

## INGREDIENT VARIABILITY

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Recent advances in poultry nutrition and feed formulation have resulted in considerable savings for the poultry industry, and have contributed substantially to the competitive position of poultry products in the market. At the same time, in order to take full advantage of nutritional and formulating advances, feed manufacturers need precise estimates of the quality of their feed ingredients. Incorrect or imprecise estimates of nutritional quality may result in costly overformulation (resulting from underestimates of ingredient quality), or in performance-reducing underformulation (resulting from overestimates of ingredient quality).

The presentation today will briefly discuss statistical measures of ingredient quality, the economic importance of correct estimates of quality, sources of variation and methods feed manufacturers may employ to detect and minimize the effects of ingredient variation.

### Measures of Quality Defined

Average values are the most commonly used measures applied to ingredient quality. However, the spread of values around the average must also be considered when evaluating quality factors, and formulating for them. Spread, or the normal range of values for an ingredient, is normally represented as the standard deviation (S.D.). Two ingredients may have the same average value, but differ considerably in their lot-to-lot variability. For formulation purposes, the effects of variation may be nullified by subtracting one-half of the standard deviation from the average value for an ingredient, and by then employing an adjusted value for formulating purposes. This procedure insures that an expected value will be met or exceeded most (about 85%) of the time. High quality ingredients meet two standards. Their average values meet or exceed expected (or guaranteed) levels, and they do not vary excessively from lot-to-lot. Their general quality is high, and only very small adjustments in their average values are required to achieve consistent nutrient levels in finished feeds.

### The Economic Importance of Accurate Ingredient Estimates

The values a nutritionist assigns to a particular mix of ingredients can influence the cost per ton of feeds produced. Table 1 illustrates the effect various estimates of quality can have on feed price.

Table 1. Influence of Ingredient Quality Estimates on Feed Cost<sup>1</sup>

<u>Ingredient</u>	<u>High (Over) Estimate</u>	<u>Low (Under) Estimate</u>	<u>Correct Estimate</u>
Alfalfa	50	50	50
Corn	1364	1233	1312
Fat	10	30	10
Fish	25	25	25
Meat	160	---	160
Soy	182	460	256
Phosphate	3	36	18
Lime	141	153	158
Methionine	0.5	0.3	0.1
Bentonite	50	---	---
Cost/Ton	\$ 145.80	\$ 150.94	\$ 148.94
Result	Poor Performance	Increased Feed Cost	Optimum Cost/ Performance Balance

<sup>1</sup> Adapted from Ward, J. B., 1974. Feed Quality and Feeding Practices. Proceedings, North Carolina Egg Industry Conference.

Obviously undetected variation in ingredient quality, or an incorrect estimate of quality is expensive, either in terms of feed cost, or in poorer-than-expected performance in the field.

Estimating Ingredient Quality

There are several sources of information available to the nutritionist to estimate the probable quality of feed ingredients. Table II illustrates some important differences in these estimates, as reported in 1974 and 1975 feed ingredient tables, and from actual assays conducted in North Carolina in the same period.

Table II. Estimates of Ingredient Quality

	<u>Soybean Meal</u>		
	<u>Moisture</u>	<u>Protein</u>	<u>Fiber</u>
Source I	10.0	49.0	3.2
Source II	---	49.3	3.2
Source III	10.7	48.5	3.0
Source IV	---	49.0	---
North Carolina Assays	11.8	48.7	3.6
Ranges	10.0 - 11.8	48.5 - 49.3	3.0 - 3.6
	<u>Fish Meal</u>		
	<u>Moisture</u>	<u>Protein</u>	<u>Fat</u>
Source I	8.0	62.0	10.0
Source II	---	61.8	10.8
Source III	8.0	60.0	7.5
Source IV	11.6	64.1	15.3
North Carolina Assays	8.2	62.0	8.9
Ranges	8.0 - 11.6	60.0 - 64.1	7.5 - 15.3

Bakery Byproduct Meal

	<u>Moisture</u>	<u>Protein</u>	<u>Fat</u>
Source I	7.5	9.8	10.8
Source II	---	9.8	10.8
Source III	9.0	10.0	13.0
Source IV	6.8	10.7	11.2
North Carolina Assays	7.0	8.9	10.7
Ranges	6.8 - 9.0	8.9 - 10.7	10.7 - 13.0

No single reference table is sufficient to obtain precise estimates of ingredient quality. The important point is that standard table values are general guides to probable ingredient values. Each manufacturer has the responsibility to determine how closely the table values correspond to his particular set of ingredients.

Obtaining a Good Estimate of Ingredient Quality

The only reliable method of estimating true quality of ingredients is by sampling them, in the condition they are received in. Sampling procedures need to take two major sources of variation into account. First, ingredients may be similarly described, and carry the same guarantees, yet differ considerably between individual suppliers. Table III illustrates supplier differences in ingredient quality.

Table III. Supplier Contribution to Variation

<u>Soybean Meal</u>	<u>Moisture</u>	<u>Protein</u>	<u>Fiber</u>
Supplier I	11.73	48.62	3.29
Supplier II	11.10	49.12	2.81
Supplier III	11.03	48.73	3.47

  

<u>Meat Meal (50%)</u>	<u>Protein</u>	<u>Fat</u>	<u>Calcium</u>	<u>Total Phosphorus</u>
Supplier I	52.54	15.35	7.88	3.96
Supplier II	51.65	12.69	8.10	3.54

<u>Meat Meal (55%)</u>	<u>Protein</u>	<u>Fat</u>	<u>Calcium</u>	<u>Total Phosphorus</u>
Supplier I	57.69	13.45	5.55	3.00
Supplier II	55.24	10.27	8.60	3.30

<u>Fish Meal (60%)</u>	<u>Protein</u>	<u>Fat</u>	<u>Calcium</u>	<u>Total Phosphorus</u>
Supplier I	62.11	9.29	5.55	3.26
Supplier II	63.46	9.70	6.57	3.44

<u>Corn Gluten Meal (60%)</u>	<u>Moisture</u>	<u>Protein</u>	<u>Fiber</u>
Supplier I	11.93	62.62	3.28
Supplier II	9.12	61.71	2.97

<u>Fat</u>	<u>Moisture</u>	<u>Insolubles</u>	<u>Unsaponifiables</u>
Supplier I	2.61	1.47	.98
Supplier II	.60	.74	.54

These differences are economically important, and need to be recognized by feed manufacturers. Each ingredient and each source needs to be sampled, assayed and analyzed separately in order to define nutritional quality well enough to minimize feed costs, or to elect alternate ingredient sources.

Ingredient quality changes with time, irrespective of supplier, and depends to a large degree on the quality of basic commodities, or sub-ingredients. Table IV illustrates some important trends in quality of ingredients from 1974 to the third quarter of 1975.

Table IV. Quality Changes in North Carolina Feed Ingredients

<u>Fat</u>	<u>1973-1974</u>	<u>Jan.-July 1975</u>	<u>July-Sept. 1975</u>
Moisture & Volatiles	3.02	1.33	0.71
Insolubles	1.49	1.16	0.52
Unsaponifiabiles	1.09	0.72	0.98
Total Fatty Acids	87.85	91.19	91.78
<u>Fish Meal</u>			
Molsture	8.49	7.59	7.49
Standard Deviation	2.01	2.09	1.59
Protein	62.30	61.58	61.24
Standard Deviation	2.45	2.26	1.80
Calcium	5.90	5.87	5.65
Standard Deviation	0.68	0.94	0.45
Phosphorus	3.39	3.30	3.24
Standard Deviation	0.32	0.46	0.24
Pepsin Digestibility	93.24	88.75	94.87
Standard Deviation	2.64	0.92	1.51
Fat	8.74	9.20	9.30
Standard Deviation	2.27	2.45	1.14
<u>Soybean Meal</u>			
Molsture	12.12	11.51	12.00
Standard Deviation	1.37	1.28	0.81
Protein	48.73	48.75	48.50
Standard Deviation	1.11	1.16	0.83
Fiber	4.17	3.21	3.09
Standard Deviation	5.06	0.74	0.43

	<u>1973-1974</u>	<u>Jan. - July 1975</u>	<u>July-Sept. 1975</u>
<u>Meat Meal (55%)</u>			
Protein	57.13	57.19	55.56
Standard Deviation	2.72	3.01	3.00
Fat	13.90	12.48	12.61
Standard Deviation	2.07	2.62	1.67
Calcium	5.59	6.14	5.93
Standard Deviation	1.38	1.80	1.45
Phosphorus	2.89	3.03	3.00
Standard Deviation	0.51	0.71	0.55

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In summary, ingredients do differ both with respect to average quality, and in lot-to-lot variability. The differences need to be recognized by feed manufacturers and nutritionists in order to take full advantage of advances in poultry nutrition and feed formulation. Two major sources of variation in ingredient quality are individual suppliers, and changes in quality over time. Both sources of variation need to be accounted for in sampling and analysis programs.

In general, the quality of feed ingredients has improved in North Carolina in the past year. Nutrient values have moved closer to expected (guaranteed) levels, and variation has been substantially reduced. Both these improvements should allow more precise characterization of ingredients, and cost-saving adjustments in feed formulations.

Ingredient quality control is a continuous process, and should be built into routine programs by feed manufacturers. As more information about feed ingredient quality becomes available, and as more sophisticated measures of quality are adopted, the potential of advances in nutrition and least-cost formulation can be more fully realized, and substantial feed cost savings can be achieved by the industry.