Feeding Value of Corn DDGS for Poultry

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Presentation Outline

- DDGS nutrient contributions to poultry diets
- Review Research re. DDGs Inclusion in Poultry Diets

What does corn-derived DDGS contribute to poultry diets?

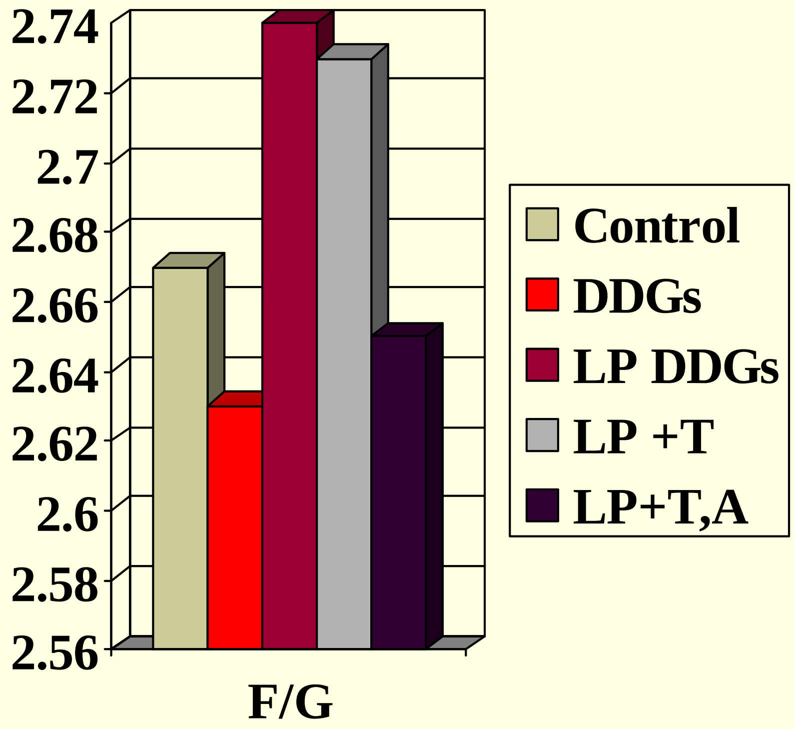
- Protein (corn)
  - Amino acid content
  - Amino acid digestibility
- Energy (metabolizable energy)
  - Proximate Composition
- Phosphorus
  - Availability
- Xanthophylls (yolk and carcass pigmentation)
- Fiber – reduction of ammonia emissions

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 and sulfur amino acids (Noll, 2003)
    - Important to formulate with minimums for:
      - Lys
      - Arg
      - Try

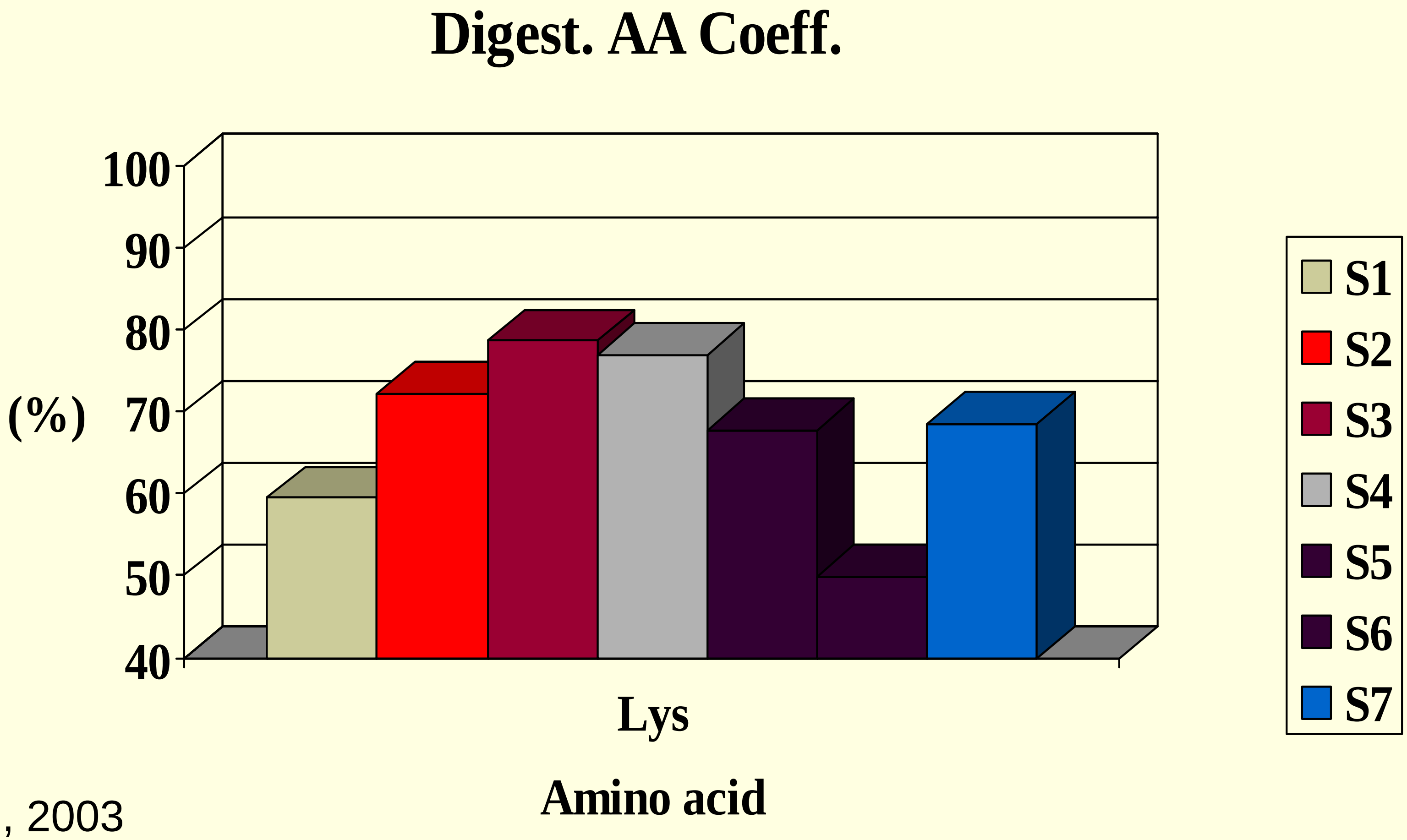
What does DDGS contribute to poultry diets

- 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
    - Amino acids most affected – lys, thr, cys
    - In DDGs, digestibility of amino acids is *variable among sources*, in particular that of lysine (Ergul et al, 2003)

Lysine Content and Digestibility

Source	No. of Samples	Lysine Content (%)		Lysine Digestibility Coefficient (%)	
		Ave.	Range	Ave.	Range
Ergul et al. 2003[1]	**20**	**.73**	**.59-.89**	**72**	**59-84**
Batal and Dale 2006[2]	8	.71	.39-.86	70	46-76
Fastinger et al. 2006[1]	5	.64	.48-.75	76	65-82

Lysine Digestibility for Poultry as Affected by Production Source



Ergul et al., 2003

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 – Re. Protein/amino acids

- Recommendations re. amino acids
  - Formulate with minimums for arg, & try in addition to lys, TSAA, and thr
  - Formulate on a digestible amino acid basis

What does DDGS contribute to poultry diets

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

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, 2006		2820

DDGs Economics and AME Energy Level

DDGs ME Kcal/kg	Fat Cost $/100 lbs	% DDGs Inclusion $4/100 lbs	DDGs Opportunity Cost, US $/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

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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)

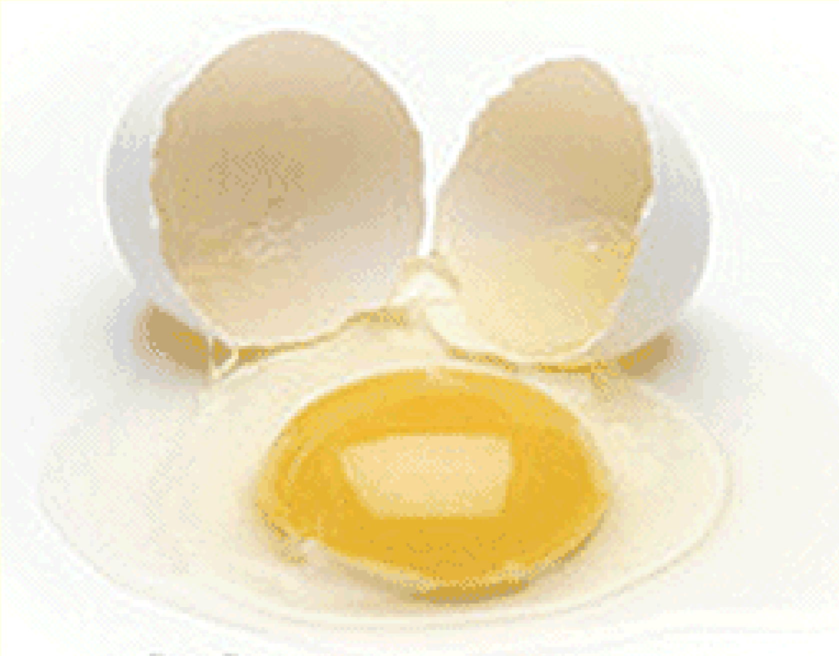
*NRC, 1994

What does DDGS contribute to poultry diets

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

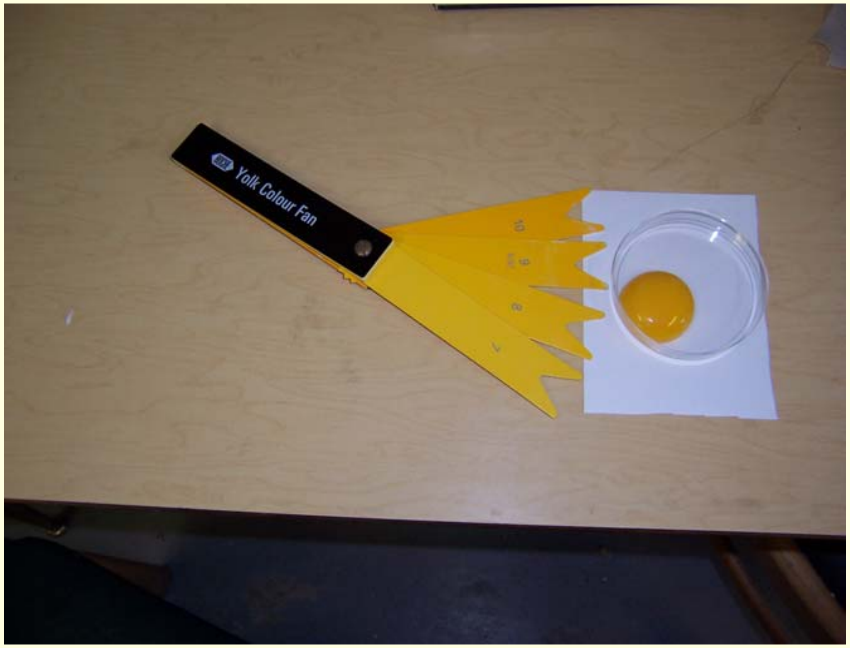
DDGs and Xanthophylls – Book Values

- 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 (2005) – no change
- Sanfandila field trial (Shurson, 2003)
  - Slight change in yolk color (10.6 vs 10.8)

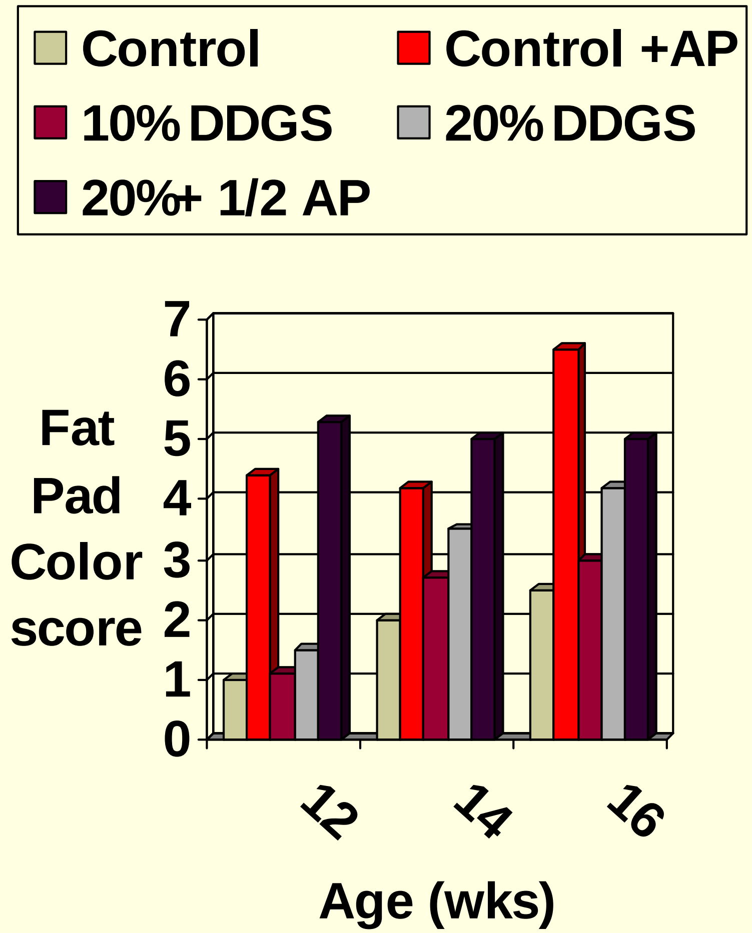


Roberson Experiment 2 – Yolk Color (9 wks)

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 Fat Pad Pigmentation

- Lu and Chen, 2004
  - Domestic dark 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



What does corn-derived DDGS contribute to poultry diets?

- Protein (corn)
  - Amino acid content
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- Energy (metabolizable energy)
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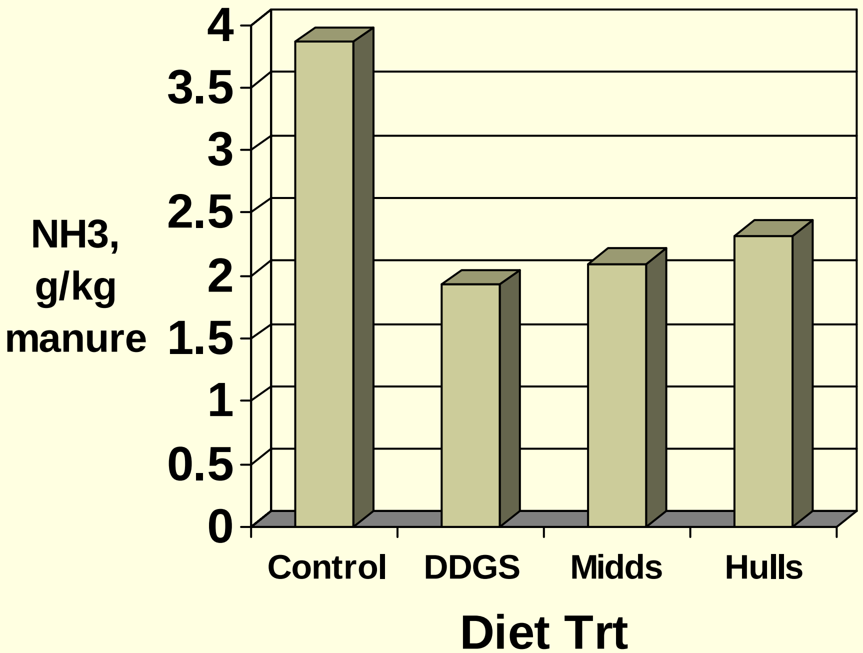
- Xanthophylls (yolk and carcass pigmentation)
- Fiber – reduction of ammonia emissions

DDGS Fiber and Reduction in Ammonia Emissions

- Addition of fiber to laying hen diets (K. Bregendahl http://www.ddgs.umn.edu/info-poultry.htm)
- Diet treatments
  - Corn soy control
  - CS + 10% corn DDGS
  - CS + 7.3% wheat midds
  - CS + 4.8% soy hulls
- Reduction in ammonia emissions by 50%

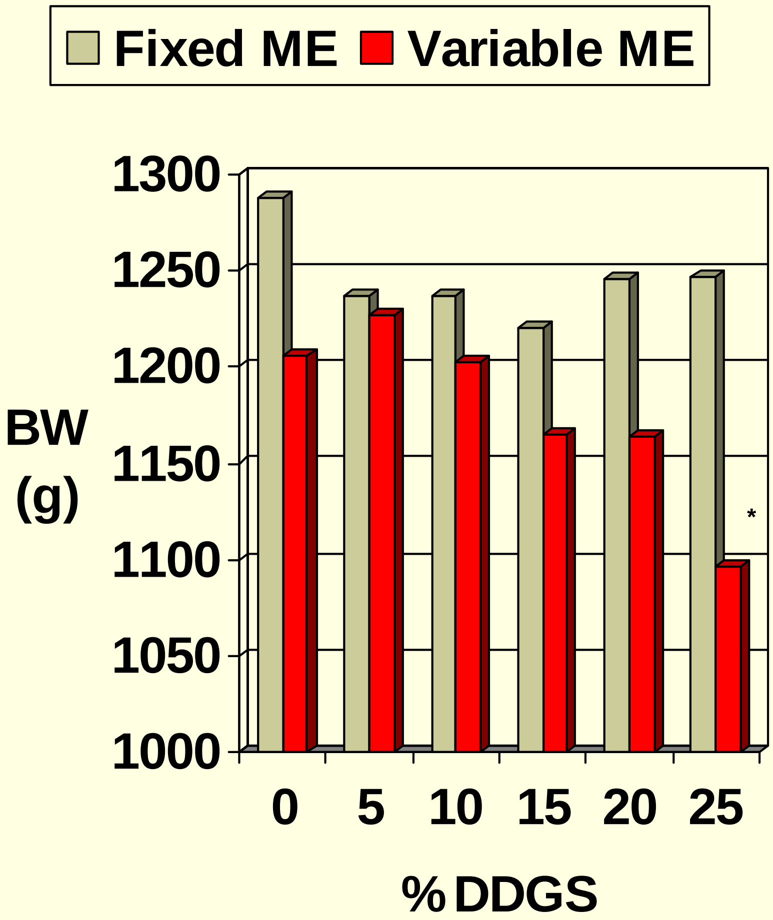
NH3 emission from manure over 7 days

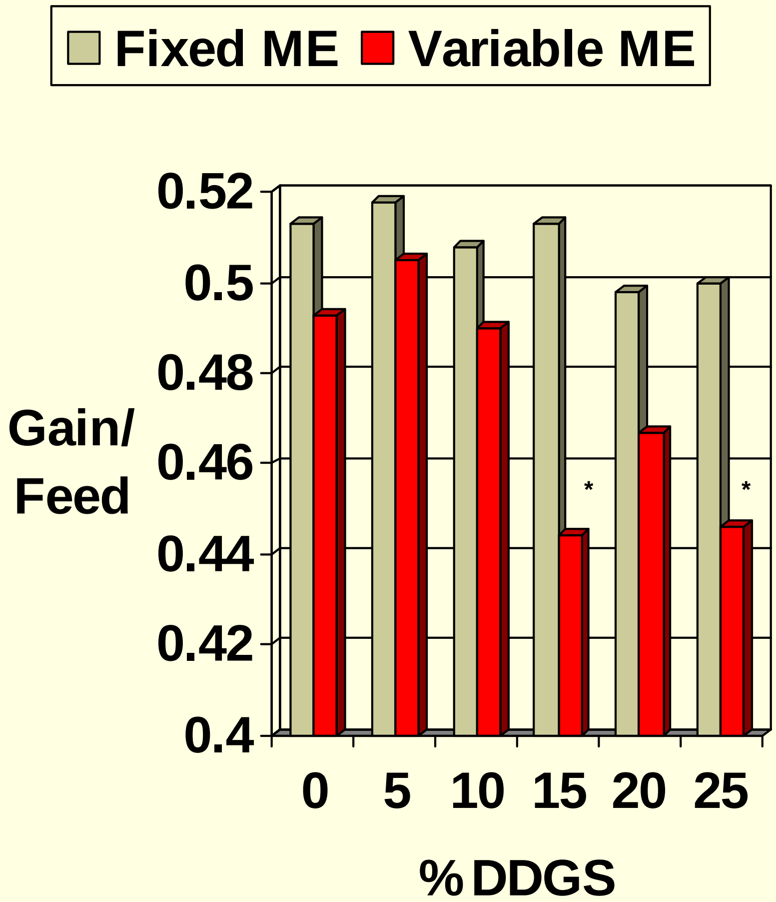


Inclusion levels for poultry

- 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

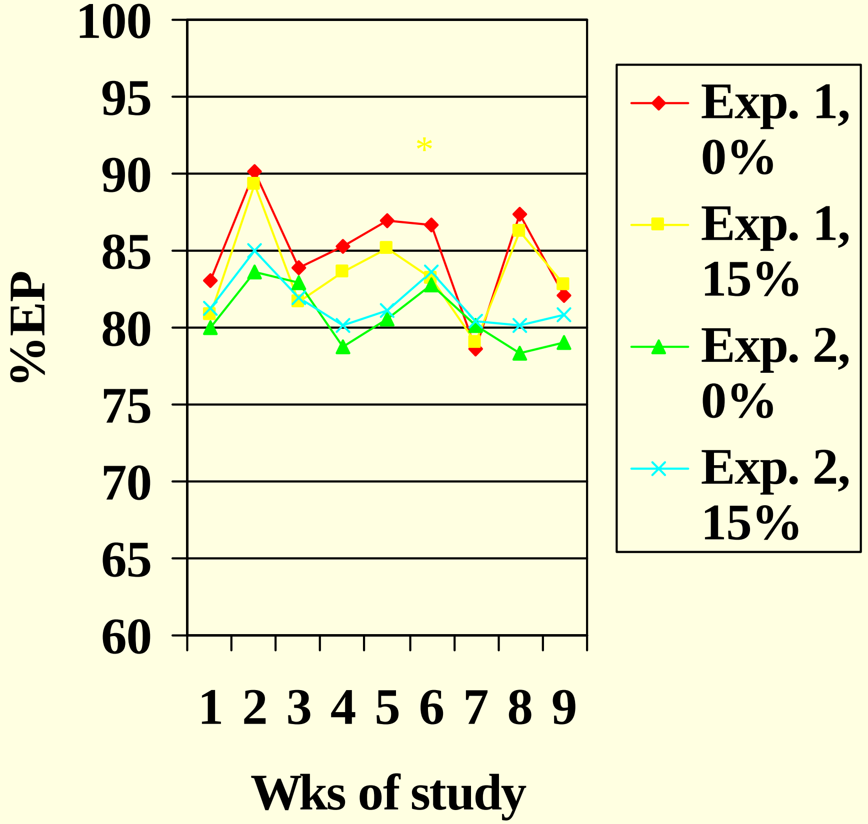
- Adjustment for lysine and energy level
  - Lowered level of use without adjustment
- Inclusion level of 15% possible
  - Starter diets 6%
  - Grower/Finisher 15%

Inclusion levels for poultry

- Chicken Layers
  - Roberson 2004 up to 15%
  - Lumpkins 2005 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

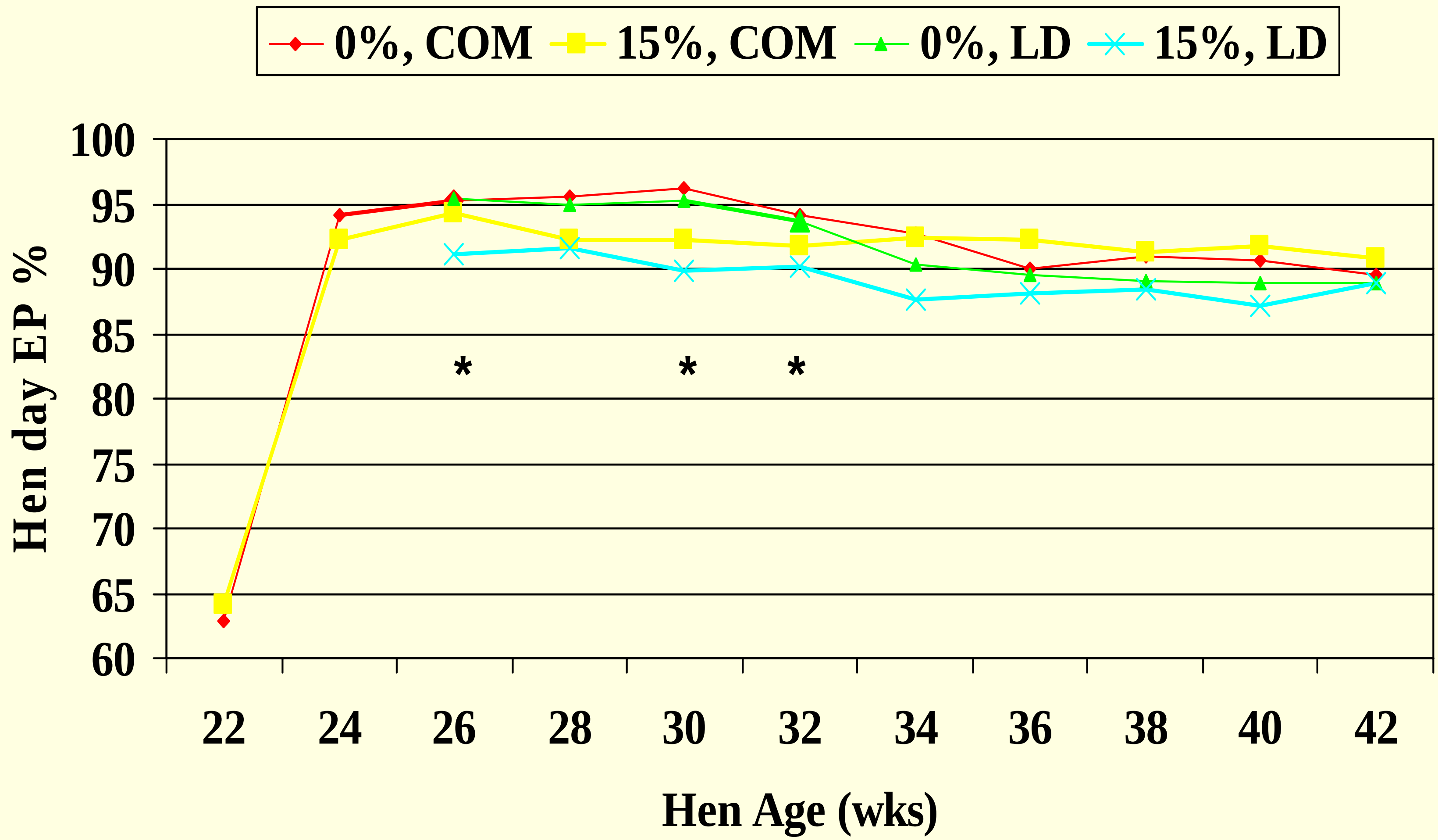
DDGS and Layer Performance (Lumpkins, et al. 2005)

- 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. 2005)

- 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., 2005

DDGS and Layer Performance (Lumpkins, et al. 2005)

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

DDGs and Recent Chicken Layer Studies

- Field trial – Sanfandila (Shurson, 2003)
  - Babcock 300
  - 12 wk trial (Post-molt, 68 wks to 80 wks of age)
  - 0 or 10% Norgold DDGS
  - Four buildings (2 each diet)
  - Study terminated early
    - Short on DDGs
    - Health problems – Influenza and Newcastle disease

Sanfandila Layer Diets

Ingredient, %	Phase 2 Control	Phase 2 +DDGS	Phase 3 Control	Phase 3 +DDGS
Sorghum	65	59.5	68.5	62.9
SBM	21.3	16.3	19.1	14.3
Acidified Oil	1.3	1.80	.3	.7
DDGS		10		10
Dical P	1.3	1.0	1.0	.8
DL Met	.085	.084	.074	.07
Phytase	+	+	+	+

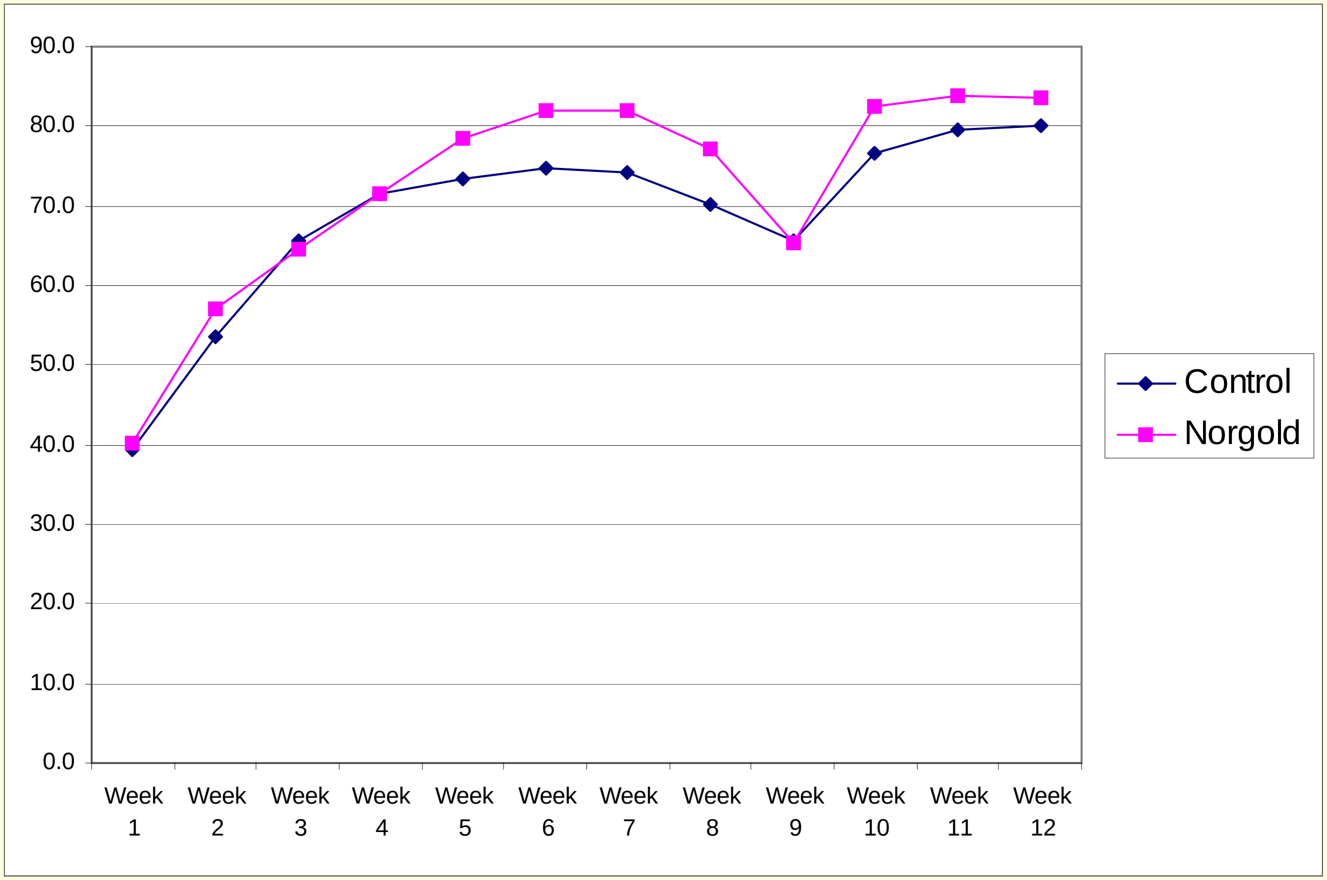
Sanfandila Layer Diets-Nutrients

Nutrient, %	Phase 2 Control	Phase 2 +DDGS	Phase 3 Control	Phase 3 +DDGS
ME kcal/kg	2797	2800	2781	2774
Protein	16.2	16.2	15.4	15.5
Lysine	.82	.82	.76	.75
M+C	.63	.63	.59	.6
Thr	.6	.59	.57	.56
Tryp	.19	.18	.18	.17
Xanthopyll, mg/kg	8.75	8.75	8.75	8.75

Measurements

- Hen-days
- Feed
- Egg production & egg weight
- Mortality
- Egg condition
  - First quality, broken, DY, shell-less
- Egg quality
  - Albumen height, SPG, yolk pigmentation

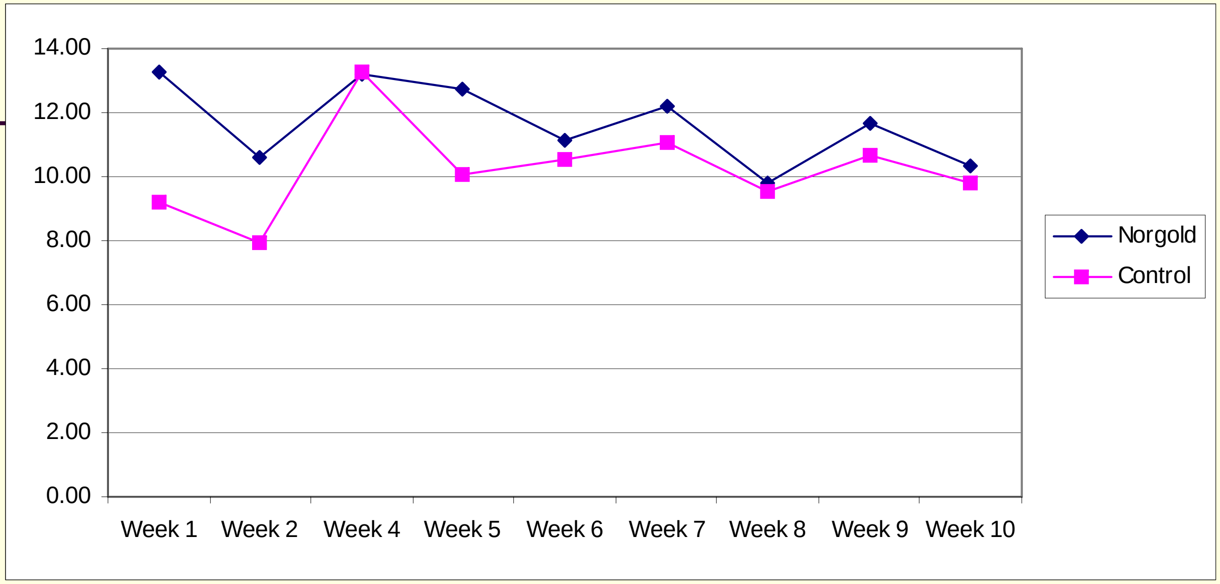
Egg Production (Weekly, %)



Sanfandila Field Trial

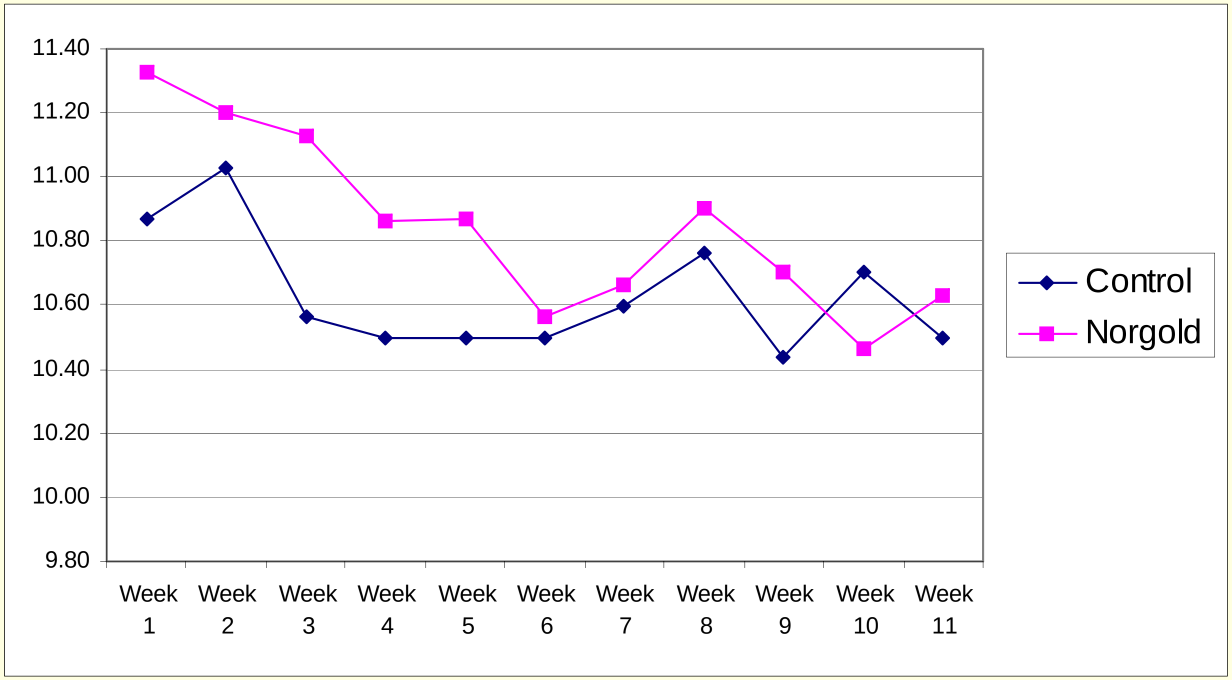
Performance	Control	Norgold DDGS	P value
EP,%	68.7	72.4	.02
First class EP,%	66.2	68.9	.10
EW/hen/wk, kg	.31	.32	.11
Cull eggs,% of total	2.2	3.5	
Dirty Eggs	1.4	2.2	.002
Egg Quality			NS

Diet Xanthophyll Content



Egg Yolk Color

(Roche Units)



Sanfandila Field Trial - Summary

- Equivalent performance
  - Feed intake, egg wt, egg quality
- Feeding of DDGS
  - Increased number & % of eggs
  - Increased proportion of broken & dirty eggs
    - Combination of phytase supplementation and high P av. in DDGS perhaps led to excess P resulting in poorer shell quality
    - Effect of AI and NC disease
  - Increased production of first quality eggs
  - Darker egg yolks

Summary: DDGs and Recent Chicken Layer Studies – Inclusion Levels

- Roberson, 2004
  - 0, 5, 10, 15%
- Lumpkins, et al. (2005)
  - 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

Inclusion levels for turkeys

- Market Turkeys
  - Hens
    - Up to 10% (Roberson et al 2003)
  - Toms (Noll, 2006)
    - Up to 10% in summer season or lowered protein diets
    - Up to 20% in winter season or normal protein diets; or diets without animal protein

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 in addition to those for lys, TSAA, and thr
- 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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