

# Diet Effects on Layer Nitrogen Excretion

David Latshaw

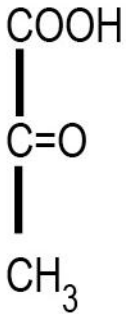
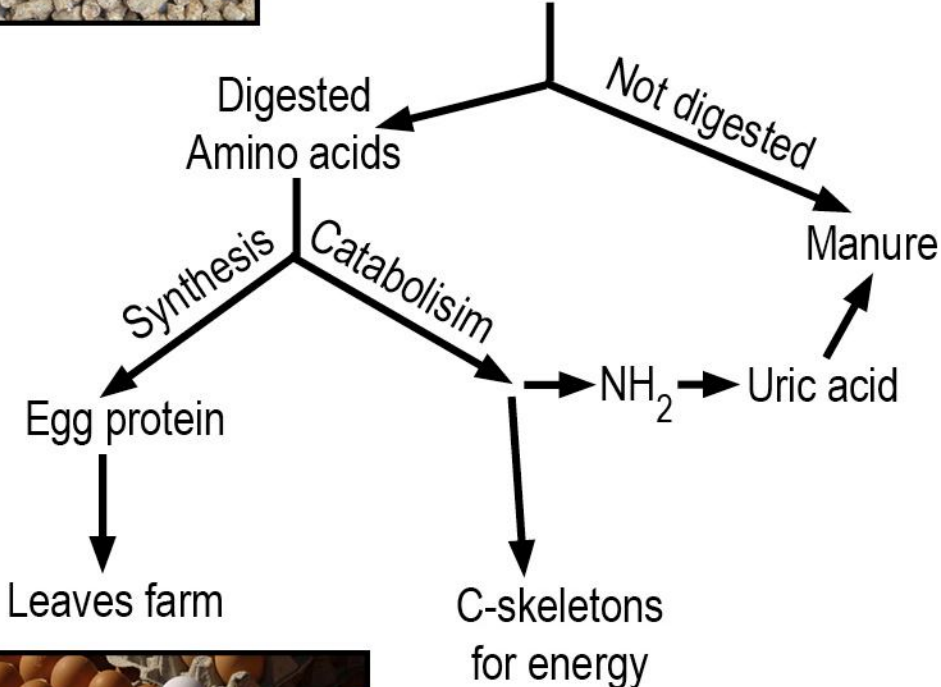
Department of Animal Sciences

The Ohio State University

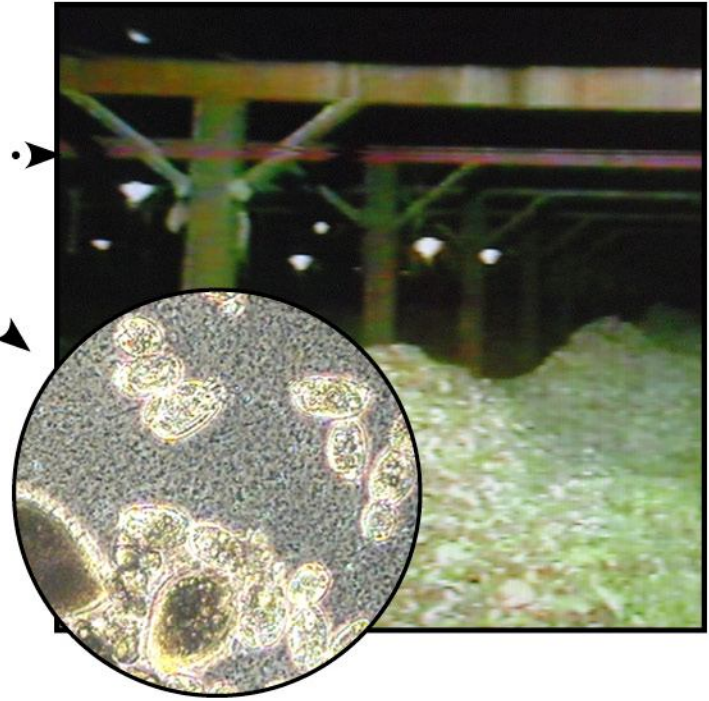
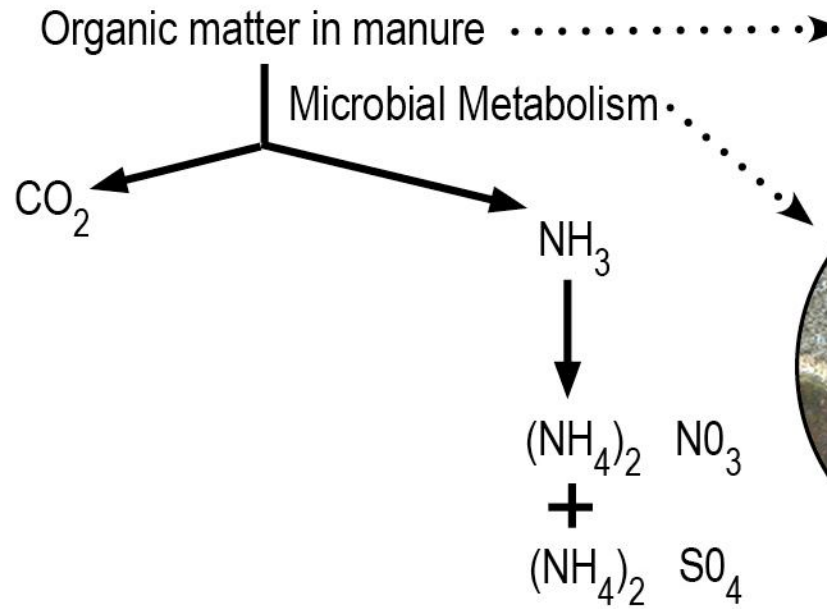
# Nitrogen Partitioning



Feed protein eaten by chickens



# Ammonia Production



Particulate matter in acid rain



## Feeding Hens to Meet Daily Nutrient Needs

### Lysine

$$\frac{0.71g \text{ lysine}}{75g \text{ feed}} \times 100\% = 1.00\% \quad \text{lysine}$$

$$\frac{0.71g \text{ lysine}}{100g \text{ feed}} \times 100\% = 0.71\% \quad \text{lysine}$$

### Calcium

$$\frac{3.75g \text{ calcium}}{75g \text{ feed}} \times 100\% = 5.00\% \quad \text{calcium}$$

$$\frac{3.75g \text{ calcium}}{100g \text{ feed}} \times 100\% = 3.75\% \quad \text{calcium}$$

## Amino Acid content of whole edible egg, amino acid:lysine ratio in the egg, and amino acid:lysine ratio in the feed

Amino Acid	Egg amino acids <sup>1</sup> g/100 g egg	Ratio of egg a.a. to lys <sup>2</sup>	Ratio of feed a.a. to lys <sup>3</sup>	Dig a.a. in feed (g/hen per d) <sup>4</sup>
Lys	0.820	1.00	1.00	0.71
Met	0.392			
Cys	0.289			
M + C	0.681	0.83	0.83	0.59
Thr	0.596	0.73	0.68	0.52
Ile	0.759	0.93	0.94	0.66
Val	0.874	1.07	1.07	0.76
Trp	0.194	0.24	0.24	0.17
Phe	0.686	0.84	0.84	0.60
Tyr	0.505	0.62		
Arg	0.777	0.95	0.95	0.67
Leu	1.066	1.30		
His	0.293	0.36		

## Composition (%) of the diets to provide 13 g and 17 g of protein at 90 and 110 g of daily feed intake

Ingredient	13 g CP/d		17 g CP/d	
	90 g feed	110 g feed	90 g feed	110 g feed
Corn	66.39	76.69	56.18	68.47
Soybean meal (48% CP)	18.29	10.42	21.75	13.57
Corn gluten meal	–	–	7.33	6.00
Soybean oil	2.00	2.00	2.00	2.00
Limestone	8.00	8.00	8.00	8.00
Oyster shell	2.31	0.43	2.97	0.40
Dicalcium phosphate	1.00	0.78	0.97	0.76
Salt	0.45	0.40	0.45	0.40
Vitamins and TM	0.24 <sup>1</sup>	0.20 <sup>2</sup>	0.24 <sup>1</sup>	0.20 <sup>2</sup>
DL-Methionine	0.25	0.16	0.05	0.01
L-Lysine (50%)	0.36	0.40	0.04	0.16
L-Threonine	0.12	0.12	0.02	–
L-Isoleucine	0.23	0.20	–	0.02
L-Valine	0.27	0.18	–	0.01
L-Tryptophan	0.05	0.02	–	–
L-Phenylalanine	0.07	–	–	–
Calculated nutrient content				
Calcium (%)	4.17	3.41	4.17	3.41
NPP (%)	0.28	0.23	0.28	0.23
Table 2, cont.				
Protein (%)	14.44	11.82	18.89	15.45
Nitrogen (%)	2.31	1.89	3.02	2.47
Dig. Lysine (%)	0.789	0.645	0.789	0.645
Dig. Met + Cys (%)	0.655	0.536	0.655	0.536
Dig. Threonine	0.578	0.473	0.578	–
Dig. Isoleucine	0.733	–	0.733	0.600
Dig. Valine	0.844	–	–	0.718
Tryptophan	0.189	–	–	–
Dig. Phenylalanine	0.667	–	–	–

Planned and actual feed intake/d, ash intake/d, nitrogen intake/d, and ash to nitrogen ratio when hens were fed 13, 15, or 17 g of protein/d.

Period <sup>1</sup>	Protein	Feed intake		Ash <sup>2</sup> g/hen per d	N <sup>3</sup> g/hen per d	Ash/ N
	Intake g/hen per d	Planned g/hen per d	Actual g/hen per d			
1	13	90	94.6	13.6	2.23	6.10
	15	90	86.2	12.4	2.35	5.28
	17	90	88.3	12.8	2.71	4.72
2	13	100	96.8	13.0	2.09	6.22
	15	90	88.0	12.8	2.42	5.29
	17	90	91.5	13.3	2.84	4.68
3	13	90	91.2	13.1	2.18	6.01
	15	90	84.4	12.2	2.32	5.26
	17	90	87.3	12.6	2.71	4.65
4	13	100	94.6	12.5	2.12	5.90
	15	90	95.2	13.5	2.62	5.15
	17	90	95.9	13.6	2.97	4.58
5	13	110	105.3	14.0	2.16	6.48
	15	100	98.4	13.2	2.44	5.41
	17	100	99.6	13.4	2.79	4.80
6	13	110	102.4	12.6	2.02	6.24
	15	110	92.6	12.4	2.30	5.39
	17	110	92.3	12.3	2.58	4.77
7	13	110	105.7	14.2	2.08	6.83
	15	100	100.3	13.5	2.49	5.42
	17	100	100.1	13.4	2.80	4.79

# Daily intake of feed, ash, and nitrogen

Protein intake g/hen per d	Period <sup>1</sup>	Feed <sup>2</sup> g/hen per d	Ash <sup>2</sup> g/hen per d	Nitrogen <sup>2</sup> g/hen per d
13		98.7 <sup>3,4</sup>	13.3	2.11 <sup>3</sup>
15		92.2 <sup>3,4</sup>	12.8	2.42 <sup>3</sup>
17		93.6 <sup>3,4</sup>	13.1	2.77 <sup>3</sup>
SE		1.13	0.15	0.10
P>f		<0.01	0.12	<0.01
	1	89.7	12.9	2.44
	2	92.1	13.0	2.45
	3	87.6	12.6	2.40
	4	95.2	13.2	2.54
	5	101.1	13.5	2.46
	6	95.8	12.4	2.30
	7	102.0	13.7	2.46
SE		0.84	0.11	0.07
P>f		<0.01	<0.01	<0.01



# Egg production and daily retention of ash and nitrogen in eggs

Protein intake g/hen per d	Period <sup>1</sup>	Egg prod %	Egg/d g/hen per d	Ash g/hen per d	Nitrogen g/hen per d	Ash/N
13		88.4	52.1	4.93	1.01	4.88
15		89.6	52.4	4.95	1.02	4.85
17		91.1	52.8	4.99	1.02	4.89
SE		1.02	0.77	0.07	0.01	0.04
P>f		0.19	0.83	0.83	0.84	0.79
	1	95.8	52.8	4.99	1.07	4.66
	2	88.5	50.2	4.75	0.99	4.80
	3	91.5	52.3	4.94	1.04	4.75
	4	91.1	53.8	5.09	1.04	4.89
	5	86.4	50.7	4.79	0.95	5.04
	6	87.5	53.8	5.09	1.01	5.04
	7	87.1	53.2	5.03	1.00	5.03
SE		0.99	0.66	0.061	0.012	0.039
P>f		<0.01	<0.01	<0.01	<0.01	<0.01

# Egg size and composition as affected by daily protein intake and period of the experiment

Protein intake g/hen per d	Period <sup>1</sup>	Egg Wt <sup>2</sup> g	-----Percentage of Egg-----			Haugh Units <sup>2</sup>
			Shell <sup>2</sup>	Yolk <sup>2</sup>	Albumen <sup>2</sup>	
13		59.1	10.3	25.0	64.7	86.1
15		58.5	10.3	24.9	64.8	85.7
17		58.0	10.4	25.1	64.6	84.8
SE		0.71	0.11	0.28	0.30	0.99
P>f		0.54	0.78	0.87	0.91	0.64
	1	55.2	10.0	24.3	65.7	90.6
	2	56.6	10.2	24.6	65.1	88.4
	3	57.2	10.4	24.9	64.7	85.8
	4	59.1	10.4	25.0	64.6	85.5
	5	58.7	10.3	25.4	64.3	83.6
	6	61.7	10.2	25.9	64.2	81.8
	7	61.0	10.3	25.9	63.8	83.0
SE		0.53	0.08	0.25	0.31	0.99
P>f		<0.01	0.01	<0.01	<0.01	<0.01

# Amount and composition of manure

Protein intake	Period	Manure DM/d	Manure ash	Manure N	Ash/N ratio
g/hen/d		g/hen/d	% DM	% DM	
13		26.0 <sup>3</sup>	26.7 <sup>4</sup>	3.98 <sup>5</sup>	6.71 <sup>3,5</sup>
15		25.0 <sup>3</sup>	24.9 <sup>4</sup>	4.85 <sup>5</sup>	5.14 <sup>3,5</sup>
17		26.7 <sup>3</sup>	25.0 <sup>4</sup>	5.68 <sup>5</sup>	4.40 <sup>3,5</sup>
SE		0.40	0.62	0.056	0.15
P>f		0.03	0.04	0.01	<0.01
	1	24.3	28.3	5.27	5.37
	2	26.6	26.4	4.68	5.77
	3	26.2	27.9	4.96	5.62
	4	28.5	25.2	4.82	5.22
	5	27.7	27.1	4.82	5.63
	6	25.1	22.8	4.69	4.86
	7	26.5	25.1	4.63	5.43
SE		0.45	0.31	0.074	0.143
P>f		<0.01	<0.01	<0.01	<0.01

# Application 1

## Composition (% of D.M.)

Fresh Manure		Stored Manure	
Ash	33.33	Ash	49.94
N	4.38	N	2.99
Ash/N	7.61	Ash/N	16.71

$$\frac{33.33 \text{ Fresh}}{49.94 \text{ Stored}} = .667$$

N in stored manure should be

$$\frac{49.94}{7.61} = 6.56\% \text{ N}$$

## Application 2

Assume 30 g manure DM/hen/d

Amount after storage

$$30 \times .667 = 20 \text{ g stored manure}$$

Stored manure/hen/year

$$\frac{20 \times 365}{1000} \times 2.2 = 18.25 \text{ lb.}$$