Feeding Value of Corn DDGS for Poultry

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What does corn-derived DDGS contribute to poultry diets?

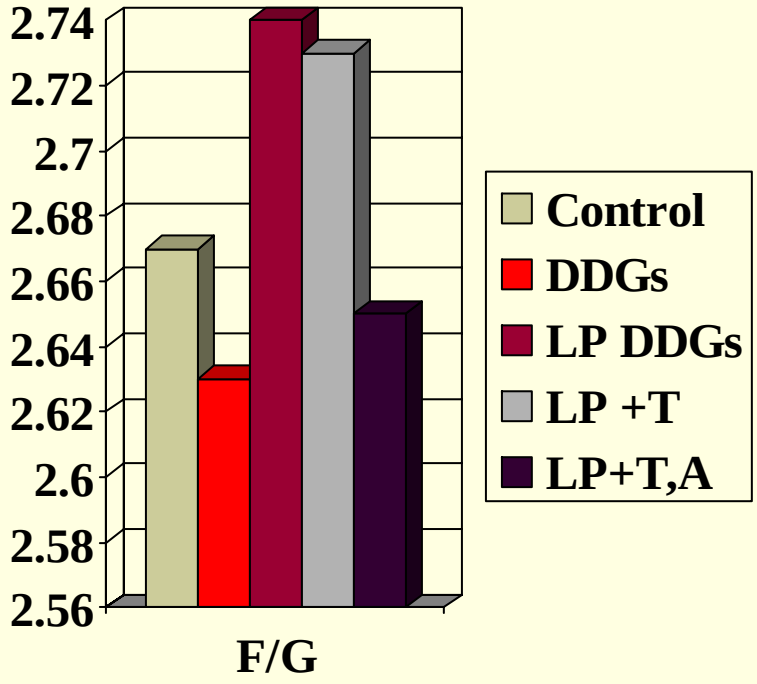
- Protein (corn)
  - Amino acid content
  - Amino acid digestibility
- Energy (metabolizable energy)
  - Proximate Composition
- Phosphorus
  - Availability
- Xanthophylls (yolk and carcass pigmentation)

What does DDGS contribute to poultry diets

- Protein (corn)
  - Amino acid content/balance
  - Influence of dietary protein level
    - Lowered protein diets
- Research by Parsons (’83)
- Lysine – 1st limiting
  - Supplementation with lysine
- Tryptophan and arginine almost equally limiting

Limiting nature of tryptophan and arginine in DDGs for turkey toms

- University of Minnesota Trial (2003)
- No performance difference – control diet & 10% DDGS diet
- Lowered protein diet (LP) with 10% DDGs resulted in poorer F/G
- F/G restored with try & arg supplementation



Noll et al, 2003

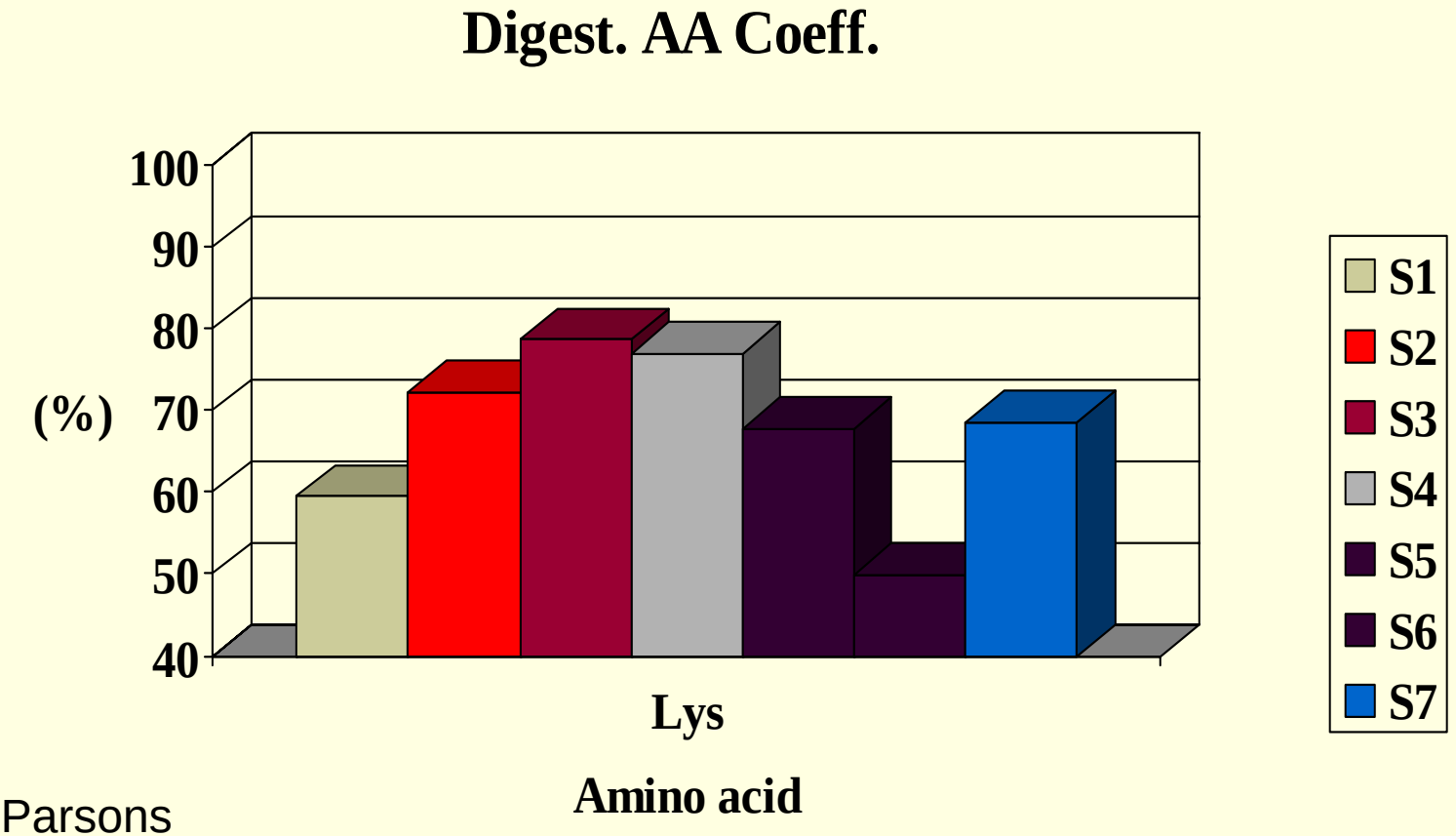
What does DDGS contribute to poultry diets

- Protein (corn)
  - Amino acid content/balance
    - Corn protein in DDGS limiting in lysine, arginine and tryptophan (Parsons et al 1983; Noll, 2003)
    - Source of threonine (Noll, 2003)
    - Important to formulate with minimums for:
      - Lys
      - Arg
      - Try

What does DDGS contribute to poultry diets

- Protein (corn)
  - Amino acid digestibility
    - Ingredient processing in particular that of heating decreases digestibility of amino acids
      - Oil seed meals
      - Meat and bone meal
    - Associated with color change - darkening
    - In DDGs, digestibility of amino acids is *variable among sources*, in particular that of lysine (Ergul et al, 2003)

Lysine Digestibility for Poultry as Affected by Production Source

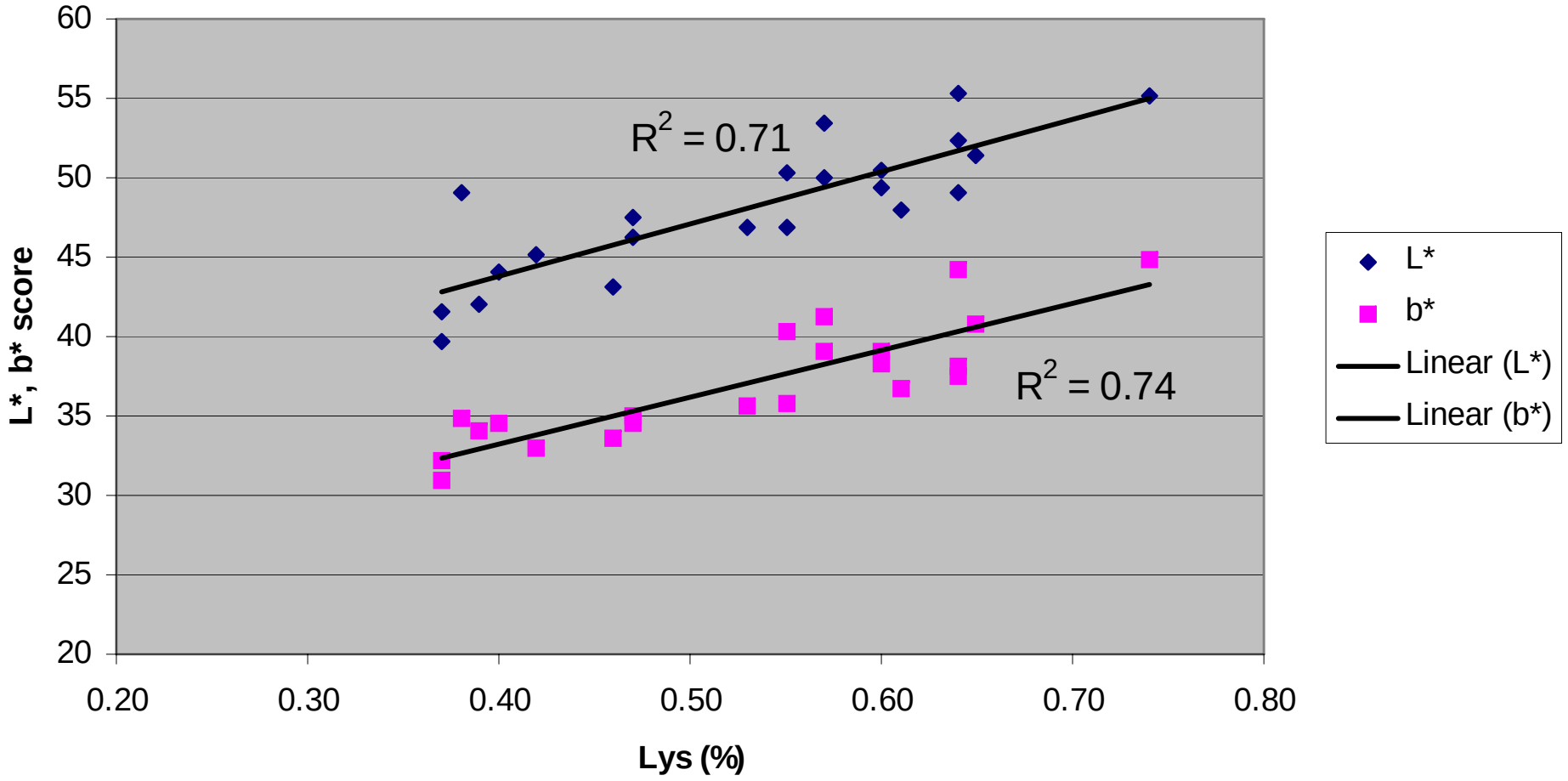


Noll and Parsons

What does DDGS contribute to poultry diets

- Protein
  - DDGS Amino acid digestibility and color
    - Lysine digestibility was shown to be correlated with Chromameter readings for L* and b* values (Ergul et al., 2003)

Fig. 1. Regression of digestible lys (%) and color (L*, b*)



Economics and DDGs Quality-Lysine Digestibility

DDGS Opportunity Cost in
Commercial Poultry Grower Diet

Comparison of DDGS Quality Total Amino Acids (Digestible)

%	Hi Dig Lys	Lo Dig Lys
CP	26.4	27.8
Met	.49(.43)	.51(.44)
Cys	.53(.42)	.49(.32)
Lys	**.81(.64)**	**.72(.46)**
Thr	1(.82)	1.03(.75)
Tryp	.24(.19)	.2(.16)

Influence of digestible lysine on value of DDGs (US $/cwt)

Ingredient Cost	High Dig Lys	Low Dig Lys
Corn, 3.10	4.78	4.28
Corn, 3.50	5.00	4.54
Corn, 5.30	6.02	5.70
SBM, 8.25	5.00	4.54
SBM, 8.70	5.21	4.72

What does DDGS contribute to poultry diets

- Recommendations re. amino acids
  - Formulate with minimums for lys, arg, & try
  - Formulate on a digestible amino acid basis

What does DDGS contribute to poultry diets

- Protein (corn)
  - Amino acid balance
  - Amino acid digestibility
- Energy (metabolizable energy)
- Phosphorus
  - Availability
- Xanthophylls (yolk and carcass pigmentation)

Metabolizable Energy for DDGS

- Importance of energy level
  - Feed conversion
  - Least cost formulation for high energy diets
- More recent determinations much higher than NRC (1994) reported value of AMEn 2480 kcal/kg (9% fat vs 10-11% in current DDGS)

Source	AMEn (kcal/kg)	TMEn
NRC, 1994	2480	
Potter, 1966	2880	
Noll, 2004	2810-2850	2833
Roberson 2004	2760	
Batal & Dale, 2004		2831

DDGs Economics and AME Energy Level

DDGs ME Kcal/kg	Fat Cost $/100 lbs	% DDGs Inclusion $4/100 lbs	DDGs Opportunity Cost, $/100 lbs	
2810	11	10		
2810	15	10		
2480	11	0	3.82	
2480	15	0	3.34	

What does DDGS contribute to poultry diets

- Protein
- Energy (metabolizable energy)
- Phosphorus
  - Availability
- Xanthophylls (yolk and carcass pigmentation)

Availability of Phosphorus

Ingredient	P, %	P, avail. %	% P Avail.
Corn*	.28	.08	28
SBM*	.62	.22	35
DDGs*	.72	.39	54
DDGs (UGA)	.74	~.47	61-68 (64)
DDGs(UI) DDGs (MSU)	.73	~.6	69-102 (82) 76-85 (80)

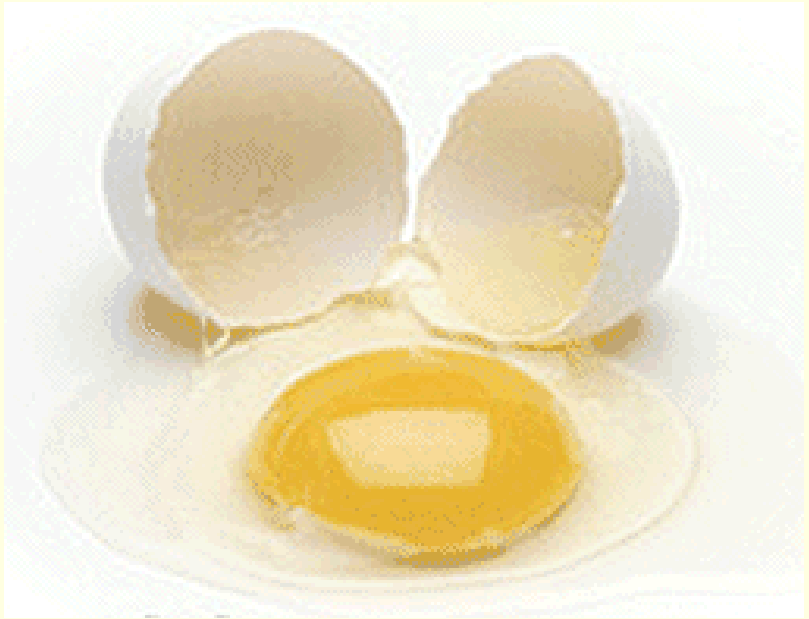
*NRC, 1994

What does DDGS contribute to poultry diets

- Protein
- Energy (metabolizable energy)
- Phosphorus
- Xanthophylls
  - yolk and carcass pigmentation

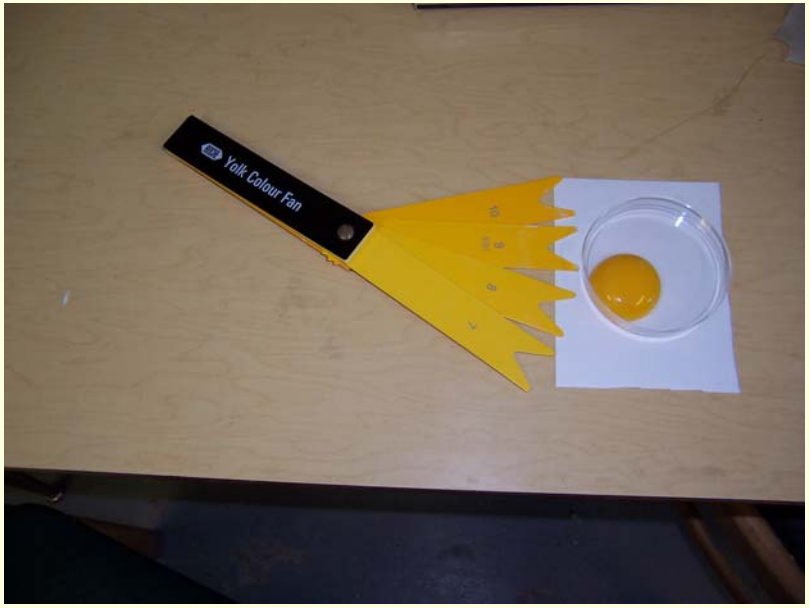
DDGs and Xanthophylls – Book Values

- Corn 15-25 mg/kg
- Corn Gluten Meal 130-170 mg/kg
- DDGs 15-20 mg/kg
  - Limited analytical results
  - May have value in diets low in corn grain



DDGS and Egg Yolk Pigmentation

- Roberson (2004) –
  - 10% 2 wks fed (Exp 1)
  - 5% at 3 wks (Exp 2)
- Lumpkins (2003) – no change
- Sanfandila field trial (Shurson, 2003) slight change in yolk color (10.6 vs 10.8)

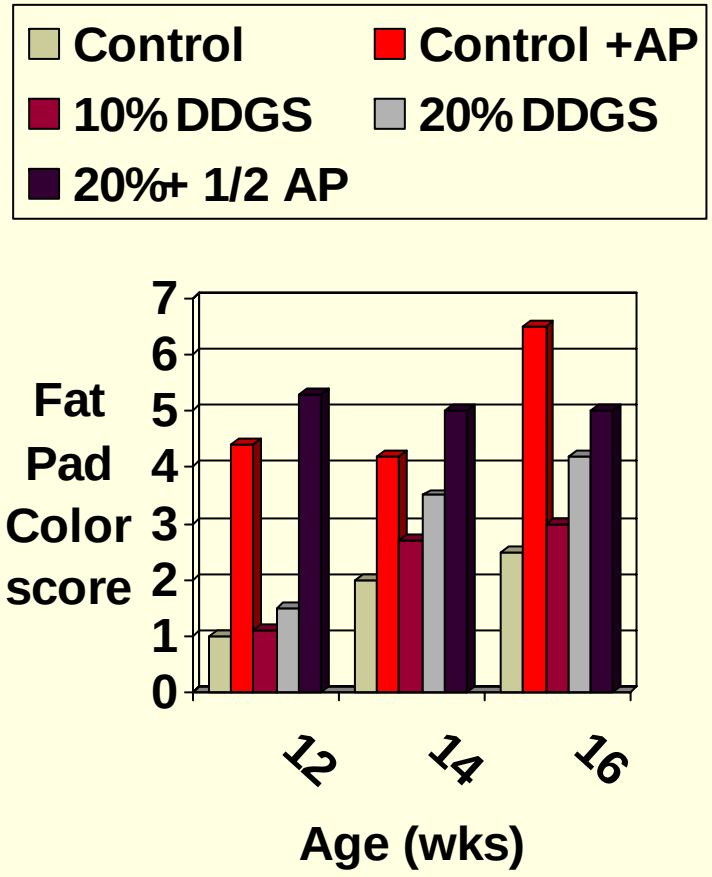


Roberson Experiment 2 – Yolk Color (9 wks)

DDGS	L*	a*	b*	Roche
0 %	77.9 a	2.70 d	88.1	8.63 b
5 %	75.9 b	4.19 c	86.7	8.98 a
10 %	76.2 b	4.74 b	87.5	9.02 a
15 %	75.9 b	6.11 a	87.7	9.22 a
SE	0.4	0.19	0.6	0.08
Trt, p<	0.004	<0.001	0.352	0.001
Linear, p<	0.007	<0.001	0.846	<0.001

DDGS and Carcass Skin Pigmentation

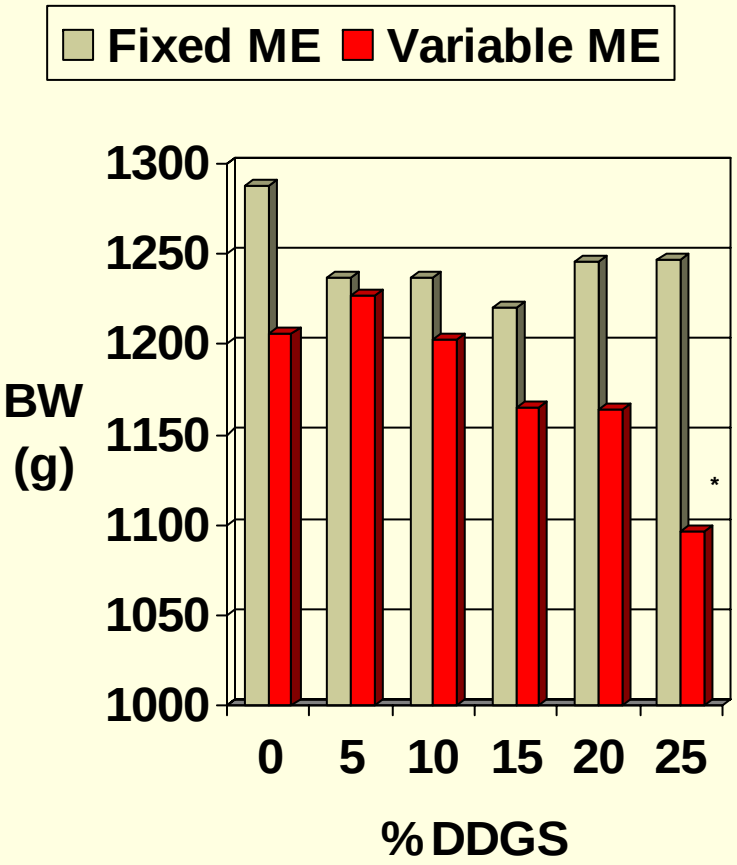
- Lu and Chen, 2004
  - Domestic color chicken
  - Control and pigments (AP)
  - 10 or 20% DDGS
  - 20% DDGS plus AP
  - Xanthophyll content of
    - DDGS 20 mg/kg
    - Corn 6-7 mg/lg
  - Diets fed to 16 wks of age
  - DDGS provided some pigmentation to abdominal fat pad and cooked carcass skin
  - Concluded AP use could be decreased by 50% with DDGs use

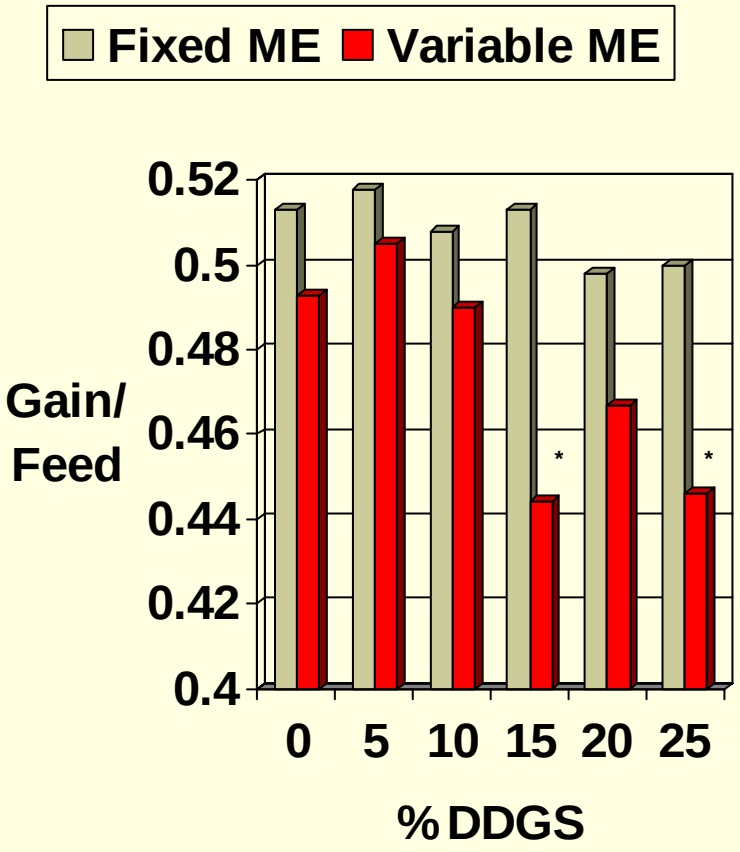


Inclusion levels for poultry

- Broilers
  - Waldroup (1981) up to 25% (adjusted for lys and ME)
  - Lumpkins et al (2004) up to 15%

Performance Response of Broiler Chickens (0-42 days) to DDGS in Diets Adjusted and Not Adjusted for Energy





*Different from control

Waldroup et al, 1981

DDGs – Broiler Diets (Lumpkins et al., 2004)

- Experiment 1 - 0 and 15% DDGs at two dietary energy levels (3200 and 3000 kcal/kg
- Experiment 2 – 0, 6, 12, & 18%

DDGs and Broiler Performance

Diet Density & DDGs Level	Gain 18d G	G:F 18d
High, 0%	556a	782a
High, 15%	555a	772a
Low, 0%	523b	712b
Low, 15%	518b	705b

Lumpkins et al., 2004

DDGs and Broilers

Level of DDGs	Gain 42d kg	G:F 0-42 d
0	2.31a	566
6	2.29a	554
12	2.29a	565
18	2.24b	554

Lumpkins et al., 2004

DDGs – Broiler Diets (Lumpkins et al., 2004)

- Experiment 1 - 0 and 15% DDGs at two dietary energy levels (3200 and 3000 kcal/kg – no difference in performance to 18 d re. DDGs
- Experiment 2 – 0, 6, 12, & 18%
  - BW to 42 days similar to 12%
  - Slight depression in BW at 18%
    - Lowered wts through 16 da

DDGs in Chicken Broiler Diets

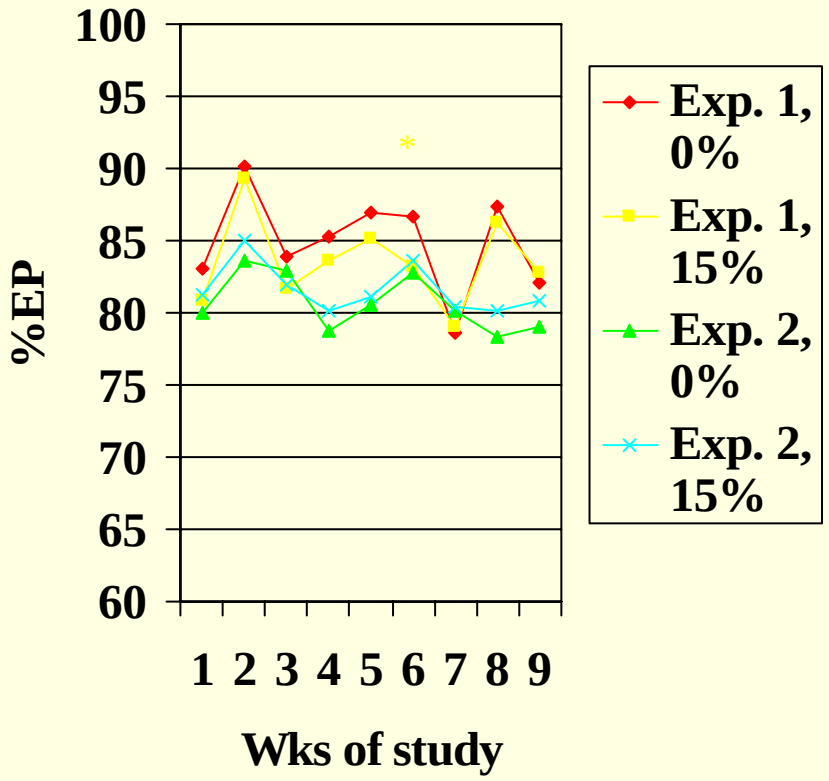
- Adjustment for lysine and energy level
  - Lowered level of use without adjustment
- Inclusion level of 15% possible
  - Starter diets 6%
  - Grower/Finisher 15%

Inclusion levels for poultry

- Chicken Layers
  - Roberson 2004 up to 15%
  - Lumpkins 2003 up to 15% in diets of commercial energy density

DDGs and Chicken Layers

- Roberson, 2004
  - Hy-line W36
  - 48 wk old hens
  - Two 9/10 wk trial
  - Level
    - 0, 5, 10, 15% DDGs



Laying Hen Study (Roberson, 2004)

- Inconsistent level effects on:
  - Weekly egg production (1 wk of 9 wks)
  - Specific gravity
    - Exp 1 (1 wk of 4)
    - Exp 2 – no effect
- No effect on egg weight

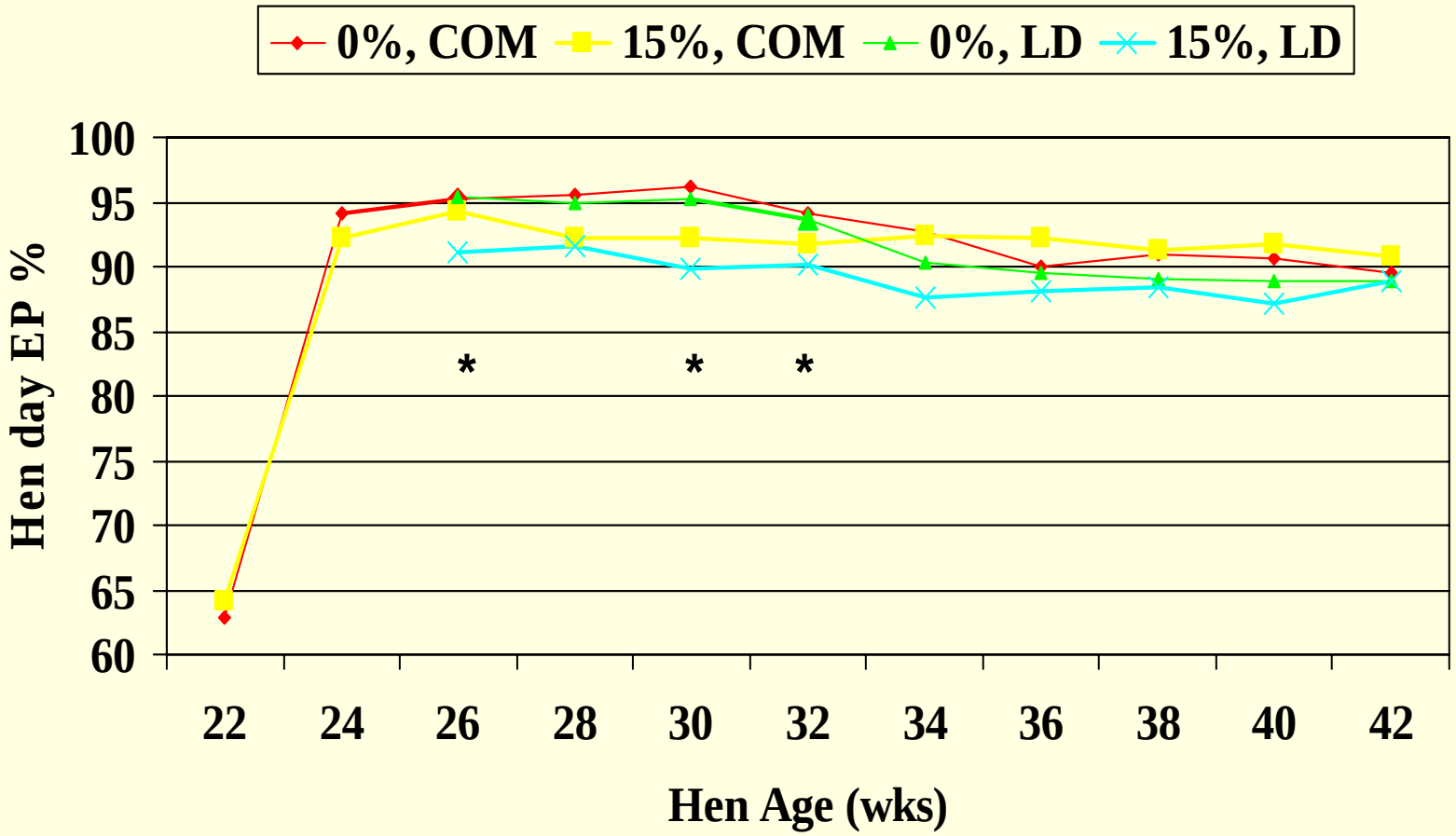
DDGS and Layer Performance (Lumpkins, et al. 2003)

- Treatments
  - 0 or 15% DDGs
  - Energy density
    - Commercial (2870 kcal/kg; 18.5% CP)
    - Low energy density (2800 kcal/kg; 17% CP)
- Hy-line W36 White Leghorns
- Summer trial (20 wk trial, June-October)

DDGS and Layer Performance (Lumpkins, et al. 2003)

- No effect of DDGs on:
  - Hen feed intake
  - Egg weight
  - Yolk color
  - Egg quality
- Interaction of DDGs level & diet energy

Egg production of hens fed diets with and without DDGs (0, 15%) at commercial or low energy density



From: Lumpkins et al., 2003

DDGS and Layer Performance (Lumpkins, et al. 2003)

- Low energy & 15% DDGs slight depression in egg production
  - Insufficient caloric intake
  - Amino acid digestibililty
    - Diets formulated on total amino acid basis

DDGs and Recent Chicken Layer Studies

- Field trial – Sanfandila (Shurson, 2003)
  - Babcock 300
  - 12 wk trial
  - 10% Norgold DDGs

Sanfandila Field Trial

Performance	Control	Norgold DDGS	P value
EP,%	68.7	72.4	.02
First class EP,%	66.2	68.9	.10
EW/hen/wk, kg	.31	.32	.11
Cull eggs,% of total	2.2	3.5	
Dirty Eggs	1.4	2.2	.002
Egg Quality			NS

Summary: DDGs and Recent Chicken Layer Studies – Inclusion Levels

- Roberson, 2004
  - 0, 5, 10, 15%
- Lumpkins, et al. (2003)
  - 0, 15%
- Field trial – Sanfandila (Shurson, 2003)
  - 10% inclusion

DDGs in Chicken Layer Diets

- Possible source of xanthophyll
- Inclusion level of 15 %
  - acceptable performance
  - Less than 15% for low density diets

Current Market Turkey Research

- Roberson, 2003
  - Hen turkeys – grow/finish diets
  - Isocaloric; digestible amino acids
- Noll ongoing – several experiments
  - Tom turkeys – grow/finish diets (5-19 wks)
  - Formulation - isocaloric; digestible amino acids

DDGs and Turkey Hen Diets

DDGs %	BW 105 da, kg	F/G 75-105 da
Exp. 1		
0	8.53*	2.99
9	8.41	3.07
18	8.23	3.21
27	8.16	3.21
Exp. 2		
0	8.51	3.44
7	8.46	3.54
10	8.50	3.46

* Significant Linear Component

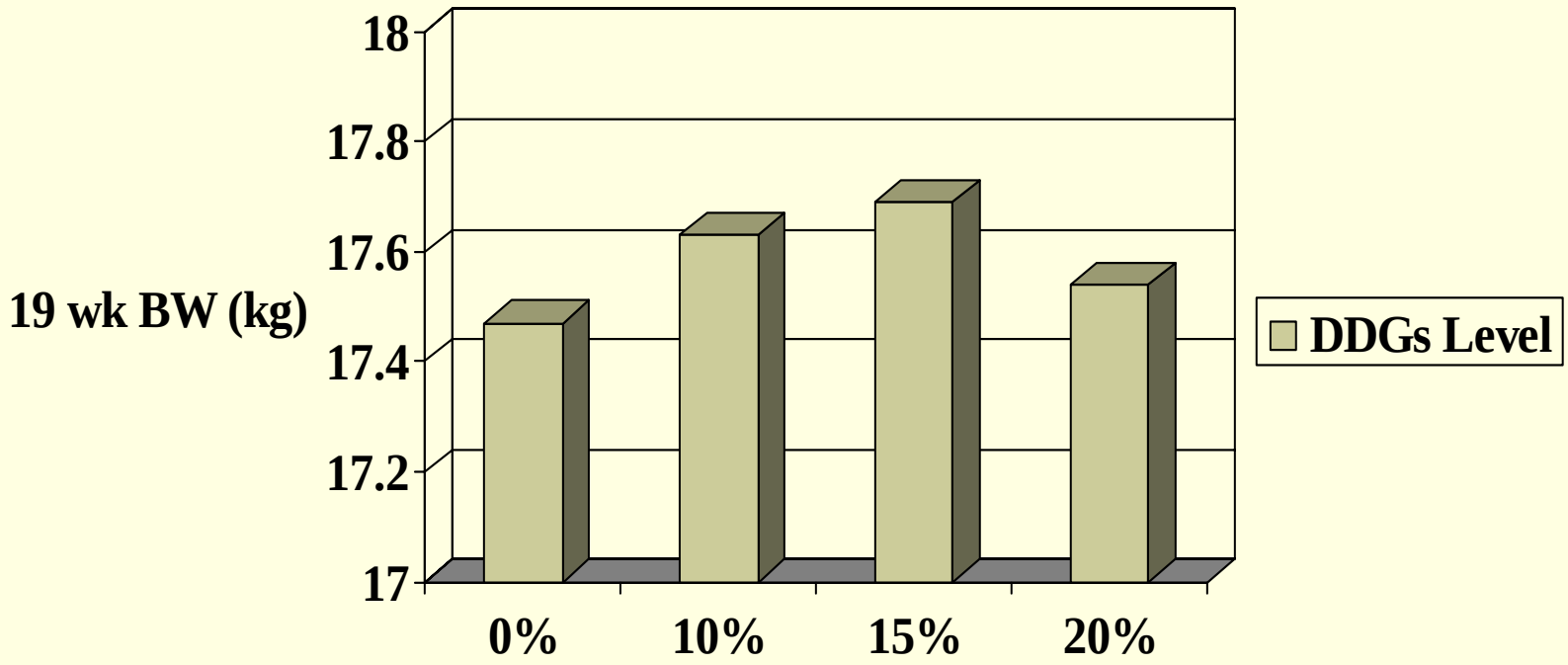
From: Roberson, 2003

Market Tom Trials-Grow/Finish Diets (University of Minnesota)

Trial*	Trt	DDGs,%	BW, kg	F/G
1	Control	0	18.9	2.44
	DDGs	12-8	19.0	2.48
2	Control	0	19.2	2.64
	DDGs	11-8	19.2	2.65
3	Control	0	18.4	2.67
	DDGS	10	18.3	2.63

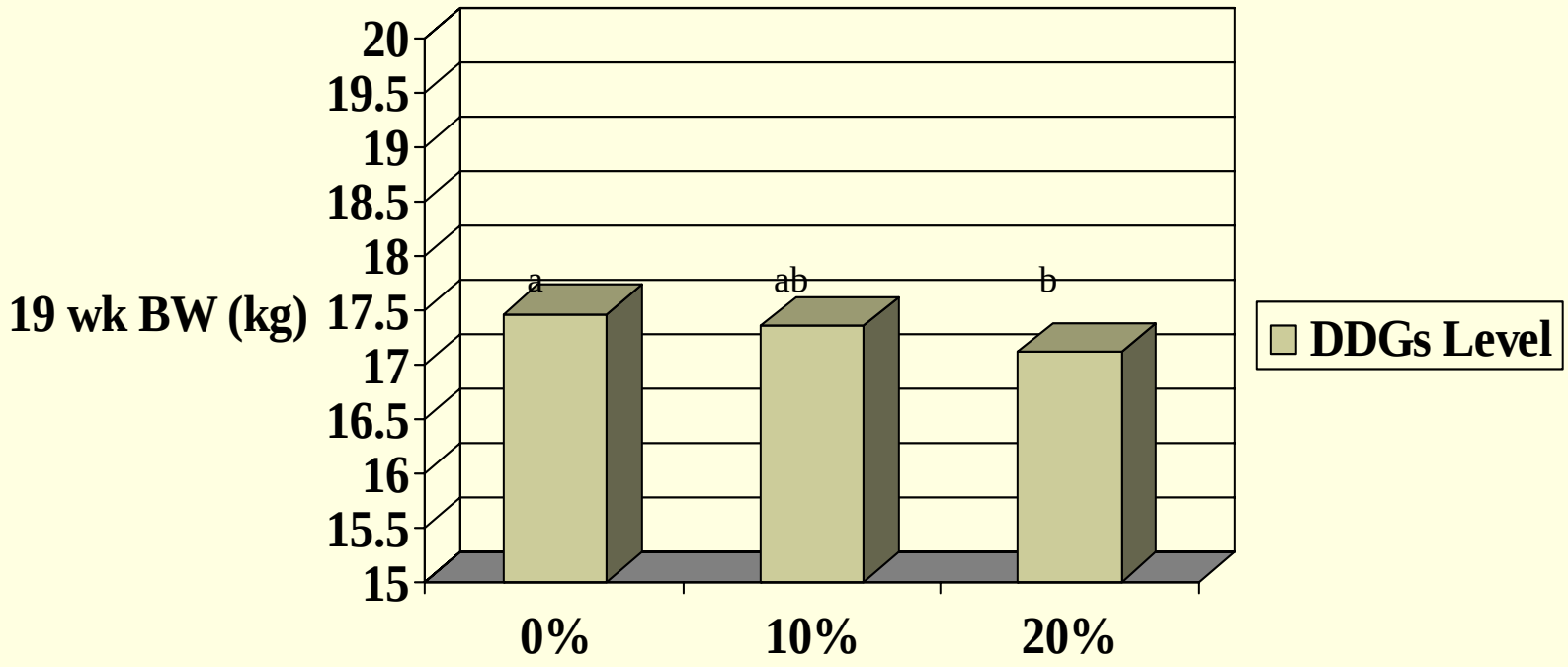
*Trial weeks of age; 1=5-19 wks; 2=8-19 wks; 3=11-19 wks

Market Tom Trials-Level of Inclusion
UM Trial 4 (Winter Trial)



Noll et al., 2004

Market Tom Trials-Level of Inclusion
UM Trial 5 (Summer Trial)



Noll et al., 2005

Differences
Trial 4 vs 5

- Feed intake levels
  - Winter vs summer rearing conditions
- Formulation – diet protein level
  - No supplemental thr vs .05% thr use
  - Lowered dietary protein with .05% thr

Inclusion levels for poultry

- Market Turkeys
  - Hens
    - Up to 10% (Roberson et al 2003)
  - Toms (Noll, 2004)
    - Up to 10% in summer or lowered protein diets
    - Up to 20% in winter or normal protein diets

Recommendations for Use of DDGs

- Corn DDGs (to 15%) can be fed to chicken layers and broilers; Turkeys - to 10% for hens; 20% of diet for toms
  - Lower levels in diets for young poultry
- Formulate with minimums for tryptophan and arginine
- Formulate on basis of digestible amino acid content
- Lower maximum level of use in low density or low protein diets
- Consider AMEn value of 2750 to 2850 kcal/kg
- Increase available phosphorus (higher than NRC ’94) – 65%

University of Minnesota DDGS Webpage

- www.ddgs.umn.edu

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