

# Determining the Value of Nutrients and Unique Feedstuffs used in Dairy Rations

Patrick D. French, Ph.D., PAS  
Southern States Cooperative Inc.  
Richmond, VA

## Introduction

The last 18 months in animal agricultural have been historical, at least economically. The dairy industry had the highest US all milk price in November 2007 at \$21.81/cwt and the last six months of 2007 were all greater than \$21/cwt. This was followed by the highest recorded cash corn prices in the summer of 2008 that topped \$7.25/bu. Although milk prices declined slightly in 2008, the escalating feed prices resulted in the lowest milk to feed ratio in 25 years. This also coincided with dramatic increases in non-feed operating costs, which further decreased income in late-2008.

The US all milk price is expected to average \$11.80 to \$12.60 per cwt in 2009, a drop from \$18.34 in 2008 (USDA-ERS, 2009). And with feed costs becoming a greater proportion of total expenses, owners and nutritionists are looking for bargains in the marketplace. This paper will discuss both “old” and “new” ways of valuing commonly traded feedstuffs and deriving pay prices for local feedstuffs.

## Simple Methods

All methods discussed herein are aimed at determining the cost/price of a nutrient/compositional component, such as energy and crude protein, based on a set of common feedstuffs and then applying these values back to both common and uncommon feedstuffs to determine the value or breakeven price. A very simple method used to compare like feedstuffs that takes only minutes to complete determines the value of a nutrient in a reference feedstuff which is used to determine the value of the feedstuff of interest. This value is then compared to the market price of the feedstuff of interest and a decision is made. For example, soybean meal containing 47% crude protein (CP) on an as-fed basis at a cost of \$330/T gives a unit cost of \$7.02 per percent CP ( $330/47=7.02$ ). Cottonseed meal containing 38.3% CP is worth \$269/T ( $38.3 \times 7.02=269$ ), which is well above its market price of \$229/T. So, on a per unit of crude protein basis, cottonseed meal is a bargain. Note that this method ignores nutritional differences such as RDP/RUP and amino acid composition.

William Peterson of the University of Minnesota first described a system of determining the cost of protein and digestible nutrients in 1932 (Peterson, 1932). Peterson's method involved using corn and cottonseed meal for determining the cost of digestible nutrients and protein, respectively. Although Peterson developed conversion factors for determining the value of other feeds, this is an algebraic method of solving for two unknowns using two equations. The two unknowns are normally CP and total digestible nutrients (TDN), and corn grain and soybean meal are used as reference feeds. Using the Peterson Method and prices and nutrients as shown in Table 1, the value of a percentage point of CP and TDN the last week of January were \$3.67 and \$2.10, respectively. As shown in the table, most ingredients except corn gluten meal, molasses and whole cottonseed are a bargain.

The Peterson Method is still widely used today and taught in university nutrition classes. It is simple and may be too simple for today's economic climate. It suffers from using a limited number of nutrients and reference feeds. Rations are balanced and feedstuffs are purchased for more than CP and TDN (energy). Effective fiber, degradable, and undegradable protein, starch, and fat are ignored if using only CP and TDN. Also, this method assumes that the reference feeds are priced perfectly and that the dairy industry moves the price of these ingredients with changes in demand which is not the case. The feed industry is expected to use less than 45% of the 2008 corn crop and the dairy industry would be a proportion of this amount. In addition, the reference feeds will never be a bargain under this system, since they set the nutrient values and will always be priced at their breakeven. This method can be expanded to include more nutrients and reference feeds as shown by Howard and Shaver (1997), but the drawbacks are not completely overcome. St. Pierre and Glamocic (2000) cover in detail the possible pitfalls of the Peterson Method.

## Complex Methods

In addition to discussing the problems of the Peterson Method, St. Pierre and Glamocic (2000) discussed an improved method of calculating nutrient values. In this method, multiple regressors (independent variables; such as RDP, RUP, NFC, NDF, Fat, etc) and regressands (dependent variables; such as the price of a number of feedstuffs) are used to predict the value of nutrients inside a marketplace using least squares estimation. A commercial program called Sesame III is available ([www.sesamesoft.com](http://www.sesamesoft.com)) that will calculate nutrient values and breakeven prices based on set of user defined feedstuffs and their prices. A drawback of Sesame III is that the user cannot change the regressors, which are in predefined groups. Although this may limit the misuse of the program it also results in pricing nutrients that are not valued in a marketplace. To overcome this, I will share with you the reference feeds and nutrients that should be used in determining value for Virginia and surrounding areas.

It seems logical that the nutrients balanced for inside ration programs to meet the requirements of dairy cows should also be the same nutrients that one determines the value of in nutrient pricing. Macronutrients such as protein (rumen degradable protein [RDP] and rumen undegradable protein [RUP]), carbohydrates (non-fiber carbohydrates and fiber carbohydrates) and fat should be considered. Further, only the digestible fractions or metabolizable amounts of each of these in feedstuffs should be used because undigested nutrients have little value and should not be priced into a feedstuff. The reference feedstuffs and their composition can be found in Table 2. Regression analysis was performed over the last 130 weeks using respective weekly prices for the feedstuffs in Table 2. Coefficients that were significant and remained in the model in all weeks were digestible RDP, digestible RUP, and digestible Fat. Digestible non-fiber carbohydrates (dNFC) remained in the model about 97% of the time and effective neutral detergent fiber (eNDF) 90% of the time. Effective NDF had a slight advantage over dNDF when both were offered to the model; however, model fit was similar when either but not both were offered.

Predicted values for the compositional descriptors mentioned above are shown in Figure 1. Digestible RUP and dFat are worth the most per percentage point ranging from \$8-16 and \$4-12, respectively, over the last 30 months. Comparatively, dNFC has been less variable over the same period and was in the range of \$1.50-2.00. Digestible NDF has shown the most volatility over time ranging from a low of \$0.10 in the summer of 2007 to a high of \$1.50 a few months later. Except for a run-up in the later part of 2008, dRDP has been on a fairly steady increase from \$1.75 to \$2.50 over the last 2 ½ years.

So, what is the utility of these numbers? First, they can be used to benchmark ration costs. Which have increased from 8 cents per lb DM in July 06 to a high of 14.5 cents per lb DM in July 08 (Figure 2). This was calculated for a ton of 90% DM dairy ration assuming 8.5% dRDP, 4.8% dRUP, 18% dNDF, 39% dNFC, 4.5% dFat, and a mineral/vitamin/additive cost of \$7/T. Most rations should be able to be formulated at a cost less than the benchmark value if one uses undervalued ingredients, which we'll cover later.

Second, based on nutrient values (Figure 1) and ration costs (Figure 2) one can evaluate the gross profitability of the dairy industry. Figure 3 shows feed costs and returns using predicted ration costs and Appalachian Federal Milk Marketing Order mailbox milk prices. Income over operating costs was near zero in Jul 2006 and is near zero today. In 2006, low operating income was mainly due to low milk prices but today it is a combination of higher feed prices and moderating milk prices.

Third and likely the most important use of nutrient values is that they can be used to determine the value of feeds that are local and do not have national pricing reference. For example, what is mechanically extracted canola meal worth in Danville, VA? What is wet brewers grain from Williamsburg, VA worth? What is corn silage or grass hay worth? If we know the composition of the feedstuff, then summation of the multiplication of the compositional numbers by the nutrient values will give an estimated value of the feed. High fat canola meal is worth \$250/T delivered, 25% DM brewers is worth \$55/T delivered, and corn silage \$65/T delivered. If the offered price is below these estimated values then the feeds are priced appropriately and one should consider purchasing if they fit the feeding program.

Forth and last, nutrient values can be used to determine the value of feedstuffs used as regressors in deriving the nutrient values. Table 3 gives the market price and predicted breakeven delivered price of feedstuffs to central Virginia as of the week of Feb 2, 2009. Feeds are sorted from best to worst value. Predicted value is calculated by multiplying the respective values in Table 2 by the weekly value of the nutrients which are dRDP=\$2.63, dRUP=\$9.74, dNDF=\$1.65, dNFC=\$1.98, and dFat=\$5.31 and summing the products. A 95% confidence limit for the predicted feedstuffs values is  $\pm$ \$28. Feedstuffs

within  $\pm\$28/T$  are considered neutral buys, since the market price falls within the confidence limits. Feedstuffs with a predicted value of  $+\$28/T$  greater than market are considered good buys and those less than  $-\$28/T$  are bad buys. Protein sources that are attractive buys are distillers, brewers, and cottonseed meal. Barley and hominy are attractive energy buys. Feeds can also be evaluated more specifically for a particular nutrient or ration component, such as protein or fiber, versus a more comprehensive analysis as described in the preceding sentences. For example, consider that fiber was needed in the ration. One can determine the market value of dNDF and eNDF using a set of reference feeds. Digestible NDF is worth \$5.03 per percentage point and eNDF is worth \$1.85 per percentage point. Two high fiber feeds that are attractive buys are stock cow grass hay and soybean hulls. If one needed eNDF then stock cow grass hay should be considered. But if one needed dNDF then soyhulls should be a consideration. The same process of determining the value of a nutrient and in turn evaluating feedstuffs can be used for dRDP and dRUP, energy, etc.

### **Conclusion**

Due to the predicted economic environment over the next year, those in the feed and nutrition industry will need critically evaluate each ingredient being purchased. Part of this evaluation should include some form of appraisal as discussed above. Readers are encouraged to develop their own methods of nutrient value assessment or use one of the publicly available systems.

### **References**

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St. Pierre, N. R., and D. Glamocic. 2000. Estimating Unit Costs of Nutrients from Market Prices of Feedstuffs. *J. Dairy Sci.* 83:1402-1411.

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Table 1. Value of crude protein and total digestible nutrients, and selected feeds using the Peterson Method.

	% DM	% TDN	% CP	\$/T AF			
Corn	88	88.4	9.8	195.00			
48% Soybean Meal	90	79.1	55	331.00			
\$ per % CP =	3.67						
\$ per % TDN =	2.10						
Feed	% DM	% TDN	% CP	Value \$/T AF	Mkt Price \$/T AF	Buy	Value
Barley Grain	88	79.7	13.2	190	125	YES	65
Citrus Pulp	91	82.1	9.8	190	126	YES	64
Corn Distillers Grain	91	83.0	30.4	260	151	YES	109
Corn Grain	88	88.4	9.8	195	195	NO	0
Corn Gluten Feed	90	77.5	25.6	231	159	YES	72
Corn Gluten Meal	91	82.8	67.2	382	487	NO	-105
Cottonseed	92	70.2	24.4	218	220	NO	-2
Cottonseed Meal	92	71.5	46.1	294	229	YES	65
Hominy	90	89.4	11.5	207	179	YES	28
Molasses	74.3	78.1	5.8	138	243	NO	-105
Soybean Hulls	91	72.6	12.1	179	146	YES	33
Soybean Meal, 48%	90	79.1	55	331	331	NO	0
Tallow	99	215.8	0	449	354	YES	95
Urea	99	274.0	281	1590	613	YES	977

Table 2. Composition of feedstuffs used calculate nutrient values.

Feed	dRDP	dRUP	dNDF	dNFC	dFat	eNDF
Dairy Alfalfa Supreme	15.9	4.7	17.3	29.4	2.5	28.8
Dairy Alfalfa Premium	12.9	4.4	16.1	29.4	2.5	31.5
Stock Cow Alfalfa	10.9	3.7	14.4	26.5	2.5	36.1
Stock Cow Grass	5.1	3.3	33.5	13.7	2.0	63.7
Corn Silage	6.0	1.4	29.3	42.1	2.0	38.3
Bakery Byproduct	8.3	2.9	5.2	65.7	9.0	0.2
Barley Grain	7.2	3.6	9.8	60.8	1.6	1.6
Beet Pulp	4.1	3.8	34.8	41.2	0.4	6.3
Brewers Grains	8.2	12.9	20.3	9.7	7.5	4.6
Canola Meal	21.2	11.0	14.1	16.2	6.0	2.1
Citrus Pulp	3.8	2.0	13.4	56.8	1.6	7.2
Corn Gluten Feed	13.7	6.7	27.1	28.9	3.0	14.4
Corn Gluten Meal	16.5	43.2	6.7	17.7	2.0	0.3
Corn Grain	4.2	4.1	6.0	74.1	3.3	0.2
Cottonseed Hulls	3.5	2.1	16.0	5.9	2.4	55.9
Cottonseed Meal	19.6	18.1	20.1	9.8	6.9	3.2
Cottonseed	13.4	6.7	14.8	0.0	19.0	31.7
Distillers Dried Grains	10.8	14.1	20.1	18.6	12.0	3.4
Feather Meal	16.2	28.2	0.0	2.9	9.0	0.0
Hominy	3.7	5.5	13.1	62.0	6.2	1.8
Molasses	7.9	0.0	0.0	74.0	0.9	0.0
Peanut Hulls	3.7	1.7	13.1	13.7	4.2	37.5
Porcine Blood Meal	12.0	59.1	0.0	5.9	1.0	0.1
Porcine Byproduct Meal	18.1	16.7	0.0	0.0	11.0	0.3
Poultry Byproduct Meal	11.7	18.0	0.0	0.0	11.0	0.3
Rice Hulls	1.1	0.6	10.8	3.9	2.0	32.4
Rice Millfeed	5.6	4.0	18.0	23.5	13.0	10.8
Soybean Hulls	6.8	4.3	52.8	16.1	2.1	16.9
Soybean Meal, 44%	27.9	15.0	11.7	26.3	2.1	4.0
Soybean Meal, 48%	30.7	17.6	6.5	27.4	2.6	2.2
Tallow	0.0	0.0	0.0	0.0	61.2	0.0
Urea	238.9	0.0	0.0	0.0	0.0	0.0
Wheat Midds	11.5	4.4	17.2	33.8	6.3	0.4

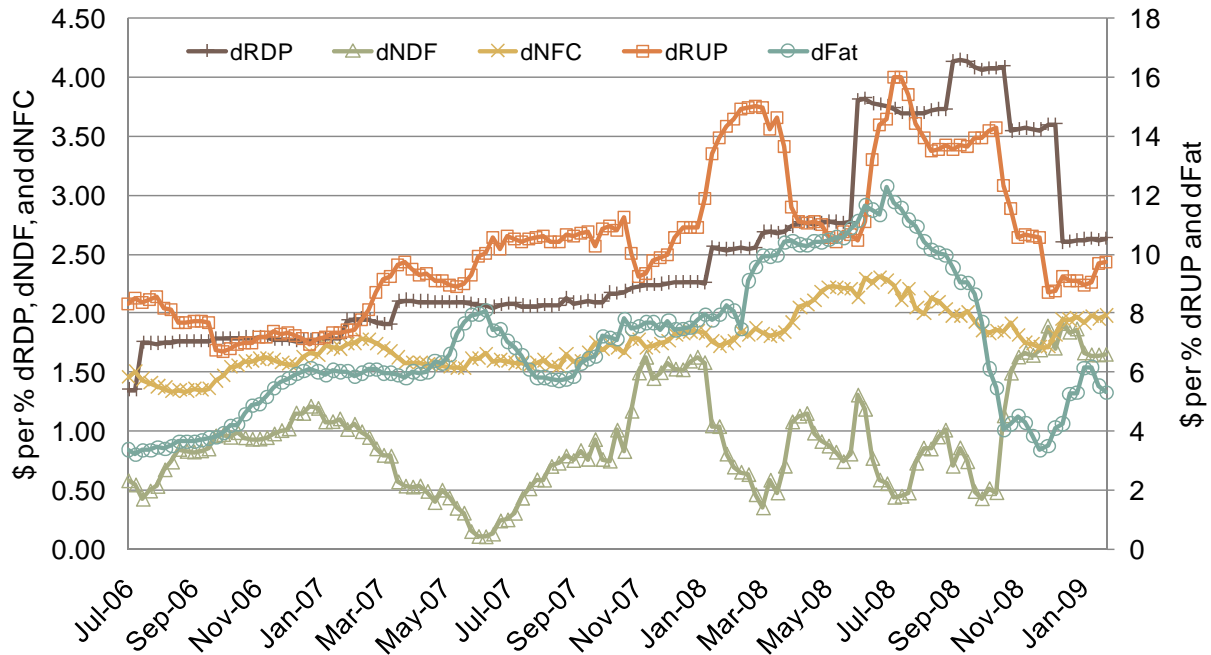


Figure 1. Predicted market value of feedstuff compositional descriptors from July 2006 to January 2009.

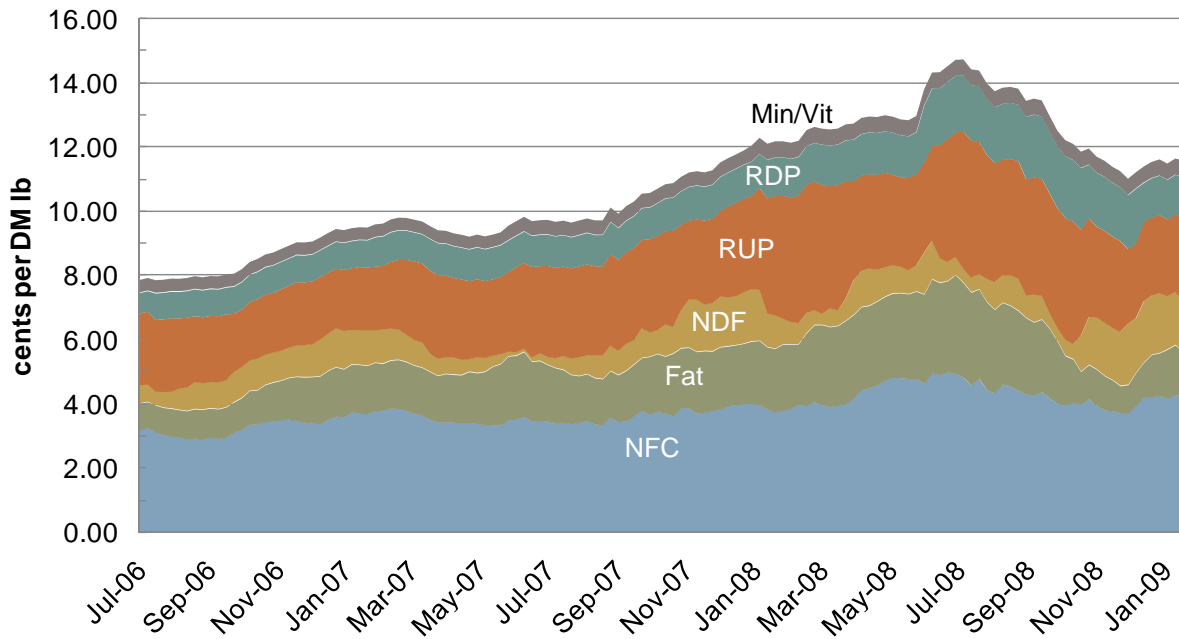


Figure 2. Cost of a typical dairy ration by ration component using values shown in Figure 1.

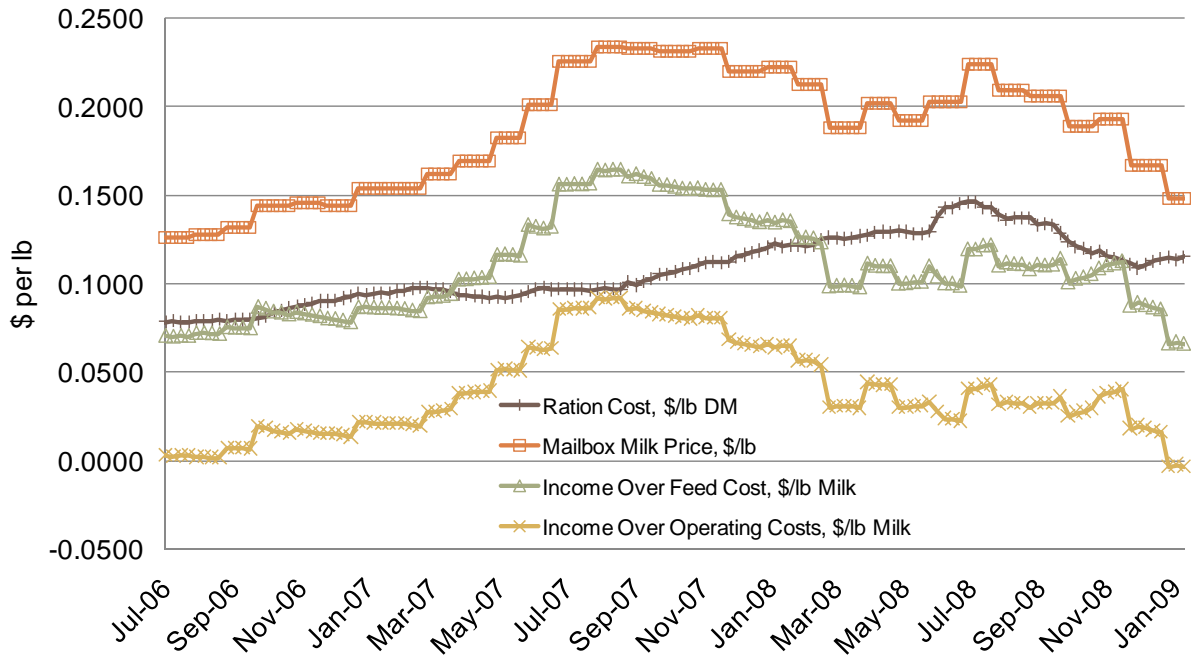


Figure 3. Dairy feed costs and returns using ration costs shown in Figure 2 and FMMO 5 mailbox milk prices. Assumes 1.4 feed efficiency and non-feed operating costs of \$0.08/lb milk.

Table 3. Market prices and predicted breakeven price of feedstuffs delivered to central Virginia.

Feed	Market Price \$/T As-Fed	Predicted Value \$/T As-Fed	Difference Pred-Mkt, \$/T
Distillers Dried Grains	177	299	122
Cottonseed Meal	223	317	94
Brewers Grains	158	240	82
Barley Grain	125	199	74
Hominy	170	241	70
Stock Cow Grass	72	138	67
Corn Gluten Feed	157	220	62
Feather Meal	309	370	61
Wheat Midds	149	202	53
Citrus Pulp	124	172	49
Corn Grain	184	225	41
Soybean Hulls	157	190	34
Bakery Byproduct	212	237	25
Cottonseed	207	226	19
Corn Silage	51	67	16
Urea	614	628	14
Peanut Hulls	85	98	13
Porcine Blood Meal	622	624	3
Rice Millfeed	131	109	-23
Soybean Meal, 48%	360	331	-29
Tallow	355	325	-30
Corn Gluten Meal	557	521	-36
Rice Hulls	86	45	-41
Soybean Meal, 44%	348	304	-44
Poultry Byproduct Meal	322	265	-57
Stock Cow Alfalfa	220	154	-67
Dairy Alfalfa Premium	242	175	-67
Dairy Alfalfa Supreme	255	188	-68
Molasses	249	172	-77
Porcine Byproduct Meal	357	268	-89
Cottonseed Hulls	183	80	-103
Canola Meal	363	250	-114
Beet Pulp	442	188	-254