Ingredient Variation in Pet Food Production

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Overview

- Why is this important?
- Why do we process ingredients?
- How does this introduce variation?
- Examples
- Impact on foods & nutrition
- Solutions
- Conclusions

Why is this important?

Guaranteed Analysis	
Crude Protein(min)	32.00%
Crude Fat (min)	10.00%
Crude Fat (max)	13.00%
Crude Fiber (max)	4.50%
Moisture (max)	10.00%
Ash (max)	7.25%
Linoleic Acid (min)	3.50%
Arachidonic Acid (ARA)(min)	0.05%
Calcium (min)	0.80%
Phosphorus (min)	0.70%
Manganese (min)	35 mg/kg
Manganese (max)	0.085%
Iron (min)	200 mg/kg
Zinc (min)	225 mg/kg
Vitamin D (min)	1,500 IU/kg
Vitamin E (min)	250 IU/kg
Taurine(min)	0.18%
Alpha-Linolenic Acid (min)*	0.60%
Ascorbic Acid (min)*	50 mg/kg
Beta Carotene (min)*	3.8 mg/kg
Docosahexaenoic Acid (DHA) (min)*	0.06%
L-Carnitine (min)*	100 mg/kg
Total Bacillus Species (min)* (Bacillus licheniformis and Bacillus subtilis)	565 Million CFU† /lb

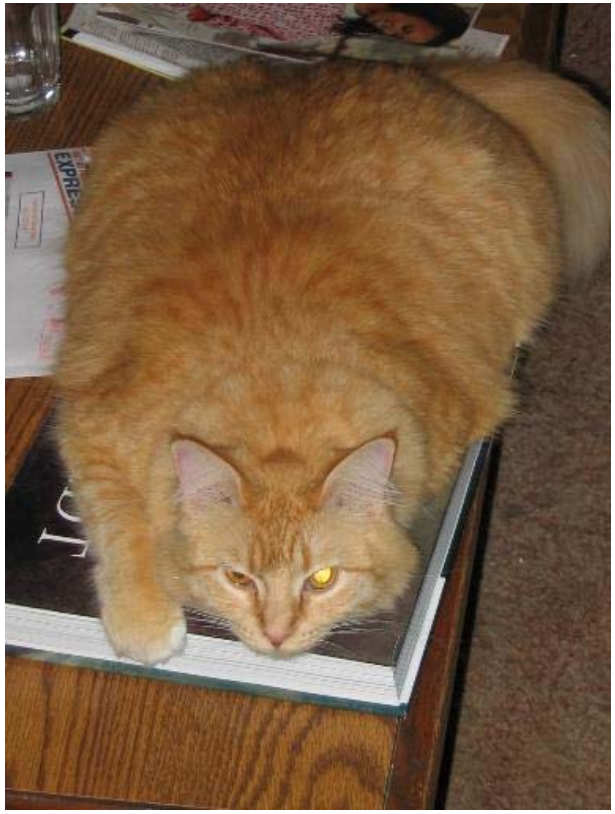
Why do we process ingredients?

- Enhancing Handling
- Improving Consistency
- Providing Safety
- Adding Stability
- Extracting or Adding Value
- Other

How does this influence variation

- Reduces variation?
- Transforms product?
- Adds variation?

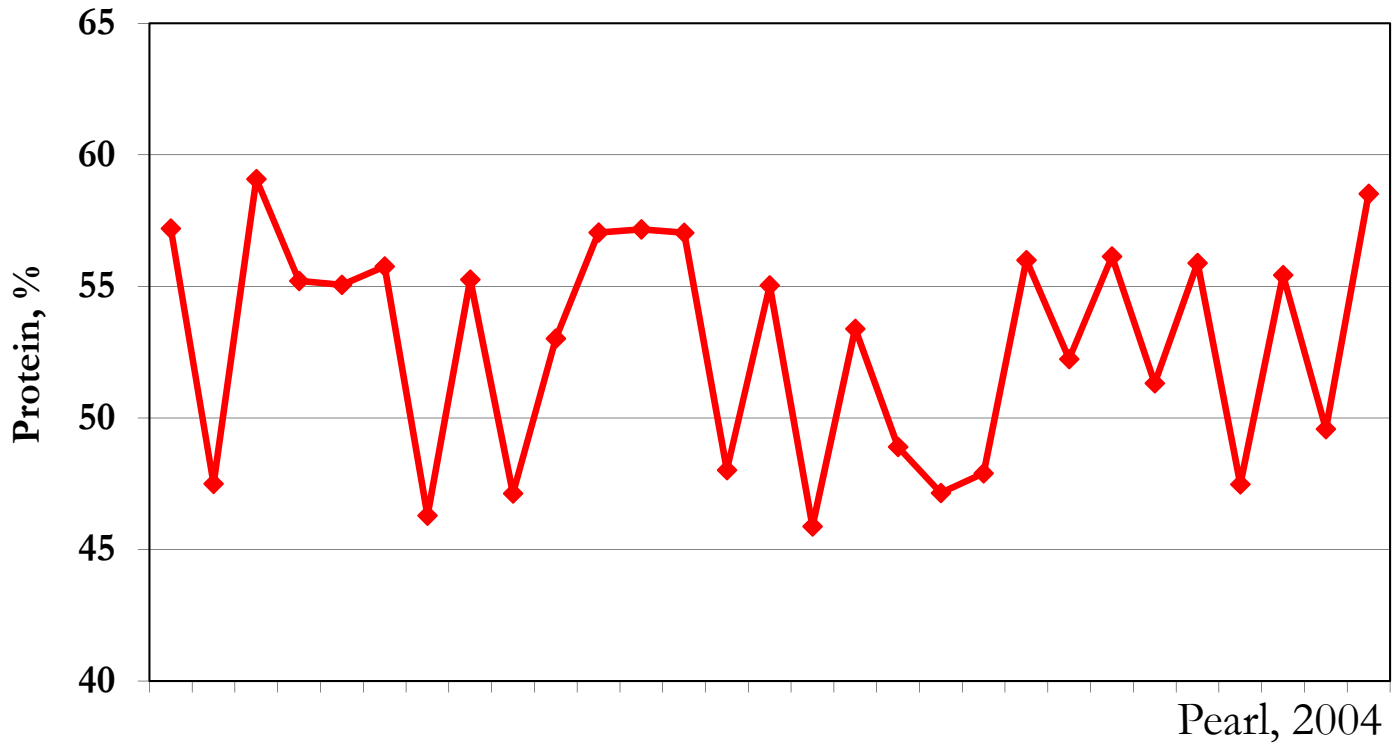
Give me some examples



Rendering

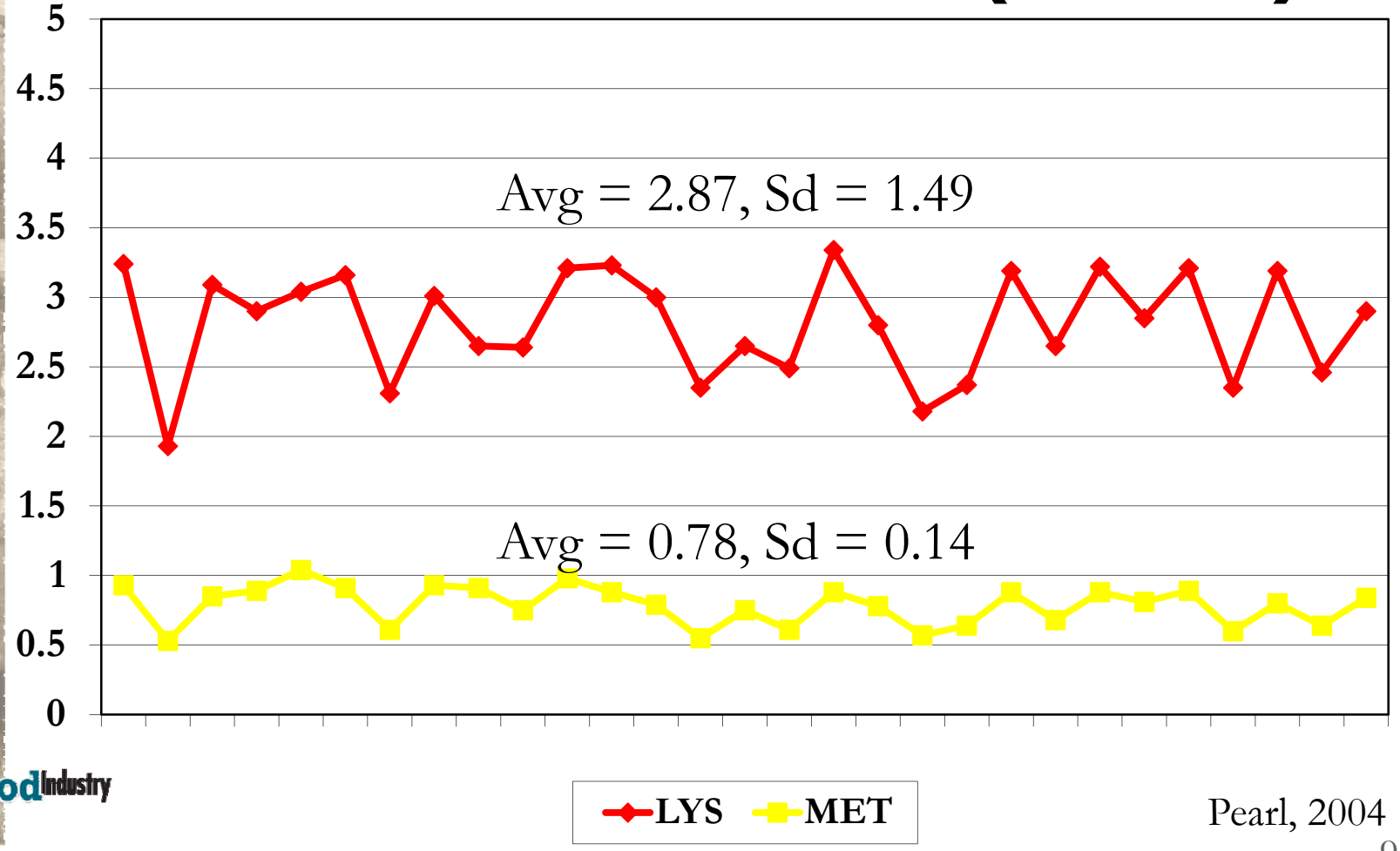
Meat & bone meal: Protein (n = 29)

Avg = 53.60, Sd = 5.99



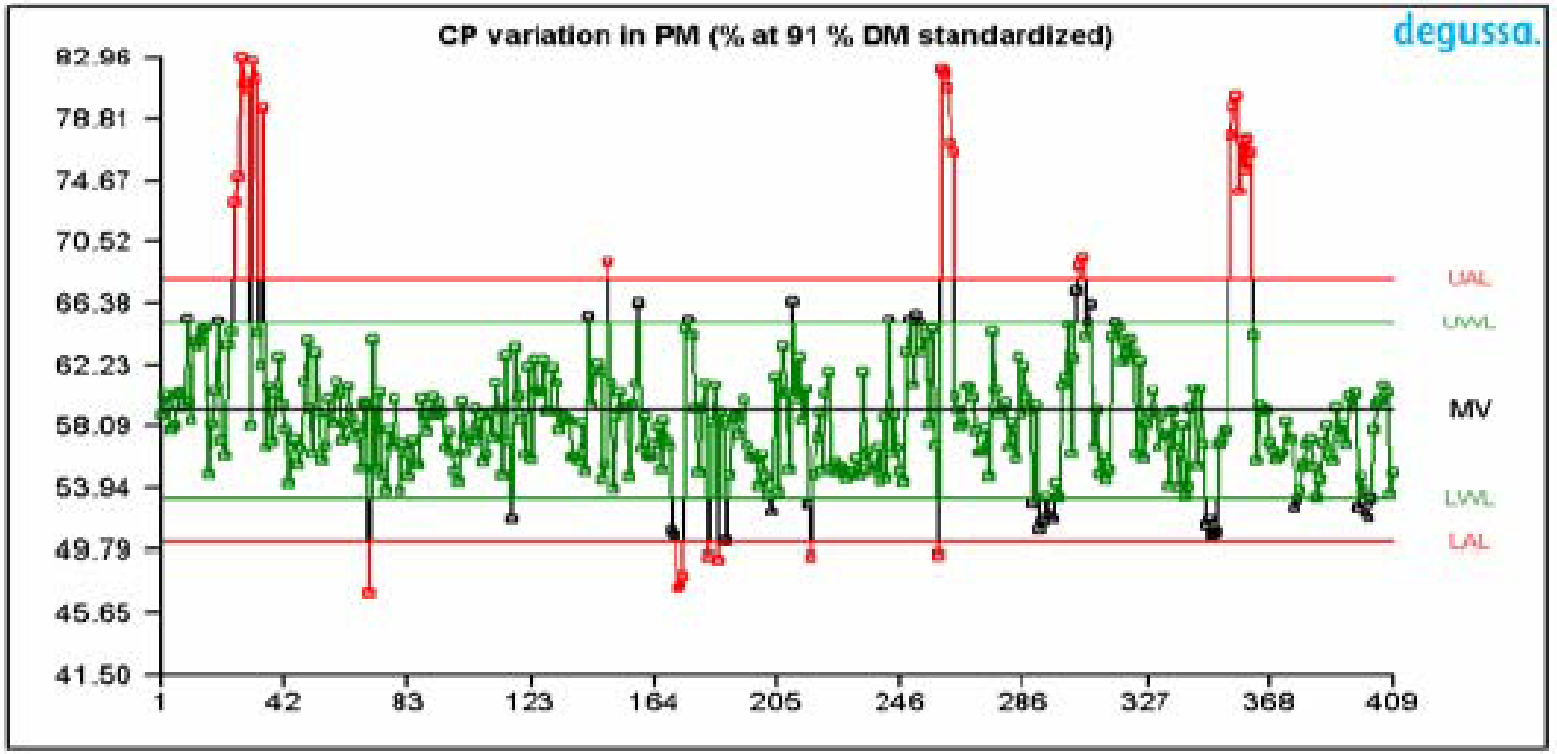
Pearl, 2004

Meat & bone meal: Lysine and Methionine (n = 29)

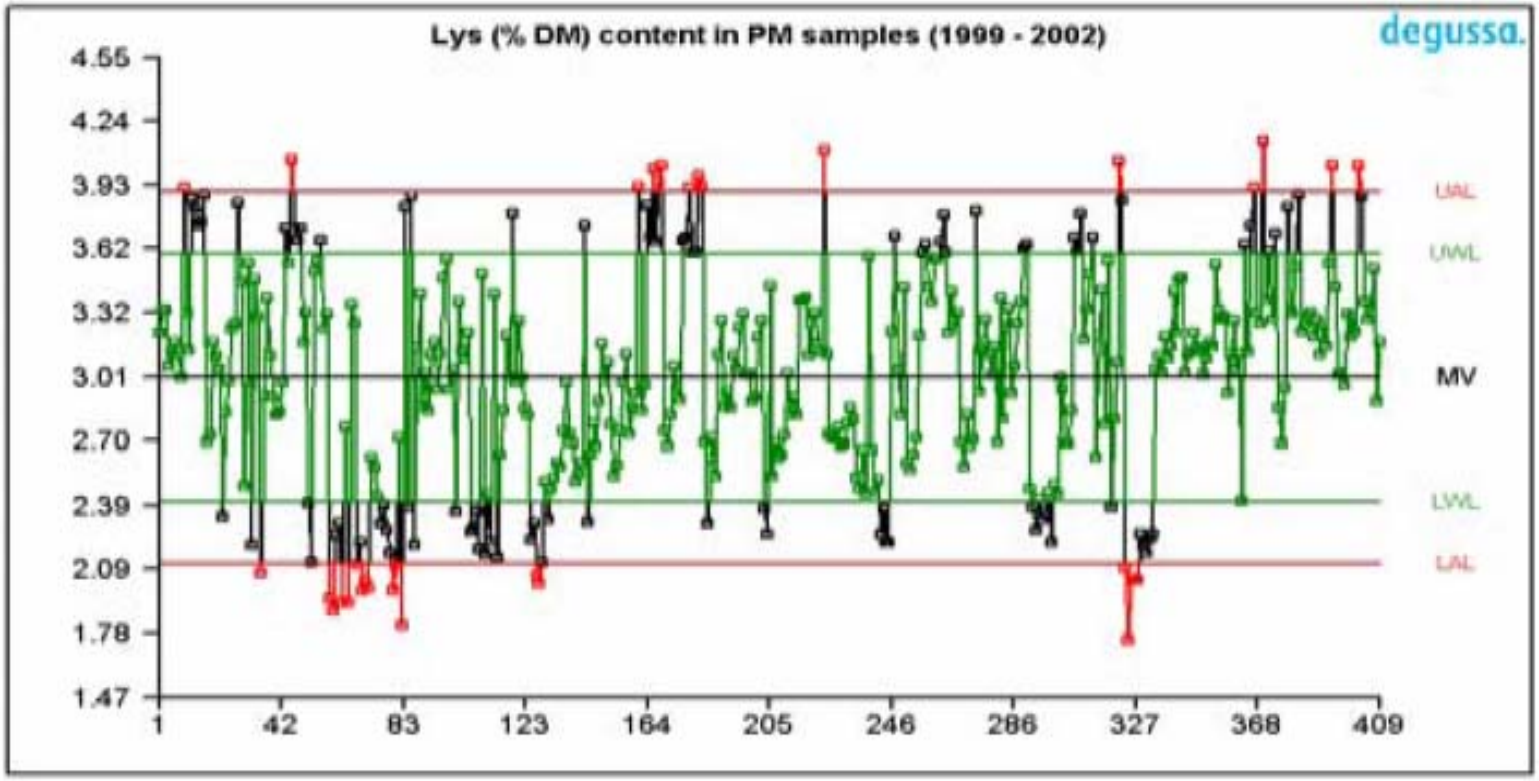


Pearl, 2004

Variation in crude protein concentration in 409 samples of poultry by-product meal (1999-2002)



Variation in lysine concentration in 409 samples of poultry by-product meal (1999-2002)



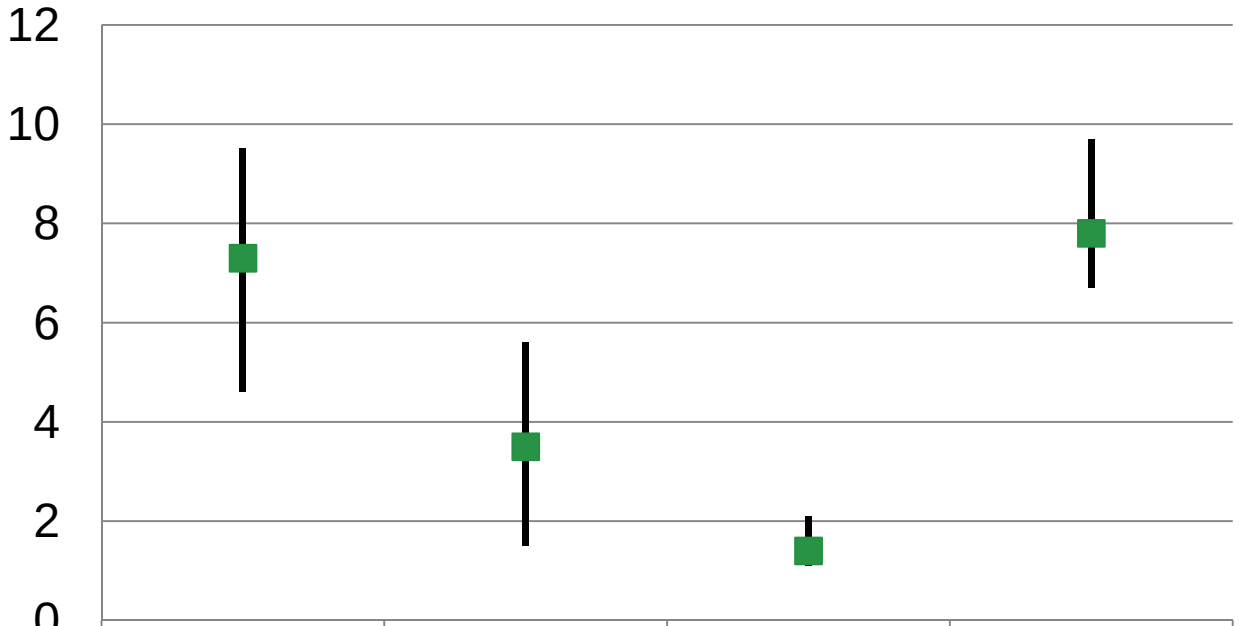
Milling

Wheat Midds

Item	Avg	Sd	N	Low	High
Moisture	10.8	1.5	185	6.0	14.2
Protein	16.7	1.3	254	7.1	20.8
Calcium	0.13	0.06	74	0.05	0.41
NDF	35.6	3.1	22	23.5	38.7

Hill et al., 2012

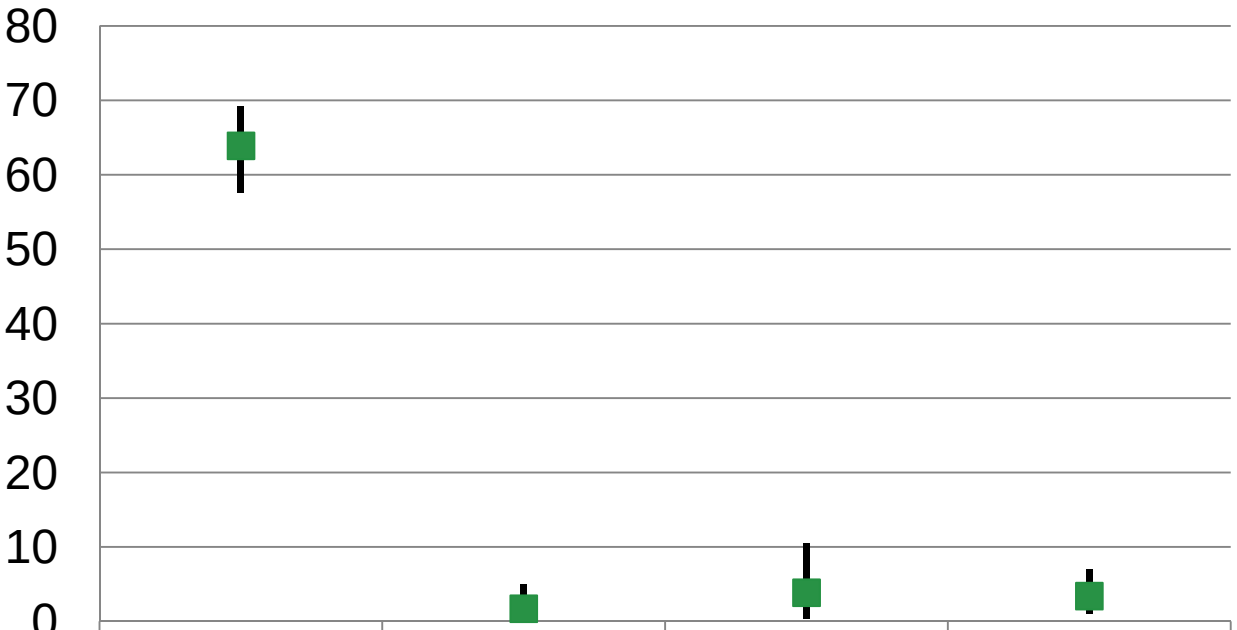
Corn, Grain



	Protein	Fat	Ash	NDF
High	9.5	5.6	2.1	9.7
Low	4.6	1.5	1.1	6.7
Average	7.3	3.5	1.4	7.8

Hill et al., 2012

Corn Gluten Meal



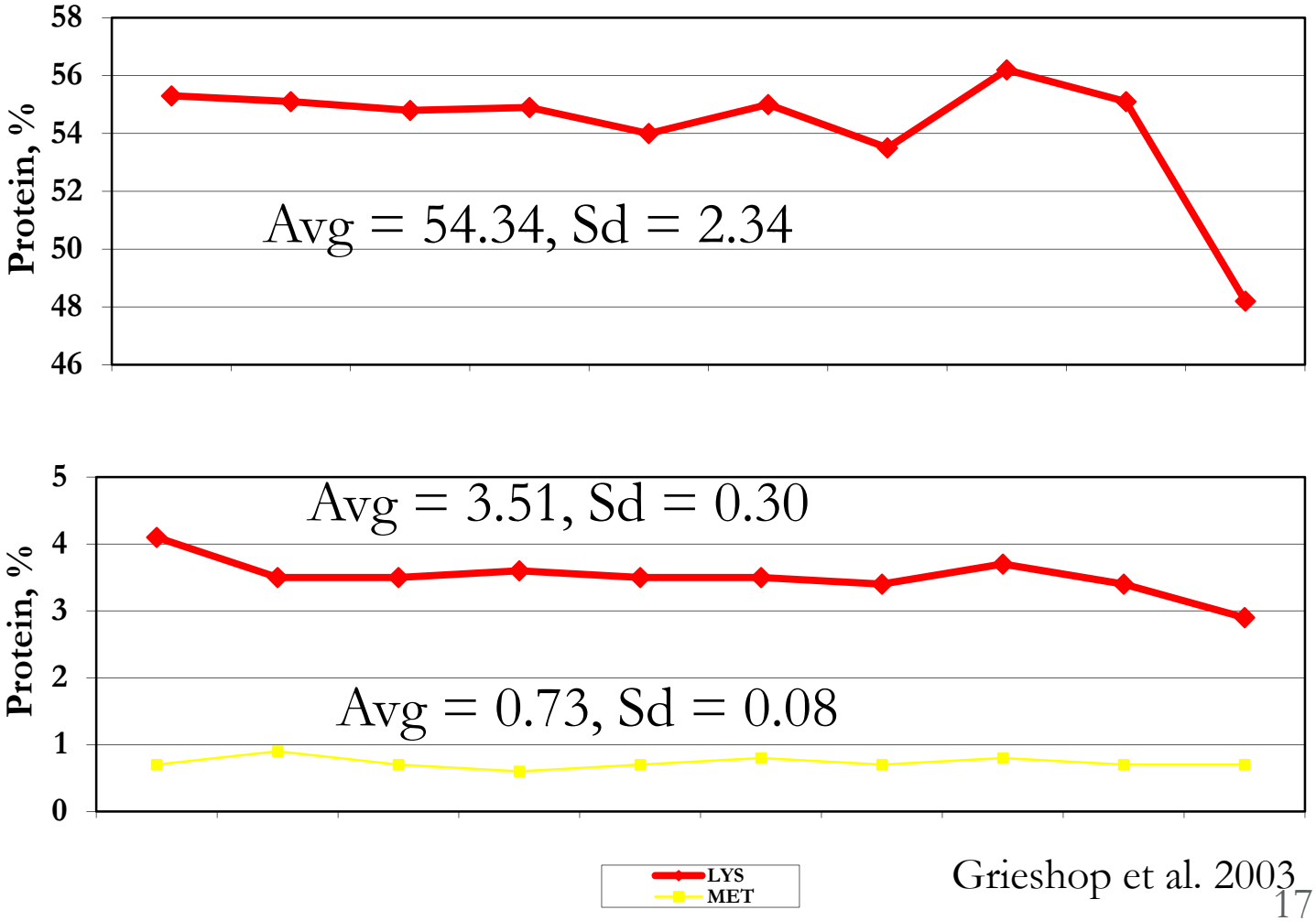
	Protein	Fat	Ash	NDF
High	69.2	5	10.4	7
Low	57.6	0.6	0.3	1
Average	63.9	1.7	3.85	3.4

Hill et al., 2012

Crushing

http://www.sugoodsweets.com/images/blog/imbb/27-soy/soybeans.jpg

Soybean meal: Protein, lysine, and methionine concentration (n = 10)



Grieshop et al. 2003

Meats

Chicken – MSC

	Protein	Fat	Ash	Dry Matter
High	11	14	2	21
Low	6	7	0.5	23
Average	9	11	1	22

Hill et al., 2012

Pulping and Extraction

Beet Pulp

Item	Avg	Sd	N	Low	High
Moisture	9.8	2.2	21	5.0	14.7
Protein	9.9	1.0	64	7.6	12.6
Calcium	0.91	0.34	55	0.32	2.42
NDF	43.9	6.2	8	32.9	51.1

Hill et al., 2012

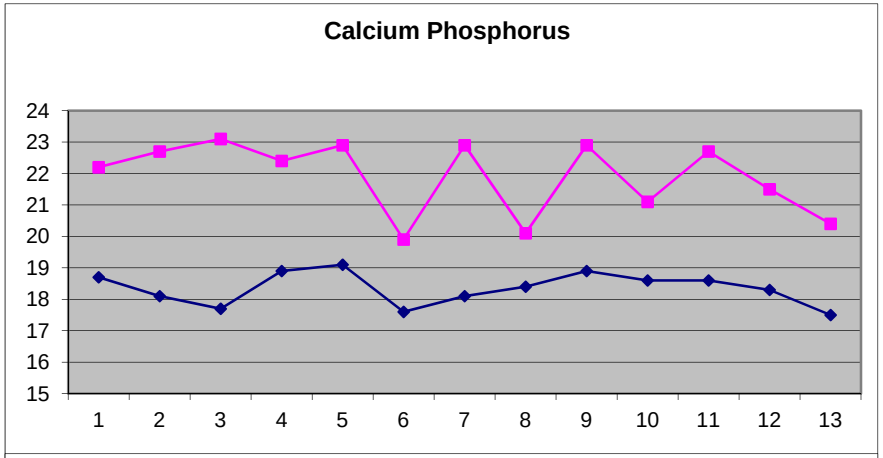
Rice Bran

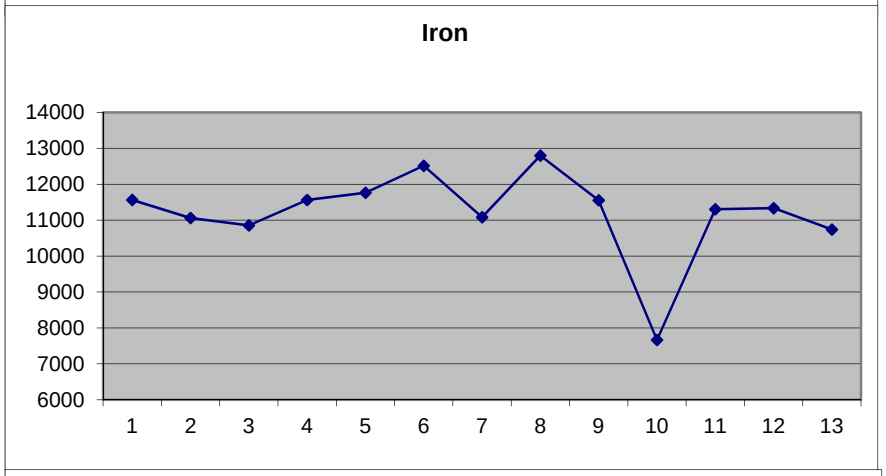
Item	Avg	Sd	N	Low	High
Moisture	7.2	2.5	33	3.5	11.6
Protein	13.5	1.3	43	7.1	15.6
Calcium	1.07	0.93	25	0.05	2.2
NDF	31	14.2	3	16.9	50.4

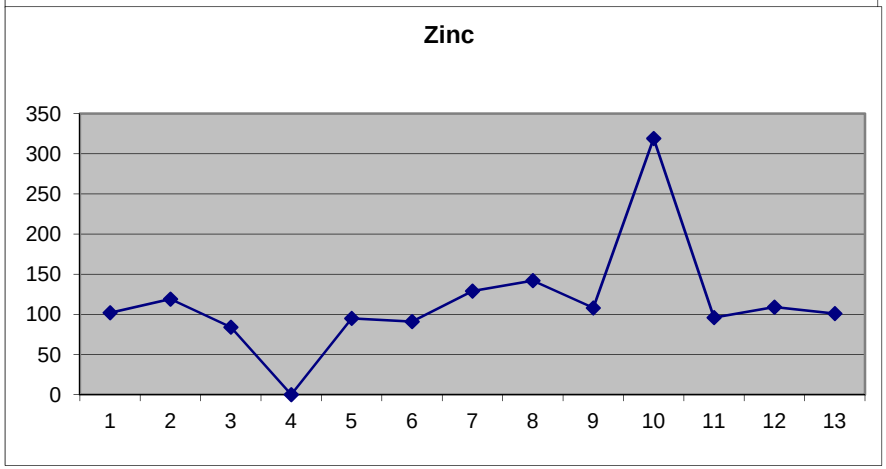
Hill et al., 2012

Additives

Dicalcium Phosphate







How does this influence the food and animal nutrition?

Variation in protein digestibility

Digestibility	Ileal		Total Tract
	CP	AA	CP
n	10	9	10
Average	72.7	73.26	80.94
Std. Dev.	7.97	6.66	8.24
Range	65.1 – 94.5	63.6 – 81.0	68.4 – 89.5

Zou et al., 1996; Murray et al., 1997; Johnson et al., 1998; Cole et al., 1999; Bednar et al., 2000; Burkhalter et al., 2001; Clapper et al., 2001; Yamka et al., 2003

Soybean meal ileal digestibility in the dog

	Yamka '03	Clapper '01	Zou '96
Soy in diet, %	46.1	44.0	37.1
Ileal CP	51.1	85.3	77.4
TT CP	65.5	83.9	84.6
Ileal Lys	71.4	89.3	85.6
Ileal Met	63.5	85.7	72.6
Ileal TAA		85.5	80.3

What can be done about it?

- Manage raw materials upstream
  - Contract, Pre-blending, other
- Formulate to the middle with some added cushion
- Assume all specifications worst case and formulate to target
- Blend variation with multiple ingredient streams

Conclusions

- Variation is inherent with ingredients
  - It impacts profitability and product performance
- Work in partnership along supply chain
- Identify a system that works and make steady continuous improvements
  - Re-evaluate on a routine basis

Formula		Cost	Computat:	Nutrient Composition; NRC 2006				
Amount, lbs	Ingredient	Cost, $/lb	Ext cost, $	Dry Matter, %	Crude Protein, %	Crude Fat, %	Crude Fiber, %	Ash, %
20	Chicken, meat & skin	$0.45	$9.00	38.2	17.6	20.3	1	2.53
17	Corn, Grain	$0.15	$2.55	89.3	9.1	4.4	2.1	1.2
17	Rice, brewers	$0.22	$3.74	89	8.7	0.7	9.8	0.6
12.5	Poultry By-Product Meal	$0.65	$8.13	93.5	59	13.5	2	16
7.5	Corn Gluten Meal	$0.40	$3.00	86.5	56.3	2.2	1.3	2.9
5	Beet Pulp	$0.21	$1.05	88.3	8.8	1	21	6.4
4	Chicken fat	$0.37	$1.48	99.9	0	99.9	0	0
3	Carrots, whole raw	$0.55	$1.65	12.2	1	0.2	1.1	0.9
3	Peas, green raw	$0.40	$1.20	21.1	5.4	0.4	2.25	0.9
3	Potatoes, flesh & skin, raw	$0.47	$1.41	8	2	0	1.25	0.8
2	Dried Egg Product	$0.97	$1.94	96.6	47.2	41.1	0	3.6
2	Brewers Dried Yeast	$0.51	$1.02	96	47.9	2.3	2.6	8
1	Ground Limestone	$0.15	$0.15	95	0	0	0	95
1	Dicalcium Phosphate	$0.35	$0.35	95	0	0	0	95
1	Dry Digest - Dog	$1.25	$1.25	95	25	10	1	10
0.5	Potassium Chloride	$0.15	$0.08	95	0	0	0	95
0.3	Salt	$0.09	$0.03	95	0	0	0	95
0.1	Vitamin Premix	$1.25	$0.13	95	10	1	15	15
0.1	Trace Mineral Premix	$1.00	$0.10	95	2	0.25	2	75
100	Total, as is		$38.24	73.43	21.00	11.81	3.84	6.51
73.43	Total, 100% DM		$52.08	100	28.60	16.09	5.23	8.87
81.59	**Air dry**		**$46.87**	**90**	**25.74**	**14.48**	**4.70**	**7.98**
		Mois %	NFE, %	kcal/kg			% of	cal
	As is	26.572	30.27	2798			Carb	37.86
	100% DM	0	41.22	3811			Fat	35.88
	Air Dry	10	37.10	4235			Prot	26.26
								100.0