

# The Use of Multi-Blending As a Technique for Managing Ingredient Purchasing for Feed Manufacturers

R. BUSSMAN, Computone Systems, Inc., Atlanta, GA 30338

## ABSTRACT

The Multi-Blend program uses multiple-product linear programming procedures to solve up to twenty individual formulas in one matrix, simultaneously. This technique utilizes the total production tonnage requirements of each feed formula. It optimizes the use of ingredient inventory within the plant's complete product line for a production period. The Multi-Blend program is especially valuable for making decisions concerning the purchase of ingredients. The program produces reports that generate ingredient usage on previous production formulas compared with current ingredient usage for the production period being analyzed. Restrictions based upon total ingredient supply may be imposed to optimize the use of a limited resource, thus maximizing profits. Conversely, the program will force bad-buy ingredients in oversupply into the group of formulas, thus minimizing losses. Both cases optimize the use of an ingredient to be purchased, in the quantities available, for purchasing and production formulation.

## INTRODUCTION

Computers, which utilize linear programming procedures, have been used widely by feed manufacturers and nutritionists to calculate single-product, least-cost feed formulations for all species of poultry and livestock for more than 20 years (1,2). In addition, multiple-product formulation programs (known as Multi-Blending) have been designed, developed and tested in the past 7 years (2,3,4,5,6). Multi-Blending is becoming popular among nutritionists throughout the world for use in allocating available ingredient supplies into a specific group of production formulas.

The use of multiple-product formulation in the purchase of ingredients warrants careful review. Purchasing guidelines enable management to project accurate rates of ingredient usage and to evaluate opportunity prices of rejected ingredients for any specific purchasing period.

## PROCEDURES

A hypothetical feed mill was envisioned to produce 2,500 tons of feed in a given purchasing period. Formulas included eight poultry rations for layers, pullets and broilers. Tonnages for each of the formulas were established, as shown in Table I.

TABLE I

### Formula Tonnage

Number	Name	Amount
1	Complete layer 18%	100
2	Complete layer 17%	150
3	Complete layer 16%	200
4	Pullet developer 18%	100
5	Complete pullet	150
6	Broiler starter	400
7	Broiler grower	600
8	Broiler finisher	800

The allocation of various high-protein ingredients, which had been previously purchased, was set as a requirement. Maximum tonnage availability for the purchasing period was projected for each of the ingredients. Total ingredient usage limits are summarized in Table II.

Single-product linear programming procedures were initially used to calculate least-cost formulas. Product specifications contained ingredient restrictions required for nutritional purposes. Restrictions on ingredient availability were not built into the formula restrictions for the single-product optimization procedures. However, ingredient usage was calculated on the formulas (Table III).

Multiple-product linear programming techniques, called "Multi-Blend," were used to incorporate formula tonnage and ingredient inventory restrictions into the optimization procedures. A Multi-Blend group specification contained the tonnages for each of the eight products (Table IV). The group specification also contained the total tonnage of previously purchased ingredients and the maximum tonnages of the high-protein ingredients available for usage during the purchasing period.

Multi-Blend summary reports were generated (Table V) to analyze ingredient usage and to compare single-product formulation procedures against Multi-Blend for use in purchasing ingredients.

## RESULTS AND DISCUSSION

Ingredient usage on the high-protein ingredients calculated from the least-cost formulas generated from single-product formulation procedures were not within the minimum/maximum tonnage ranges, which were set as restrictions in Multi-Blending. Multi-Blend adhered to the total ingredient restrictions required. A summary of the usage of the restricted ingredients is listed in Table VI.

Single-product formulation generated overusage of Meat and Bone Meal, Poultry-By-Product Meal and Fish Meal A. Ingredients that were used in insufficient quantities included Soybean Meal-44, Feather Meal and Fish Meal B. Usage of Soybean Meal-48.5 fell within the required inventory limits.

Many factors can create problems when using standard

TABLE II

### Ingredient Usage Requirements (in tons)

Number	Name	Minimum	Maximum
156	Meat & Bone Ml-50	0	50.
280	Soybean Meal-44	30.	Unlimited
282	Soybean Meal 48.5	300	400
231	Poultry-By-Prod Meal	0	50
98	Feather Meal	20	Unlimited
114	Fish Meal-A	0	40.
113	Fish Meal-B	25.	Unlimited

TABLE III

Ingredient Usage—Single-Product Solutions

Plant . . . . . Computone Systems, Inc.				
Date and Time. . . . . 11/10/80 13.19.37				
Ingredient Usage.				
Options in use . . . . . Summary				
Ingredient Usage				
Num Name	Bin	Pounds	Tons	% of Total
<b>Bulk Ingredients</b>				
060 Corn	1	3,431,724.35	1,715.862	68.63
282 Soy ml S-48.5	3	676,250.00	338.125	13.53
156 Mt&Bone scrp-50	5	128,000.00	64.000	2.56
072 Corn glut ml cp	8	75,250.00	37.625	1.51
002 Alfa, dhy 17-516	9	9,000.00	4.500	.18
231 Poul by-prod ml	9	234,000.00	117.000	4.68
113 Fish meal B	10	40,000.00	20.000	.80
114 Fish meal A	10	110,500.00	55.250	2.21
098 Feather ml hyd	16	575.70	.288	.01
278 Soya mill feed	17	25,000.00	12.500	.50
244 Rice mill feed	18	34,000.00	17.000	.68
720 IMC 18.5 dynafo	19	11,102.01	5.551	.22
734 Dicalcium phosp	19	15,100.00	7.550	.30
217 Phos defluor	20	14,600.00	7.300	.29
146 Limestone	21	73,500.00	36.750	1.47
251 Salt	22	8,350.00	4.175	.17
<b>Liquid Ingredients</b>				
092 Fat an&veg hydr	1	90,000.00	45.000	1.80
044 Chol chlorid-70	5	1,787.07	.894	.04
<b>Hand Weighed Ingredients</b>				
148 Lysine-L 78.4	20	2,679.77	1.340	.05
317 Vit. premix - N	23	12,499.99	6.250	.25
266 Selenium	24	250.00	.125	.01
162 Meth-MHA-90	25	5,681.11	2.841	.11
587 SQM non-ruminan	26	150.00	.075	.003
Totals		5,000,000.00	2,500.000	100.0
<b>Products</b>				
Num Name		Pounds	Tons	% of Total
1 Complete layer (g prod)		200,000.00	100.000	4.00
2 Complete layer (g prod)		300,000.00	150.000	6.00
3 Complete layer (g prod)		400,000.00	200.000	8.00
4 Pullet develope (g prod)		200,000.00	100.000	4.00
5 Complete pullet (g prod)		300,000.00	150.000	6.00
6 Broiler starter (g prod)		800,000.00	400.000	16.00
7 Broiler grower (g prod)		1,200,000.00	600.000	24.00
8 Broiler finisher (g prod)		1,600,000.00	800.000	32.00
Totals		5,000,000.00	2,500.000	100.0

single-product formulation procedures in purchasing. Ingredient price fluctuations may cause a different set of formulations to be created between the time of ingredient purchase and the time of usage in the feed mill. If the price of an ingredient is significantly reduced in relation to other ingredients of similar nature, usage may increase drastically. Conversely, with an increase in price, usage of an ingredient may fall below the levels at which it has been previously purchased.

Variation in production tonnage affects purchasing. A sharp reduction in the volume of products to be produced may create an oversupply of certain ingredients; the oversupply creates a shortage in storage capacity. Therefore, usage of those ingredients must be increased. Increased sales may then cause a short-supply of certain ingredients, which would require allocating the scarce ingredients.

Transportation delays, mill breakdowns and other related problems, which cause temporary formula substitutions, force purchasing to adjust ingredient supply by rescheduling shipments or by spot-purchasing ingredients. Temporary formula substitutions may cause a dramatic increase in

TABLE IV

Multi-Blend Group Specifications

Plant . . . . . Computone Systems, Inc.			
Date and Time. . . . . 11/10/80 13.20.19			
Multi-Blend Group . . . . . 1			
Store Products			
Products to be blended. . . . . Production . . . . . Amt . . . . . Batch Size			
Num Name	Pounds	Tons	Pounds
1 Complete layer 18%	200,000.0	100.00	2,000.000
2 Complete layer 17%	300,000.0	150.00	2,000.000
3 Complete layer 16%	400,000.0	200.00	2,000.000
4 Pullet developer 18%	200,000.0	100.00	2,000.000
5 Complete pullet	300,000.0	150.00	2,000.000
6 Broiler starter	800,000.0	400.00	2,000.000
7 Broiler grower	1,200,000	600.00	2,000.000
8 Broiler finisher	1,600,000	800.00	2,000.000
Ingredients restricted . . . . . Minimum . . . . . Maximum . . . . .			
Num Name	Pounds . . . . .	Tons . . . . .	Pounds . . . . . Tons
156 Mt&Bone scrp-50			100,000.0 50.000
280 Soybean ml S-44	60,000.00	30.000	
231 Poul by-prod ml			100,000.0 50.000
98 Feather ml hyd	40,000.00	20.000	
282 Soy ml S-48.5	600,000.0	300.00	800,000.0 400.00
114 Fish meal A			80,000.00 40.000
113 Fish meal B	50,000.00	25.000	
Temporary ingredient overrides . . . . .			
Prod..Ingr..	Minimum..	Maximum	Prod..Ingr..Minimum..Maximum

formulation cost if they are not monitored and controlled.

Single-product, least-cost formulation does not give a purchasing department concise answers in evaluating what effect a given price change will have on the total usage of a commodity. Analyzing several formulas may produce conflicting results and lead to incorrect purchasing decisions. Since a purchasing department is dealing with total ingredient usage, it may be more concerned with total soybean meal usage than with "How much soybean meal is used in the Broiler Finisher formula?"

The use of Multi-Blend allows the purchasing department to set restrictions for minimum total ingredient usage for ingredients that are in inventory, in transit, or committed for shipment, while applying a maximum tonnage that can be delivered during the purchasing period. Multi-Blend will simultaneously least-cost a group of up to twenty products and provide one set of optimum formulas that accurately reflect requirements for total ingredient usage. A "buying guide summary" shows total ingredient usage, buy-prices for unused ingredients, and the relative value of the last unit of each ingredient used in purchasing formulas.

Coordination of the purchasing, production and nutrition departments in allocating ingredient inventory may be the most important benefit in Multi-Blending. When an oversupply of ingredients occurs, the system is used to minimize the potential reduction in profits and force additional amounts of those ingredients from inventory into a group of production formulas. It will maximize profits in the allocation of scarce ingredients. The use of Multi-Blending as a technique for managing ingredient purchasing should be a valuable tool for feed manufacturers.

REFERENCES

1. Maddy, K.H., "After Linear Programming—What's next," Feed Management, April (1973).
2. Waldroup, P.W., and Z.B. Johnson, "Multiple Blending of Diets as a Means of Allocating Scarce Ingredients on a Least-cost Basis," Feedstuffs, September 3 (1973).

SOYA MEAL—Round table

TABLE V

Multi-Blend Summary Report

Plant . . . . . Computone Systems, Inc.  
 Date and Time. . . . . 11/10/80 13.22.22  
 Multi-Blend . . . . . Group 1 Blended on 11/10/80  
 Options in use. Summary only.

Products Blended	Amount	Date	Production Formula.	Pricing	Blend	
Num Name	Tons	Stored	Original \$/Ton	Current \$/Ton	New \$/Ton	Margin
1 Complete layer 18%	100.00	11/09/80	173.94	173.94	175.15	-1.21
2 Complete layer 17%	150.00	11/09/80	167.71	167.71	168.73	-1.01
3 Complete layer 16%	200.00	11/09/80	162.90	165.91	166.06	-.15
4 Pullet developer 18%	100.00	11/09/80	171.98	174.89	175.30	-.41
5 Complete pullet	150.00	11/09/80	156.21	158.83	159.12	-.30
6 Broiler starter	400.00	11/09/80	214.54	214.54	216.35	-1.80
7 Broiler grower	600.00	11/09/80	201.69	201.69	203.72	-2.02
8 Broiler finisher	800.00	11/09/80	202.77	202.77	205.05	-2.27

Production Totals	Amount	Current Cost	New Cost	Blend Margin
	2,500.00	\$486,099.79	\$490,239.65	-\$4,139.85

Ingredient Usage	Current	Actual	Actual	New Multi-Blended Formula.	Min.	Max.	% of	Ingr
Num Name	Formula Tons	Pounds	Tons	Min. Tons	Tons	Total	Cost	
98 Feather ml hyd	.29	39,999.97	20.00	20.00		.80	6,399.99	
113 Fish meal B	20.00	56,999.40	28.50	25.00		1.14	13,109.86	
114 Fish meal A	55.25	79,999.91	40.00		40.00	1.60	17,199.98	
156 Mt & Bone scrp-50	64.00	99,999.88	50.00		50.00	2.00	14,499.98	
231 Poul by-prod ml	117.00	100,002.6	50.00		50.00	2.00	15,250.39	
280 Soybean ml S-44		71,762.26	35.88	30.00		1.44	9,149.69	
282 Soy ml S-48.5	338.13	799,999.1	400.00	300.00	400.00	16.00	107,999.88	
2 Alfa, dhy 17-516	4.50	9,000.00	4.50			.18	675.00	
16 Bakery pro 1800								
20 Barley, gr. 10%								
44 Chol chlorid-70	.89	2,480.59	1.24			.05	840.92	
58 Cn gr yl 8.5/12								
60 Corn	1,715.9	3,359,164	1,679.6			67.18	201,549.81	
61 Corn, gr. 9/12								
72 Corn glut ml cpc	37.63	47,525.23	23.76			.95	7,841.66	
92 Fat an & veg hydr	45.00	129,540.3	64.77			2.59	22,669.55	
138 Hominy fd yl								
146 Limestone	36.75	77,923.90	38.96			1.56	1,519.52	
148 Lysine-L 78.4	1.34	1,312.84	.66			.03	2,231.83	
162 Merh-mha-90	2.84	6,897.17	3.45			.14	10,345.75	
163 Milo 9.0/78								
185 Oats, pulv.								
217 Phos defluor	7.30	32,739.44	16.37			.65	4,337.98	
244 Rice mill feed	17.00	22,131.29	11.07			.44	497.95	
251 Salt	4.17	8,956.09	4.48			.18	335.85	
266 Selenium	.13	250.00	.13			.01	27.50	
278 Soya mill feed	12.50	13,026.72	6.51			.26	677.39	
283 Soybean ml S-49								
310 Vit A 30								
317 Vit. premix - no anal	6.25	12,499.99	6.25			.25	49,999.94	
340 Wheat midds std								
347 Whey, dr whole								
587 SQM non-ruminant p/m	.07	150.00	.07				75.00	
720 IMC 18.5 dynafos	5.55	12,008.77	6.00			.24	1,212.89	
725 IMC 21.0 biofos		15,630.98	7.82			.31	1,791.31	
734 Dicalcium phosphate	7.55							
Ingredient Usage Totals	2,500.0	5,000,000.0	2,500.0			100.0	490,239.65	

Products Blended	Amount	Date	Production Cost	Pricing Cost	Comments
Num Name	Tons				
1 Complete layer 18%	100.00	11/09/80	17,393.82	17,514.59	
2 Complete layer 17%	150.00	11/09/80	25,157.18	25,309.40	
3 Complete layer 16%	200.00	11/09/80	33,181.75	33,211.32	
4 Pullet developer 18%	100.00	11/09/80	17,488.83	17,529.71	
5 Complete pullet	150.00	11/09/80	23,823.84	23,868.12	
6 Broiler starter	400.00	11/09/80	85,817.70	86,539.32	
7 Broiler grower	600.00	11/09/80	121,016.68	122,229.27	
8 Broiler finisher	800.00	11/09/80	162,219.98	164,037.91	

Production Totals	Amount	Current Cost	New Cost	Blend Margin
	2,500.00	\$486,099.79	\$490,239.65	-\$4,139.85

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TABLE VI

Usage of High-Protein Ingredients (in tons)

Num	Name	Single-product	Mult-Blend	Restrictions	
				Min	Max
156	Meat & Bone ML-50	64.0	50.	0.	50.
280	Soybean Meal-44	0.0	30.	30.	Unlimited
282	Soybean Meal-48.5	338.13	400.	300.	400.
231	Poultry-by-prod Meal	117.0	50.	0.0	50.
98	Feather Meal	.29	20.	20.0	Unlimited
114	Fish Meal-A	55.25	40.	0.	40.
113	Fish Meal-B	20.0	28.5	25.0	Unlimited

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