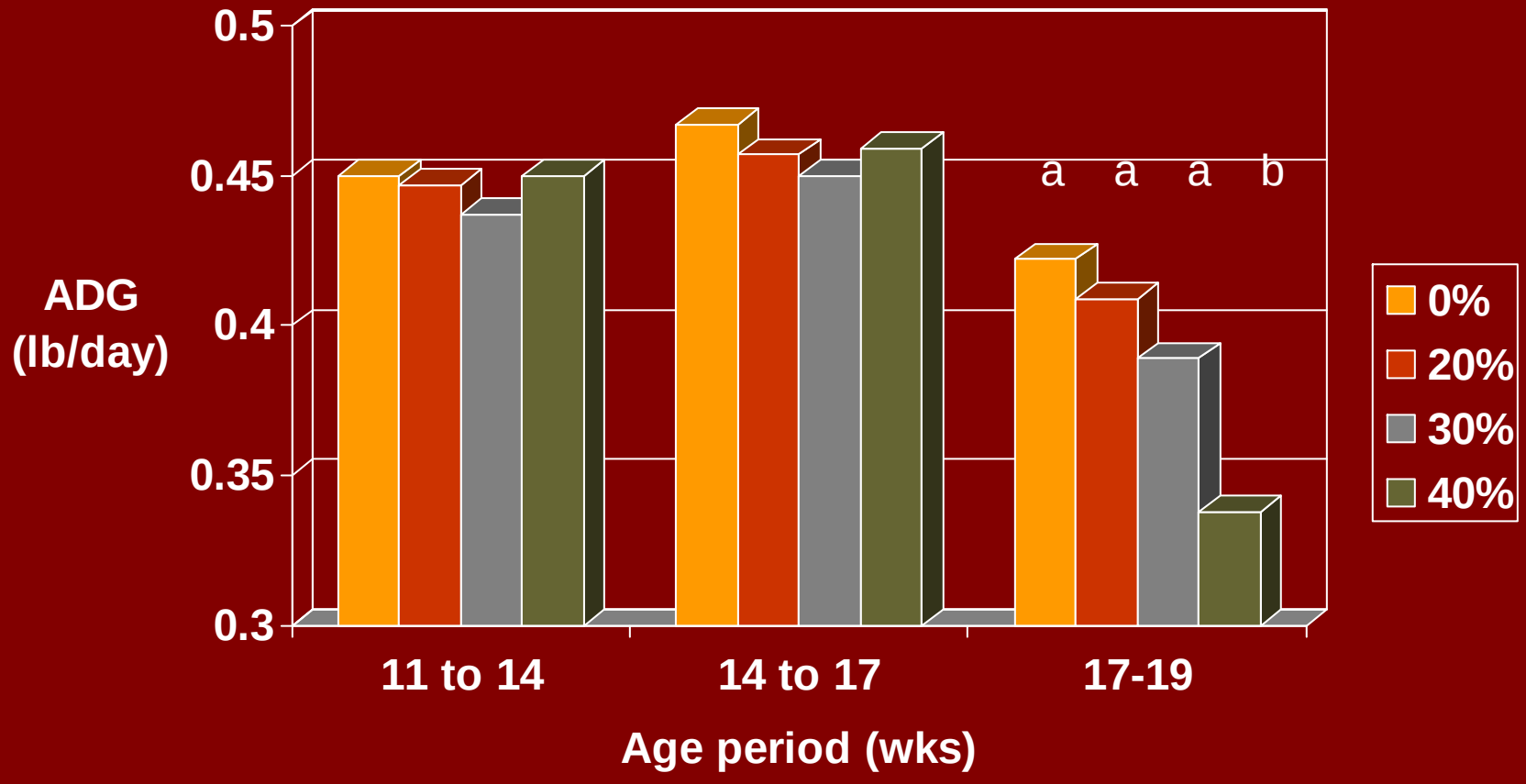
DDGS Level (11-19 wks of age*) and 19 wk Tom Weight



Linear Trend (P<.03)

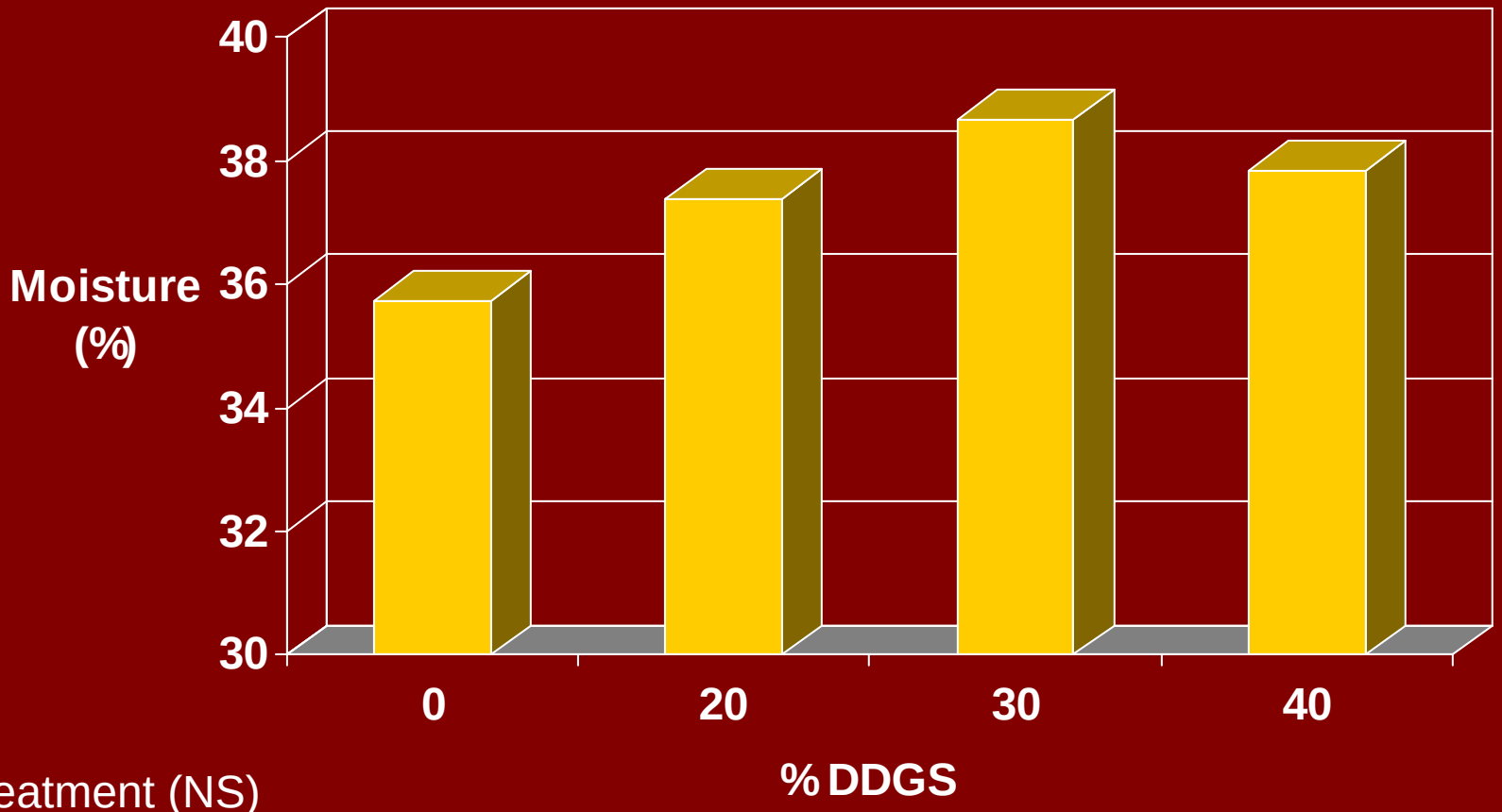
*Lower levels fed 2-11 wks

DDGS Level (11-19 wks of age*) and gain



*Lower levels of DDGS fed during 2-11 wks of age

DDGS Level (11-19 wks of age*) and Litter Moisture (15 wks)



Treatment (NS)

No DDGS vs DDGS (NS)

Linear Trend (NS)

*Lower levels fed 2-11 wks

Summary

- Inclusion up to 30% DDGS was possible in turkey poult starter diets
- Inclusion of 40% DDGS depressed 19 wk body weight
  - Gain during 17-19 wks depressed
- Litter moisture was not affected by DDGS inclusion

Feeding High Levels of DDGS Dependent on:

- Good quality product (KNOW YOUR SOURCE)
- Analyzed nutrient content available
  - CP, fiber, fat, amino acids, electrolytes
- Formulate on a digestible amino acid basis
  - Lys, TSAA, thr, arg, tryp
- Phosphorus availability adjustment
- Appropriate energy level assignment
- No mycotoxins
- Effects on pellet quality

Crude Glycerol (Glycerine) as a Feed Ingredient

- Potential energy source
  - Gross energy of ~ 3600 kcal/kg
- By-Product of Biodiesel Process
  - Feedstocks (oils, fats, grease)
  - Utilizes the fatty acid portion of the triglyceride molecule leaving glycerol behind
  - During production add
    - Methanol
    - Catalyst - sodium or potassium

What's in Crude Glycerol?

(%)	Lammers '08	Noll '08	Thompson & He '06**
Glycerol	87	83.5	75-83
Moisture	9.22	12	
Ash	3.19		.25-2.80
Methanol*	.028	LT .015	
Fat	.12		2-13%
Protein	.41		.05-.2
Sodium	1.26	.98	1-1.2
Potassium	<.005		
Chloride	1.86	1.52	

*FDA limit of .015% or 150 ppm **Produced from various vegt. oils

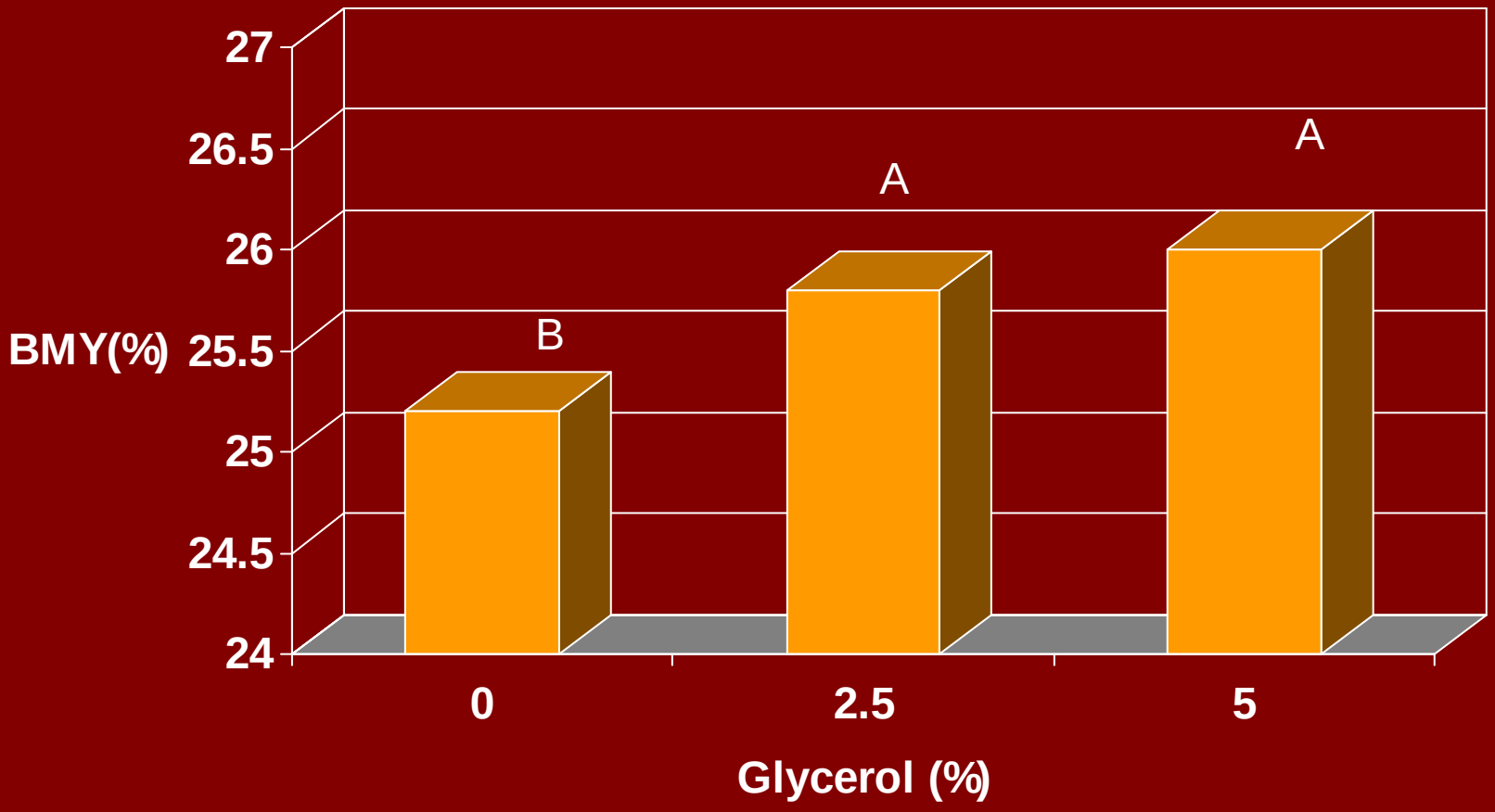
Inclusion of Glycerin and Diet Formulation (Turkey Grower Diet Example)

Ingredient (%)	0%	4%	8%
Corn	58.53	54.21	49.89
SBM	18.28	18.95	19.62
MBM	8	8	8
DDGS	10	10	10
Fat	3.84	3.61	3.38
CP	*20.38*	*20.37*	*20.35*
ME (kcal/kg)	*3230*	*3230*	*3230*

Recent Studies with Feeding of Glycerin

- Broiler studies (Cerrate et al., 2006)
  - Used an AMEn value of 3527 for diet formulation
    - Gross energy was 3596 kcal/kg
    - Fed as crumbles/pellets
  - 0, 5, 10% inclusion
    - 10% decrease growth, increased litter moisture
      - Flowability of feed
  - 0, 2.5, 5% inclusion
    - No effect on BW or F:G
    - Improved breast meat yield

Glycerin and Broiler Breast Meat Yield (Exp. 2, Cerrate et al., 2006)



Recent Studies with Feeding of Glycerin

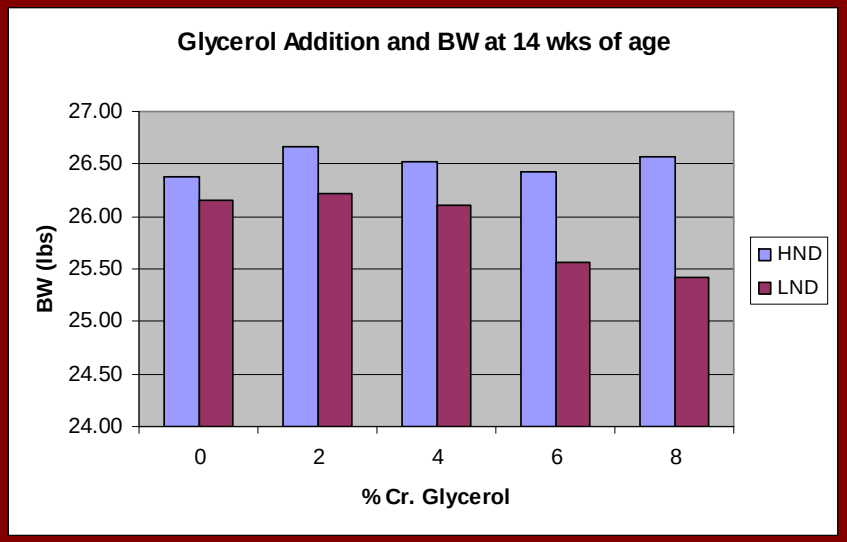
- Laying Hen (Lammers et al., 2008)
  - 0, 5, 10, 15% to 40wk old W36 hens
  - Short term study no effect on performance
  - AMEn 3805 (+/- 240 kcal/kg)

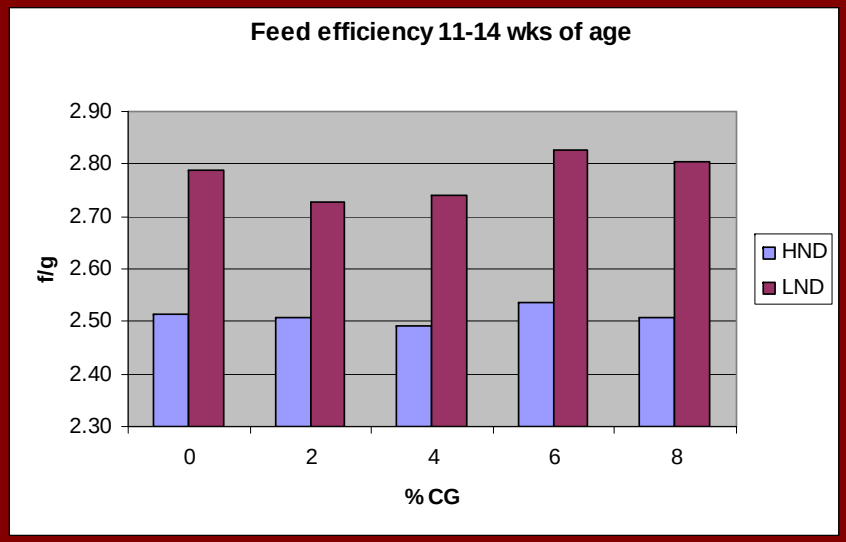
Market Tom Response to Crude Glycerol

- Glycerin additions (0,2,4,6,8%)
  - Replaced corn – weight equivalent
- Two diet regimens (HND and LND)
- Experimental period 8-19 wks of age
- Diets fed as mash

Funded by MTGA, MPRP; Glycerol supplied by Central Bi

Market Tom Response to Glycerol Addition (TG074 Preliminary Results)





Crude glycerol and pellet production
(Swine feeding trials, Groesbeck, KSU 2007)

- Experiment 1
  - Glycerol addition to 9% increased PDI
  - Decreased production energy
- Experiment 2
  - Glycerol of 3 and 6% increased PDI
- Flowability improved in meal diets with hammer mill grd. corn

Summary - Glycerin as a source of energy

- Provides primarily energy & some minerals
  - No significant protein content!
- GE 3625 kcal/kg
  - Chickens - AMEn 3600-3800 kcal/kg
  - Turkeys (preliminary) - 3600 kcal/kg
- Variability in content
  - Glycerol, methanol, Na and K

Summary - Glycerin as a source of energy

- Meat yield/quality characteristics??
- Seasonal product flowability changes (cold temperature)
- Handling and flowability issues at high inclusion levels??
  - Improve pellet quality??
  - Decrease dust
- Economics of use
  - Tied to cost of protein and ME sources

Concluding Remarks

- What will future poultry diets contain for ingredients?
  - Potential loss of corn, SBM, fat
  - Including more alternatives
    - Dealing with nutrient variability
    - Higher levels of alternatives can be utilized
      - Detrimental properties

Acknowledgments-UM Turkey Research Program

- Funding/Supplies
  - Central Bi-Products
  - CSC
  - ADM
  - USDA-CSREES Special Research Grant to the Midwest Poultry Consortium
  - MTGA
  - AURI
- Technical
  - UM – J. Brannon, F. Hrbek
  - UI – C. Parsons, P. Utterback
  - MTGA Nutrition Advisory Committee – G. Engelke, J. Halvorson, G. Johnson, D. Nelson, V. Stangeland, G. Speers

University of Minnesota DDGS Webpage

- www.ddgs.umn.edu