Chapter 8

Ingredient Value and Cost Calculator for Livestock and Poultry Diets

Garland Dahlke and John D. Lawrence

Editors' note: The Ingredient Value and Cost Calculator for Livestock and Poultry Diets described in this chapter is available at http://www.matric.iastate.edu/DGCalculator

Livestock producers and feed manufacturers face increased competition for corn from ethanol production and also have more feedstuffs such as distillers grains with solubles available to them. As biofuel producers adopt new methods of extracting value from grain and oilseeds, new feedstuffs are created and remaining co-products are altered. For example, some ethanol producers are extracting, or plan to extract, corn oil through either "front-end" fractionation before fermentation or "back-end" centrifuging after fermentation. Both technologies produce a feedstuff co-product that has different nutritional values and characteristics than conventional distillers grains with solubles. When composition and prices of feedstuffs change, best-cost diets for animal performance also change. Livestock and poultry producers, nutritionists, and feed manufacturers and distributors need to be aware of the evolving nutrient composition of available feedstuffs but should also know how to price them appropriately.

Whether a feedstuff should be used in a diet and whether it increases or decreases the cost of the diet—or more importantly, the cost of producing a unit of animal output—depends on the price of the feedstuff compared to its relative feed value. The relative value of a feedstuff depends on two primary factors: its price and the portfolio of nutrients that it is contributing to the diet compared with what it is replacing.

Nutrients in the diet have physiological requirements, such as minimums, maximums, and their ratio to other nutrients. They also express

---

Garland Dahlke is an assistant scientist at the Iowa Beef Center, and John D. Lawrence is a professor of economics and director of the Iowa Beef Center, at Iowa State University.

economic principles, and these must be considered. First, nutrients have "value if needed," meaning that additional amounts beyond what an animal requires do not have value and may suppress performance or even be toxic at high levels and thus have a negative value. Second, nutrients also express diminishing marginal returns. A nutrient will have a higher value per unit at low levels in a diet, but it will have less value per unit at higher levels in the diet. Finally, it is important to consider the value of a feedstuff in terms of its opportunity cost, that is, what it is replacing in the diet.

The computer application described in this chapter can be used to determine the economic value of a feedstuff. A feedstuff's economic value is compared to its price to determine if there is an economic advantage in including it in the diet. The economic value also serves as the maximum price a producer or feed manufacture would be willing to pay for the ingredient.

The application begins with the current or representative diet being fed to a particular class of animal. Next, it uses linear programming to solve for the least-cost formulation to achieve the same nutrition as the original diet and thus determines the relative value of including a particular feedstuff. It includes additional characteristics of the feedstuff, such as moisture, shrink, and handling cost, to determine how much a producer would be willing to pay for the feedstuff, or how much a feed manufacturer should charge for it.

The Computer Application

The purpose of this computer application is to help livestock and poultry producers, nutritionists, and feed distributors determine the economic value of a given ingredient. This economic value may be viewed by producers as whether the specified ingredient is a good buy when it is included in a diet, and by distributors as the appropriate price to charge for the ingredient. A brief example of how the representative diet affects the economic value of a feedstuff is given. This is followed by step-by-step instructions for using the computer application.

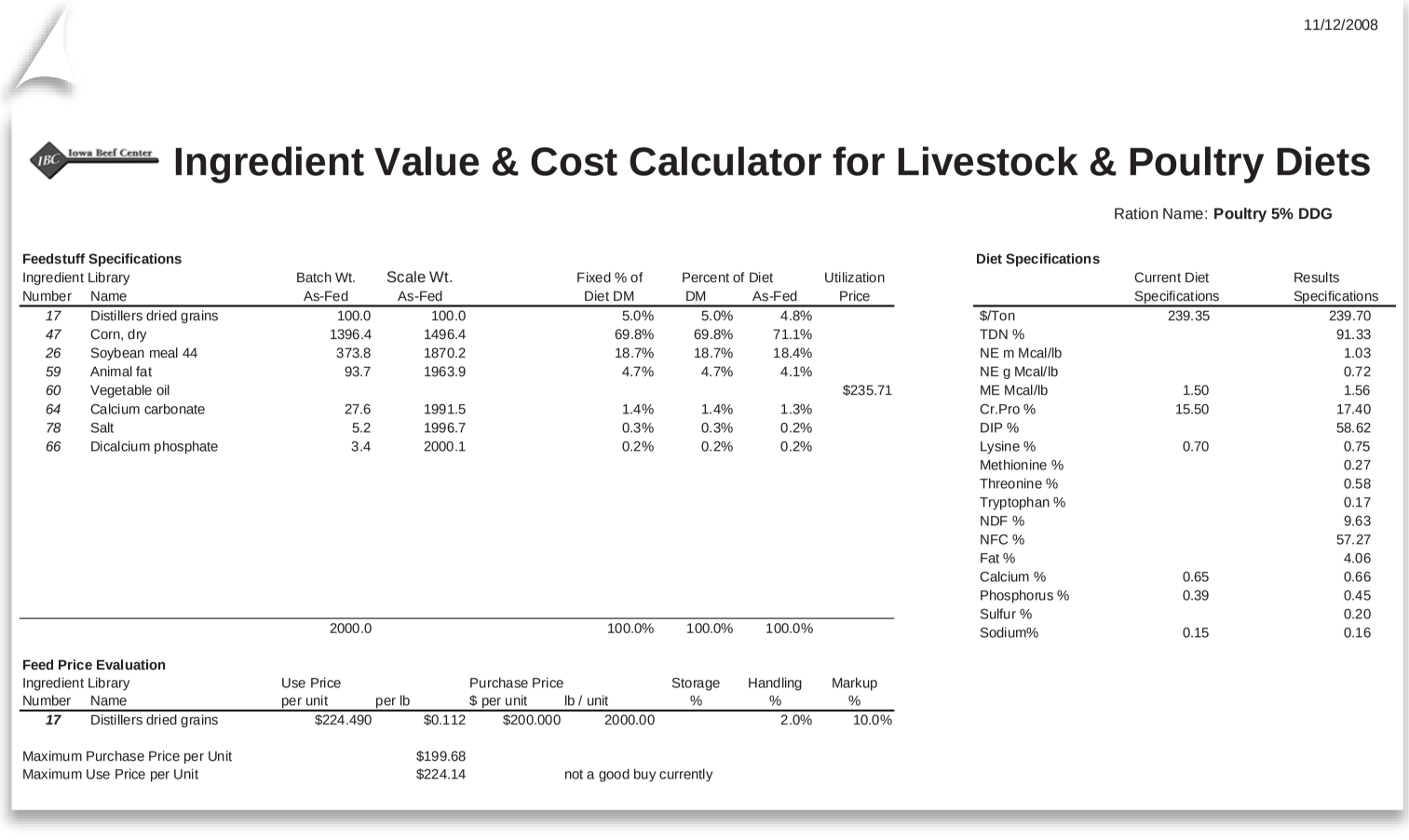
Pricing is based on value, and value is composed of the quantity of nutrients provided, the rate of utilization in a diet, the handling properties

of the feed, and the value of the initial inputs necessary to make the given feed. For example, corn-based distillers grains can be a plentiful source of energy in the form of fat, digestible fiber, protein, energy, sulfur, and phosphorus, depending on the animal species consuming this product. Different processes in the production of corn-based ethanol and co-product extraction can modify the concentrations of the nutrients present and therefore modify the value of the resulting feed. Because distillers grains have more than one nutrient and because some of these nutrients have a window of opportunity, after which they may have a detrimental effect in the diet, an ingredient can only be properly assessed in the context of the diet for which it is to be provided.

Consider the following examples in which distillers dried grains are used in the diet at 5% for broilers, 10% for growing pigs, and 40% for feedlot steers. The three species vary in their ability to utilize distillers dried grains in feeds, and these usage rates are reflected in the respective sample diet formulations presented in Figures 8.1 through 8.3. In the example in Figure 8.1, the 5% utilization rate in the broiler diet is achieved primarily by substituting distillers dried grains for soybean meal and corn. At the pricing structure used in the example, this substitution rate does not favor the use of distillers dried grains in the diet. However, a price reduction of $0.36 per ton for distillers dried grains allows this ingredient to be included in the diet.

An increase in the use rate changes this scenario. As noted, the grower pig diet can utilize distillers dried grains at a rate of 10% of dietary dry matter. As shown in Figure 8.2, at the 10% rate of use, the distillers dried grains replace soybean meal, animal fat, corn, and some minerals and become more valuable in the grower pig diet, with a $12.78-per-ton advantage. Finally, the growing steer is capable of utilizing distillers dried grains at 40% of the overall dietary dry matter. This diet is a little different from that of the pig and broiler since other protein sources can be used to balance the diet. These protein sources, which are generally more cost-effective, change the extent to which we may value the product, but even in this case the higher inclusion rate has a price advantage of up to $16.48 per ton in the use of distillers dried grains (see Figure 8.3).

By evaluating an ingredient in the context of a given diet, we address the nutrient density and nutrient quantity simultaneously. When the diet is then



11/12/2008

Iowa Beef Center

Ingredient Value & Cost Calculator for Livestock & Poultry Diets

Ration Name: **Poultry 5% DDG**

Feedstuff Specifications

Ingredient Library Number	Name	Batch Wt. As-Fed	Scale Wt. As-Fed	Fixed % of Diet DM	Percent of Diet DM	Percent of Diet As-Fed	Utilization Price
17	Distillers dried grains	100.0	100.0	5.0%	5.0%	4.8%	
47	Corn, dry	1396.4	1496.4	69.8%	69.8%	71.1%	
26	Soybean meal 44	373.8	1870.2	18.7%	18.7%	18.4%	
59	Animal fat	93.7	1963.9	4.7%	4.7%	4.1%	
60	Vegetable oil						$235.71
64	Calcium carbonate	27.6	1991.5	1.4%	1.4%	1.3%	
78	Salt	5.2	1996.7	0.3%	0.3%	0.2%	
66	Dicalcium phosphate	3.4	2000.1	0.2%	0.2%	0.2%	
		2000.0		100.0%	100.0%	100.0%	

Diet Specifications

	Current Diet Specifications	Results Specifications
$/Ton	239.35	239.70
TDN %		91.33
NE m Mcal/lb		1.03
NE g Mcal/lb		0.72
ME Mcal/lb	1.50	1.56
Cr.Pro %	15.50	17.40
DIP %		58.62
Lysine %	0.70	0.75
Methionine %		0.27
Threonine %		0.58
Tryptophan %		0.17
NDF %		9.63
NFC %		57.27
Fat %		4.06
Calcium %	0.65	0.66
Phosphorus %	0.39	0.45
Sulfur %		0.20
Sodium%	0.15	0.16

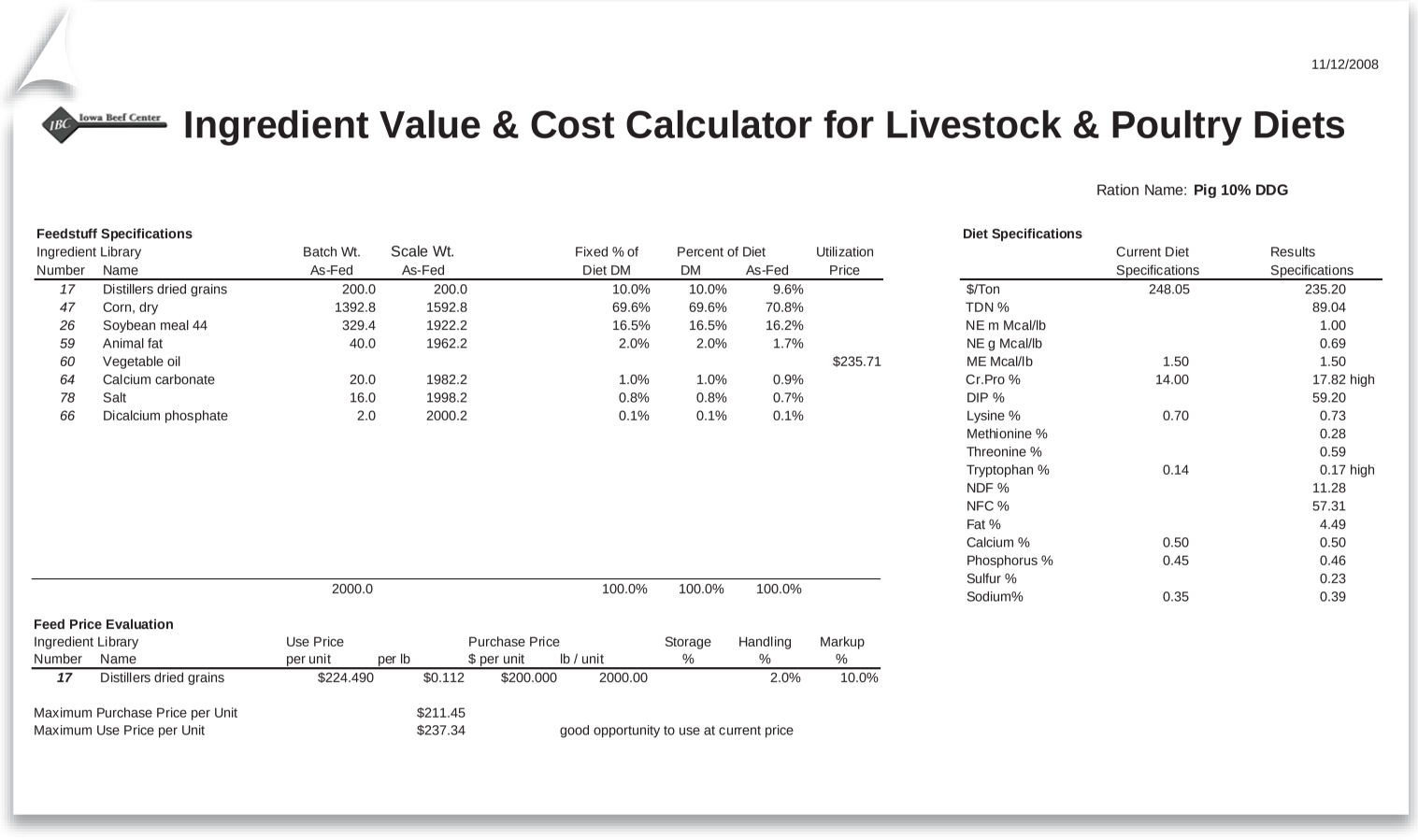
Feed Price Evaluation

Ingredient Library Number	Name	Use Price per unit	per lb	Purchase Price $ per unit	lb / unit	Storage %	Handling %	Markup %
17	Distillers dried grains	$224.490	$0.112	$200.000	2000.00		2.0%	10.0%

Maximum Purchase Price per Unit $199.68

Maximum Use Price per Unit $224.14 not a good buy currently

Figure 8.1. Summary printout for a broiler diet using distillers dried grains at a 5% inclusion rate



11/12/2008

Ingredient Value & Cost Calculator for Livestock & Poultry Diets

Ration Name: **Pig 10% DDG**

Feedstuff Specifications

Ingredient Library Number	Name	Batch Wt. As-Fed	Scale Wt. As-Fed	Fixed % of Diet DM	Percent of Diet DM	Percent of Diet As-Fed	Utilization Price
17	Distillers dried grains	200.0	200.0	10.0%	10.0%	9.6%	
47	Corn, dry	1392.8	1592.8	69.6%	69.6%	70.8%	
26	Soybean meal 44	329.4	1922.2	16.5%	16.5%	16.2%	
59	Animal fat	40.0	1962.2	2.0%	2.0%	1.7%	
60	Vegetable oil						$235.71
64	Calcium carbonate	20.0	1982.2	1.0%	1.0%	0.9%	
78	Salt	16.0	1998.2	0.8%	0.8%	0.7%	
66	Dicalcium phosphate	2.0	2000.2	0.1%	0.1%	0.1%	
		2000.0		100.0%	100.0%	100.0%	

Diet Specifications

	Current Diet Specifications	Results Specifications
$/Ton	248.05	235.20
TDN %		89.04
NE m Mcal/lb		1.00
NE g Mcal/lb		0.69
ME Mcal/lb	1.50	1.50
Cr.Pro %	14.00	17.82 high
DIP %		59.20
Lysine %	0.70	0.73
Methionine %		0.28
Threonine %		0.59
Tryptophan %	0.14	0.17 high
NDF %		11.28
NFC %		57.31
Fat %		4.49
Calcium %	0.50	0.50
Phosphorus %	0.45	0.46
Sulfur %		0.23
Sodium%	0.35	0.39

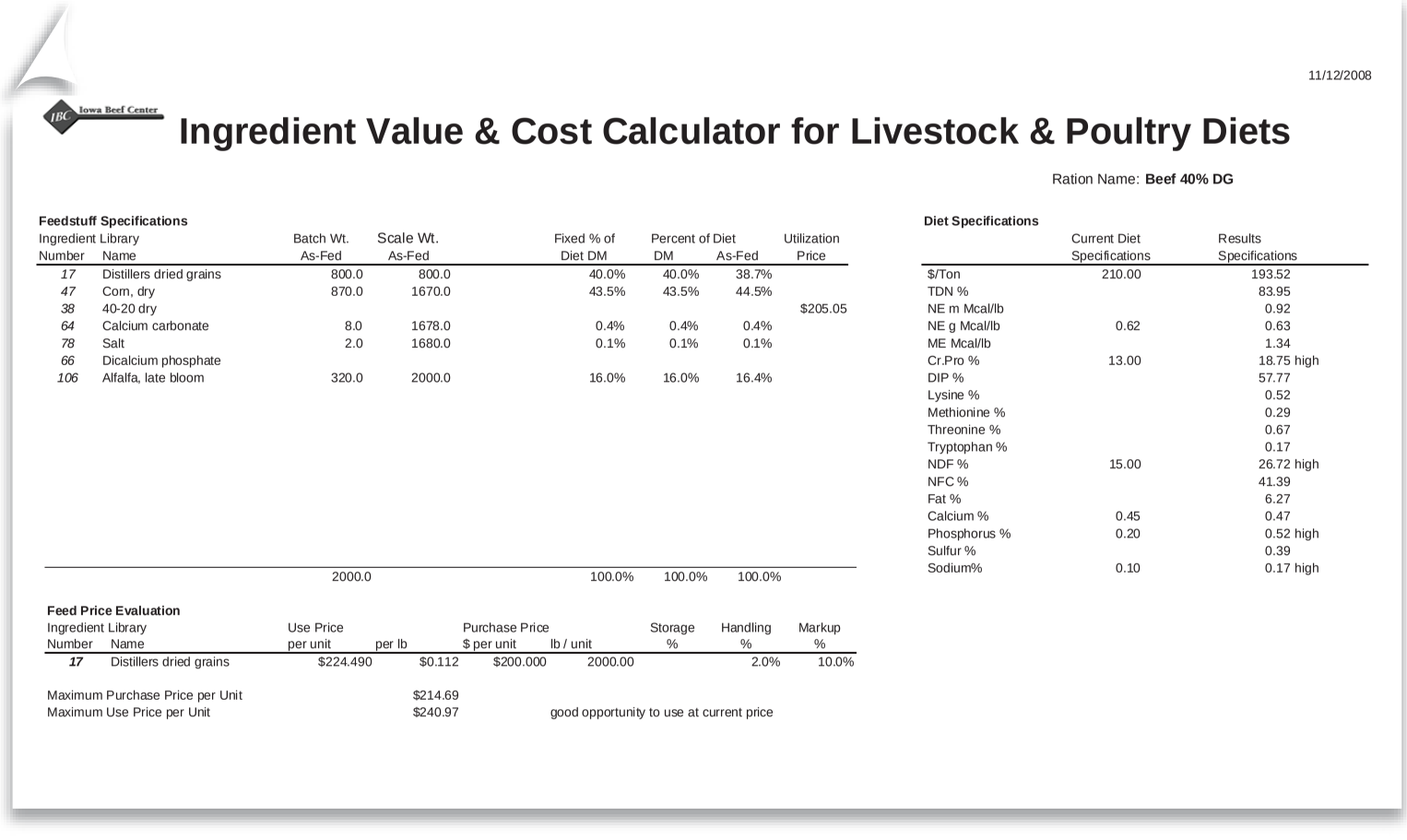
Feed Price Evaluation

Ingredient Library Number	Name	Use Price per unit	per lb	Purchase Price $ per unit	lb / unit	Storage %	Handling %	Markup %
17	Distillers dried grains	$224.490	$0.112	$200.000	2000.00		2.0%	10.0%

Maximum Purchase Price per Unit $211.45

Maximum Use Price per Unit $237.34 good opportunity to use at current price

Figure 8.2. Summary printout for a pig diet using distillers dried grains at a 10% inclusion rate



11/12/2008

Iowa Beef Center

Ingredient Value & Cost Calculator for Livestock & Poultry Diets

Ration Name: **Beef 40% DG**

Feedstuff Specifications

Ingredient Library Number	Name	Batch Wt. As-Fed	Scale Wt. As-Fed	Fixed % of Diet DM	Percent of Diet DM	Percent of Diet As-Fed	Utilization Price
17	Distillers dried grains	800.0	800.0	40.0%	40.0%	38.7%	
47	Corn, dry	870.0	1670.0	43.5%	43.5%	44.5%	
38	40-20 dry						$205.05
64	Calcium carbonate	8.0	1678.0	0.4%	0.4%	0.4%	
78	Salt	2.0	1680.0	0.1%	0.1%	0.1%	
66	Dicalcium phosphate						
106	Alfalfa, late bloom	320.0	2000.0	16.0%	16.0%	16.4%	
		2000.0		100.0%	100.0%	100.0%	

Diet Specifications

	Current Diet Specifications	Results Specifications
$/Ton	210.00	193.52
TDN %		83.95
NE m Mcal/lb		0.92
NE g Mcal/lb	0.62	0.63
ME Mcal/lb		1.34
Cr.Pro %	13.00	18.75 high
DIP %		57.77
Lysine %		0.52
Methionine %		0.29
Threonine %		0.67
Tryptophan %		0.17
NDF %	15.00	26.72 high
NFC %		41.39
Fat %		6.27
Calcium %	0.45	0.47
Phosphorus %	0.20	0.52 high
Sulfur %		0.39
Sodium%	0.10	0.17 high

Feed Price Evaluation

Ingredient Library Number	Name	Use Price per unit	per lb	Purchase Price $ per unit	lb / unit	Storage %	Handling %	Markup %
17	Distillers dried grains	$224.490	$0.112	$200.000	2000.00		2.0%	10.0%

Maximum Purchase Price per Unit $214.69

Maximum Use Price per Unit $240.97 good opportunity to use at current price

Figure 8.3. Summary printout for a beef diet using distillers dried grains at a 40% inclusion rate

compared with a nutrient-equivalent diet, we can arrive at an appropriate pricing structure that takes into account current market demands and supplies.

How to Use the Ingredient Value and Cost Calculator

Computer Software Requirements

a. Microsoft Excel must be installed on your computer to run this program.

b. Microsoft Excel security levels must be set to low or medium. If needed, use Excel Help to determine how to set the security level.
   – To access the Excel help menu, select the F1 button while the Excel program is running and search for security level or Trust Center.
   – Enable macros if asked.

See the Definitions section at the end of these instructions for an explanation of the terms used in the Ingredient Value and Cost Calculator.

Step 1. Enter ingredient value and cost information into the Ingredient Library.

a. Open the Ingredient Value and Cost Calculator in Microsoft Excel and select the "Ingredient Library" tab at the bottom of the Excel page to open the Ingredient Library worksheet (see Figure 8.4). Modify ingredient values as needed.

   Note: When entering or changing nutrient content, the values entered should be appropriate for the species being fed. This means that available levels of the nutrient should be entered, rather than total levels. For example, inputs such as DIP (degradable intake protein) are specific for ruminants. All ingredient nutrient contents are to be indicated on a 100% dry matter basis.

b. To update values for existing ingredients, simply change the values as needed in each column.

c. To enter a new ingredient, use any open row in the library, enter the ingredient name, number of pounds per unit (for example, 50

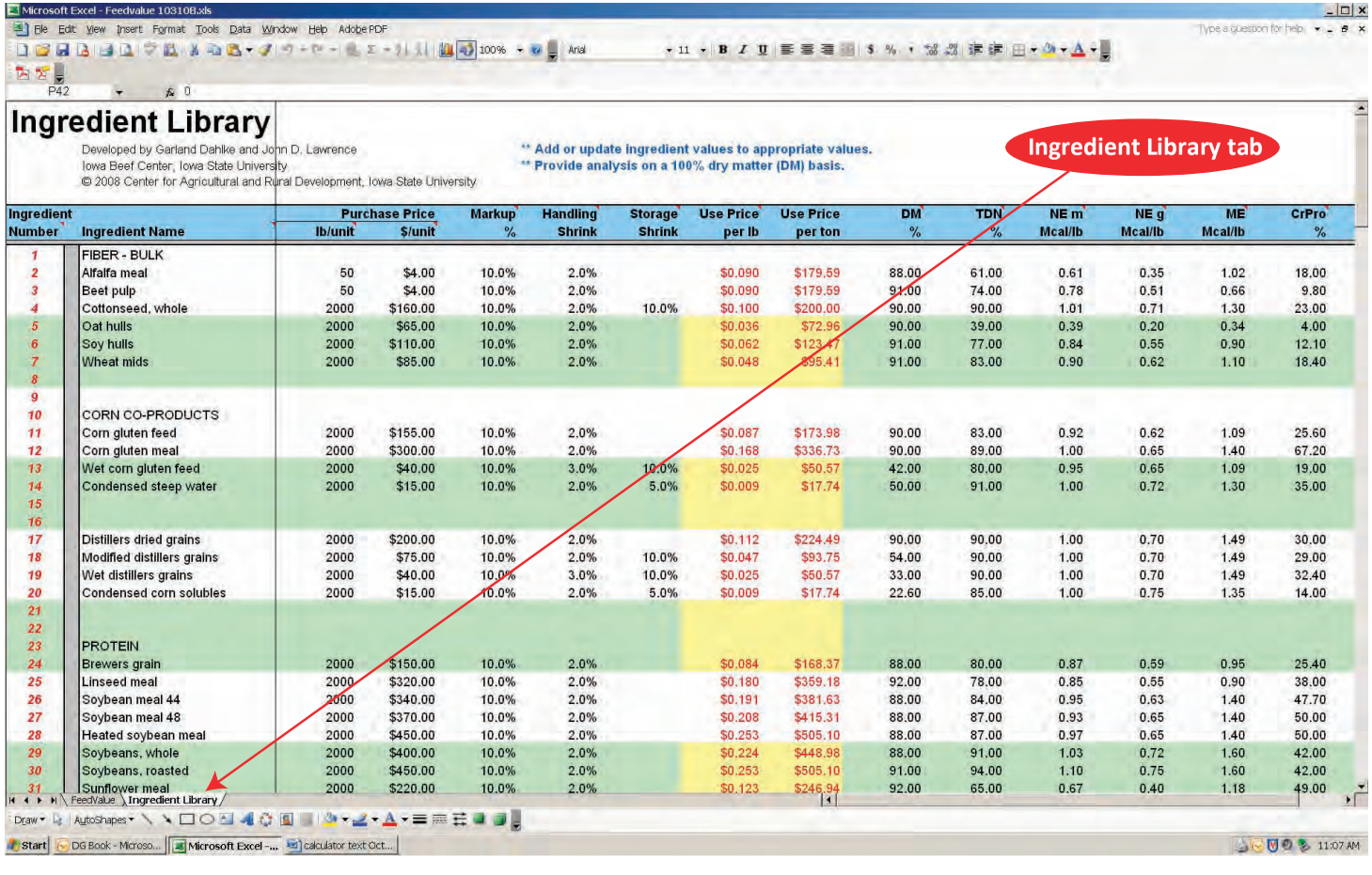


Figure 8.4. Ingredient Library page of the calculator

for a 50-pound bag or 2,000 for a ton), and purchase price. If applicable, enter the percent margin markup and estimates of percent handling and storage shrink. If these values are not applicable, the columns can be left blank. The program will automatically use these values to calculate the use price. For the distributor, the use price is the price per pound that must be charged on the outgoing ingredient to satisfy shrinkage losses and provide the necessary margin to maintain the business. For the producer, the use price is the price per pound that will be paid for the ingredient.

d. When finished, select "Save" from your Excel menu.

Note that the pre-set numbers in the Ingredient Number column are used to identify individual ingredients in the following steps.

Step 2. Enter the feedstuff specifications of the diet to be calculated.

a. Select the "FeedValue" tab at the bottom of the Excel page to open the Calculator page (see Figure 8.5).

b. In the *Feedstuffs Specifications* box, enter an Ingredient Library Number under the column labeled *Number* for each ingredient being considered for use in the diet. The corresponding ingredient name will automatically appear in the column labeled *Name* (see Figure 8.6).

c. Indicate a fixed percentage of dietary dry matter, as desired, to hold the inclusion rate constant for any of the ingredients under the column labeled *Fixed % of Diet DM*. As shown in Figure 8.6, the user has specified 40% distillers dried grains, which will force a 40% inclusion rate when the ration is balanced. The program will calculate percentages for the other ingredients.

Step 3. Enter the diet specifications.

a. In the Diet Specifications box, under the column labeled Current Diet Specifications, indicate the price per ton of the diet currently being fed (or the diet being used for comparison). By indicating this price, a basis can be established for arriving at the price for the new diet you have specified in the Feedstuffs Specifications box (see Figure 8.7).

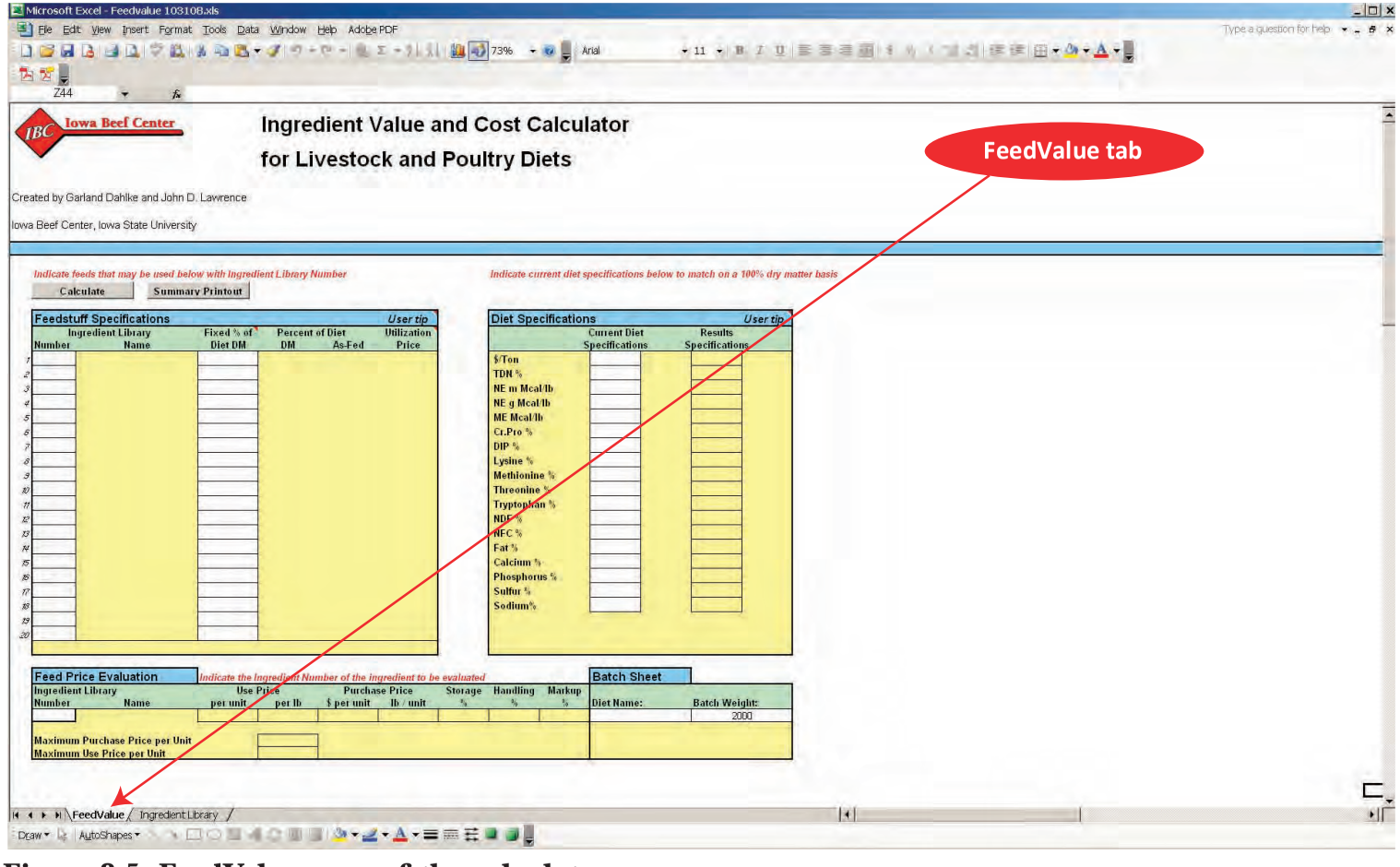


Figure 8.5. FeedValue page of the calculator

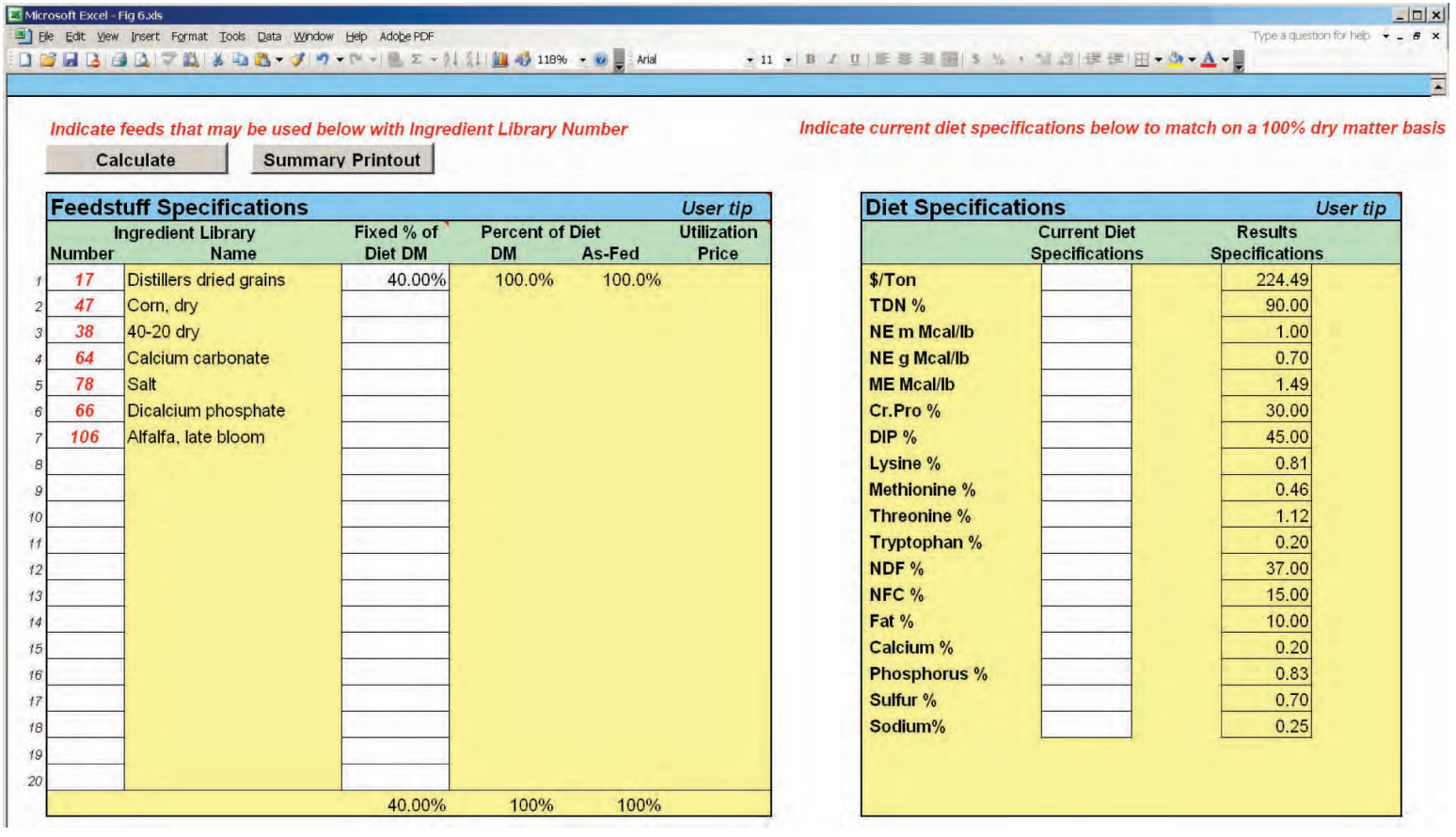


Figure 8.6. Feedstuff specifications for desired ingredients in a ration using 40% distillers dried grains

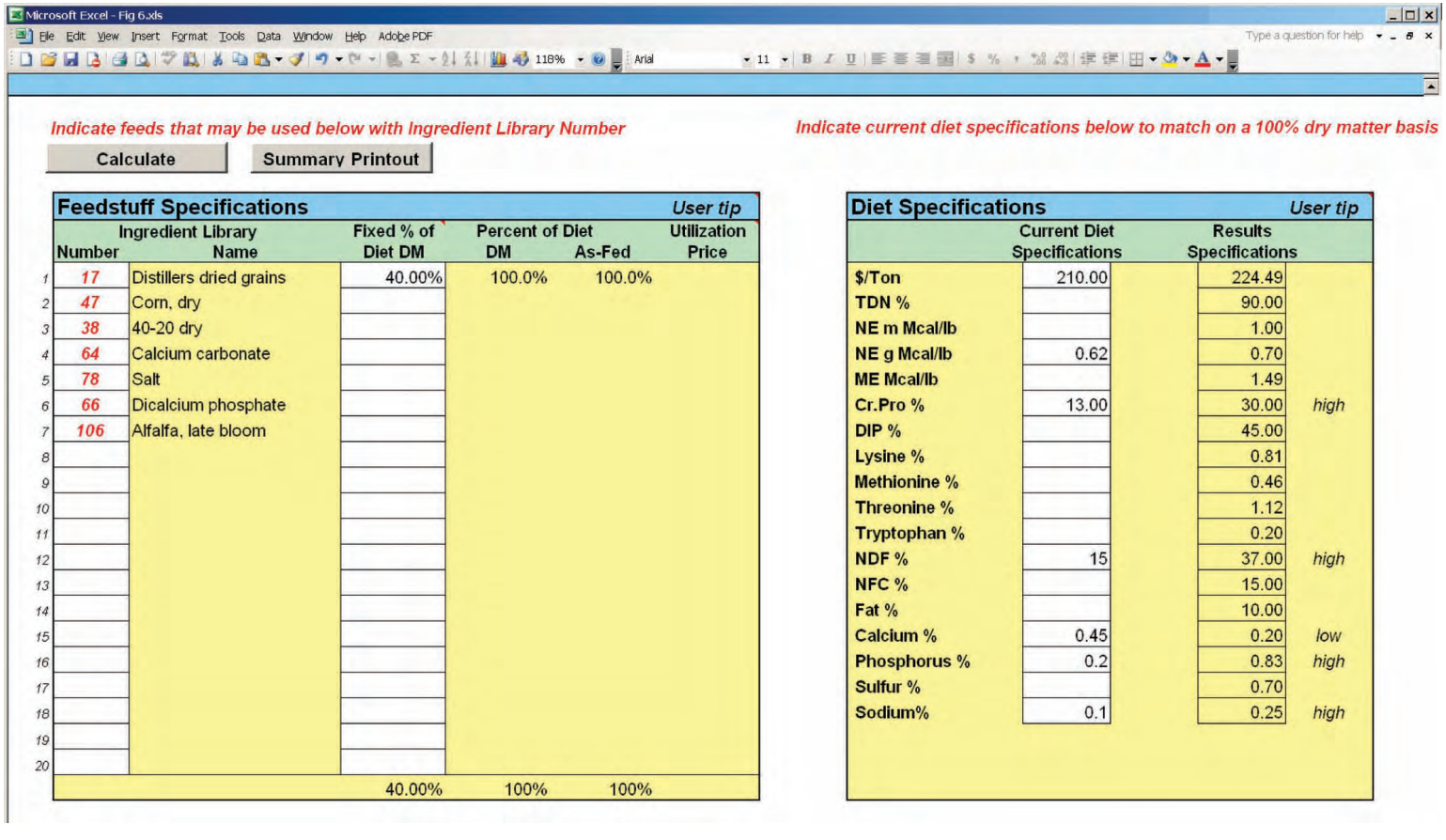


Figure 8.7. Diet specifications for current diet priced at $210 per ton

b. Also in the *Diet Specifications* box, enter the nutrient specifications of the diet currently being fed (or the diet being used for comparison). Only the diet specifications that you wish to indicate need to be provided here; the rest can be left blank (see Figure 8.7).

Step 4. Calculate the ingredient value and cost of the new diet.

a. Select the "Calculate" button, located above the *Feedstuff Specifications* box. (If nothing happens, evaluate your macro security or Trust Center settings because they are preventing the program from functioning.)

b. Once the "Calculate" button has been selected, the program will formulate the diet as closely as possible to your specifications in a "least-cost" manner. The results for the example are shown under the column labeled *Results Specifications* (see Figure 8.8).

c. The calculator will also indicate the utilization price of ingredients, or the price to which the ingredient must be reduced before the program will consider using it in the diet formulation. In this example, 40-20 dry must fall below $205.05 (see Figure 8.8).

d. If the program cannot find a suitable solution, you may need to specify other ingredients or manually adjust the fixed % of diet dry matter values to arrive at a reasonable cost and nutrient content. In this example, the user adjusts the fixed % of diet dry matter for ingredients rather than specifying new ingredients (see Figure 8.9).

Note that if a nutrient level is not met, a "low" flag will appear next to the results for that nutrient in the *Diet Specifications* box. If the nutrient content exceeds the original specification by more than 15%, a "high" flag will appear next to the results for that nutrient.

Step 5. Evaluate the price of a selected ingredient.

a. Scroll down to the *Ingredient Price Evaluation* box and indicate the ingredient library number of the ingredient you are interested in pricing from the diet balanced in Step 4 (see Figure 8.10).

b. In this example, the selection is distillers dried grains (see Figure 8.10). The *Ingredient Price Evaluation* results are based on the proper-

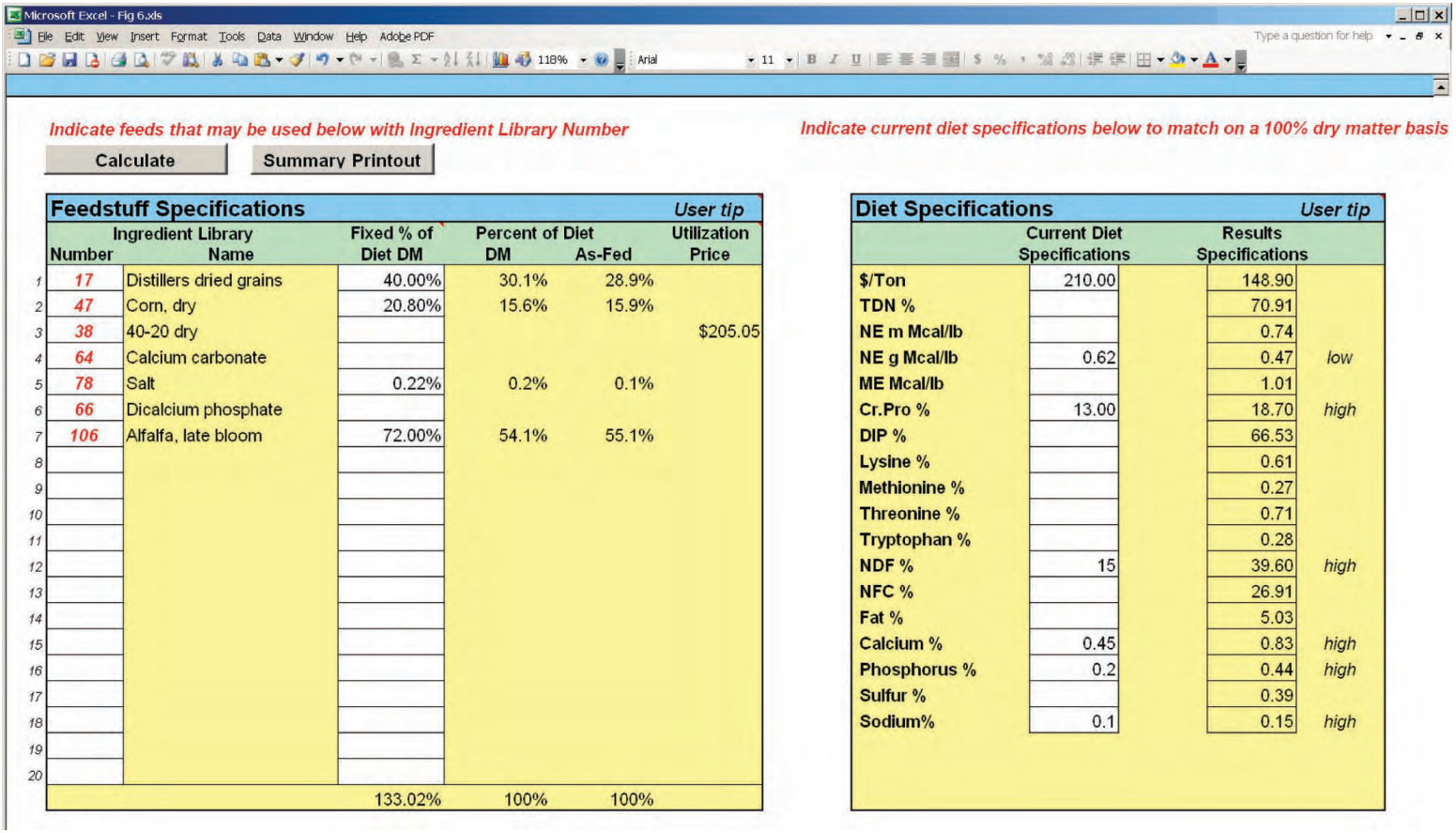


Figure 8.8. Initial calculation based on values entered into the program

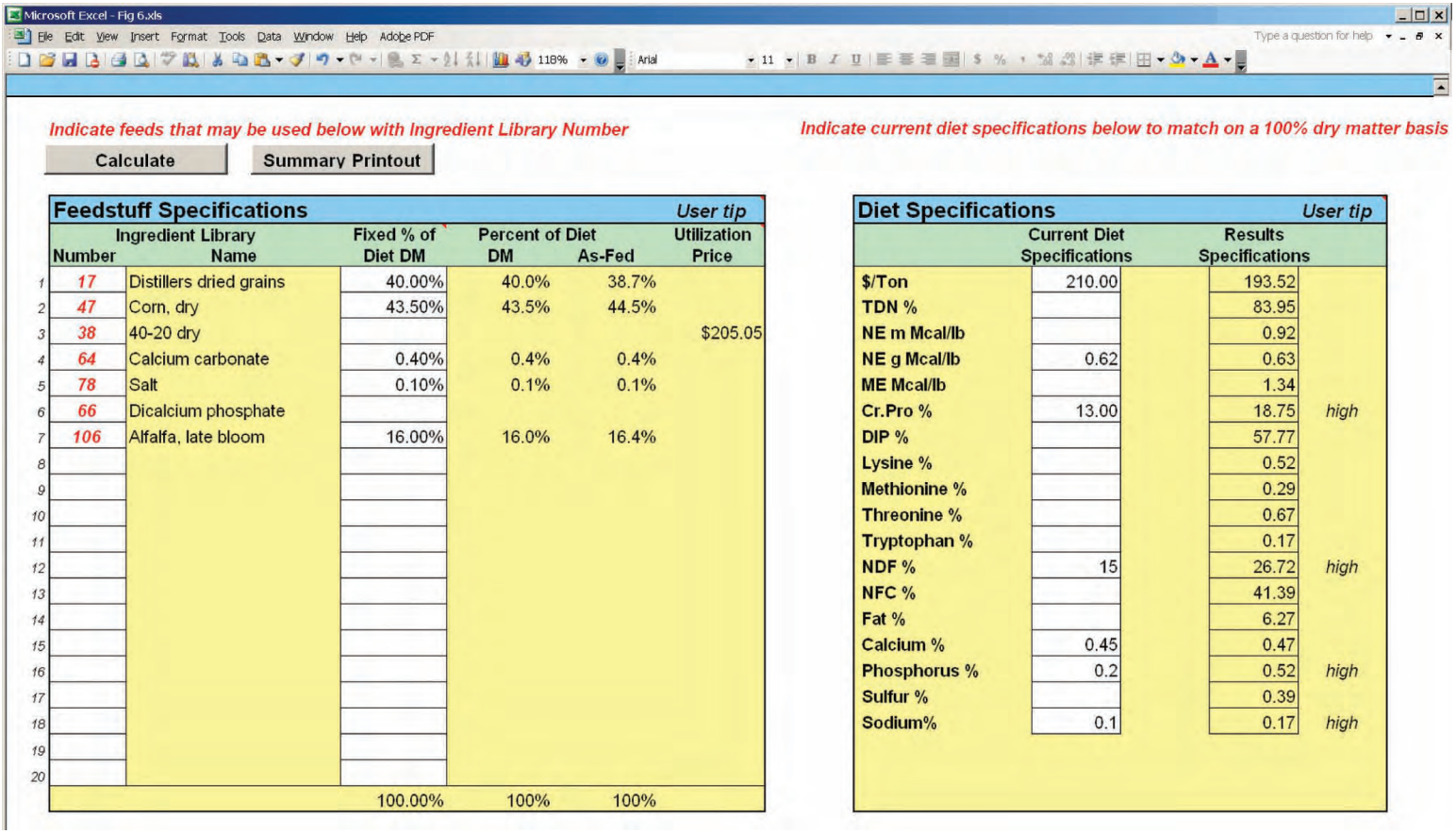


Figure 8.9. Second calculation after manually adjusting feedstuff specifications

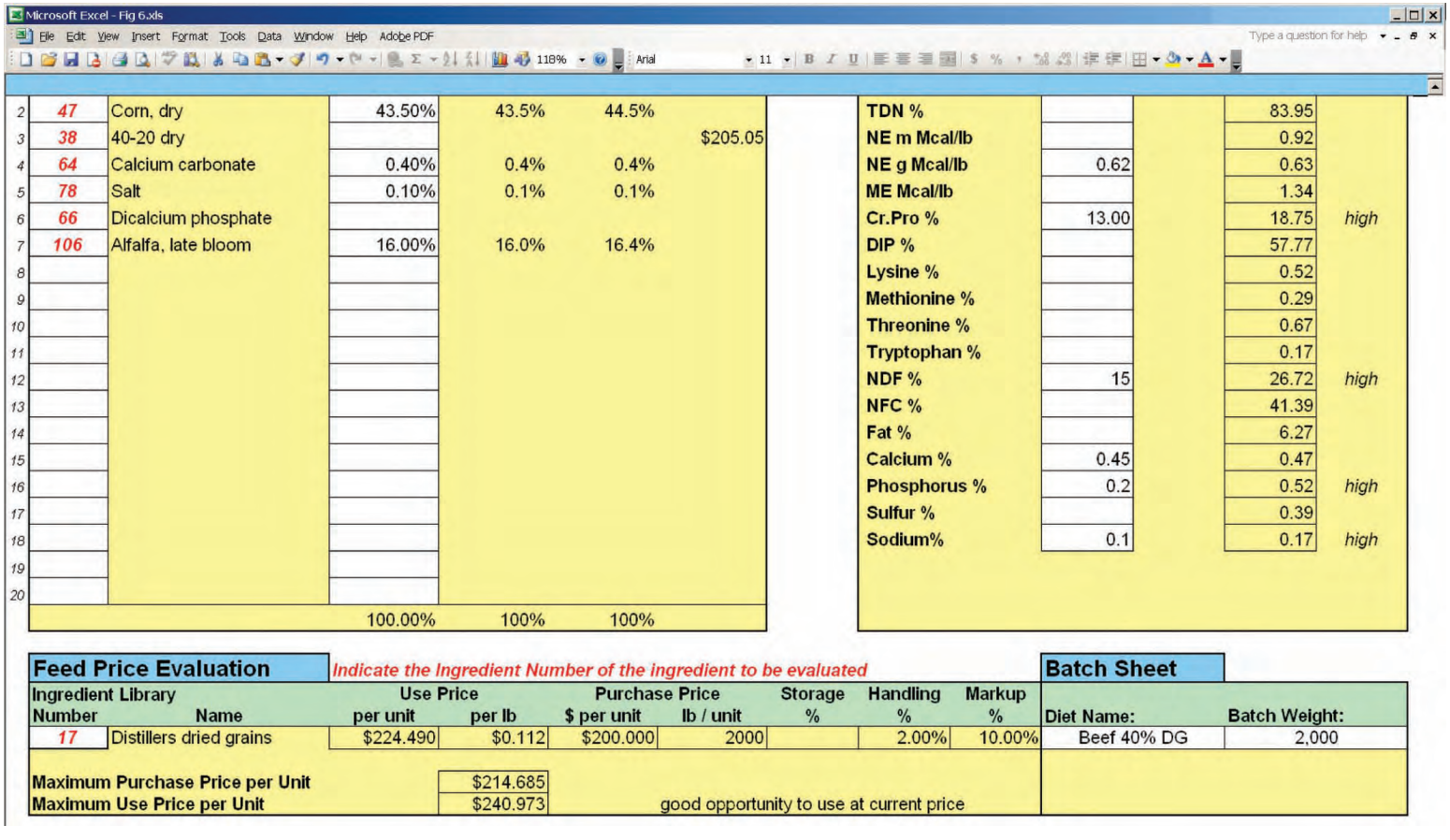


Figure 8.10. Feed price evaluation for distillers dried grains with diet name and batch weight entered

ties and price of distillers dried grains relative to the comparison diet. The calculator holds the prices of all other ingredients constant in this evaluation, and the pricing results of the selected ingredient are given in terms of a maximum purchase price per unit and a maximum use price per unit. A diet name and batch weight can be specified in the *Batch Sheet* box (optional). The batch weight defaults to 2,000 lb.

Step 6. Generate a Summary Printout.
Generate a summary printout by selecting the "Summary Printout" button, located next to the "Calculate" button at the top of the Calculator page. (If the "Summary Printout" button does not work, you will need to re-evaluate your macro security or Trust Center settings because they are preventing the program from functioning.) The summary printout for the example used in Steps 1 through 6 is shown in Figure 8.11. If a batch size was indicated in Step 5, the summary printout will show the weight of each ingredient to be included when the feed is mixed.

Definitions

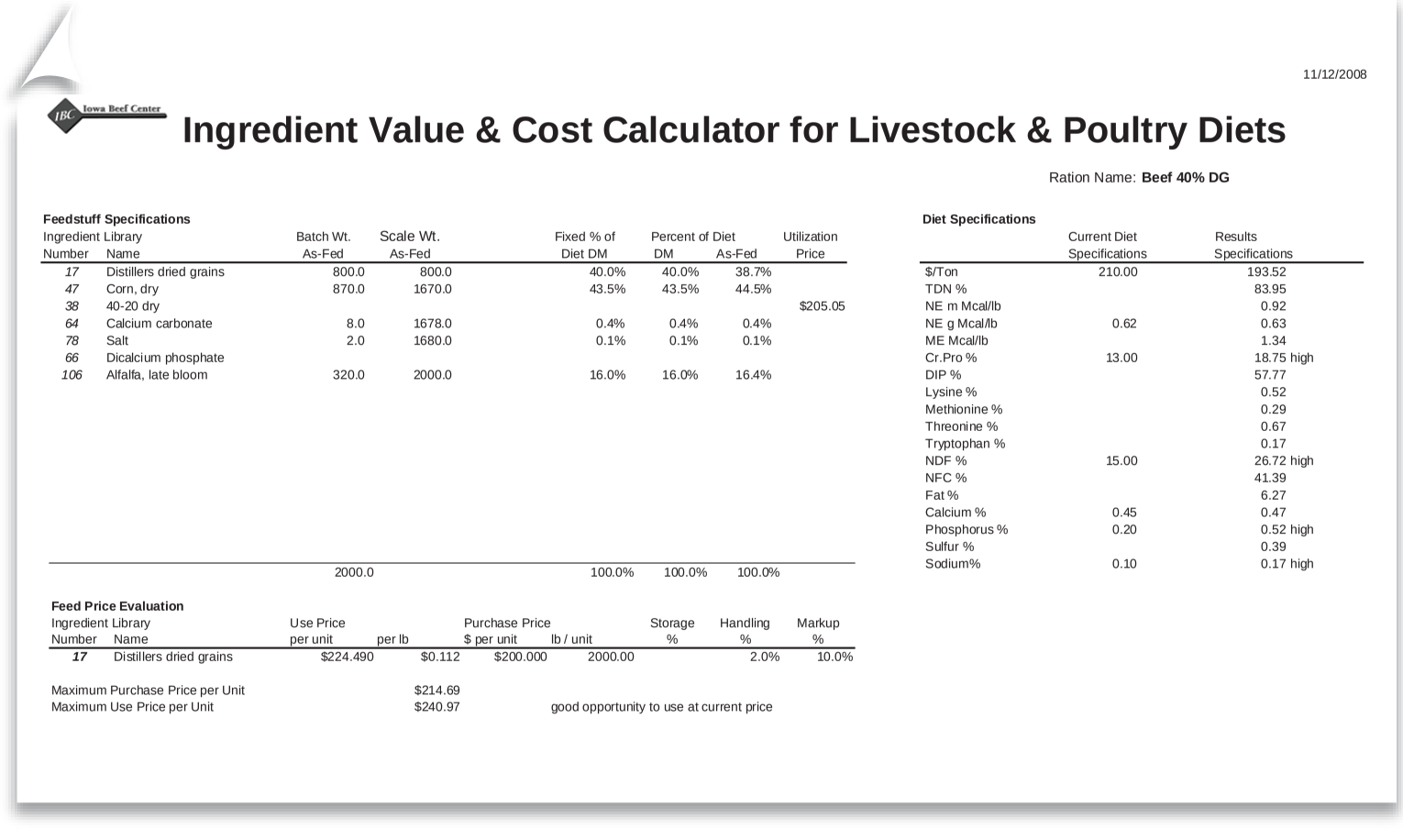
Batch Weight – The weight of a batch of feed for the diet being calculated (optional). If desired, this weight is entered in the *Batch Sheet* box and will appear on the summary printout. The batch weight defaults to 2,000 lb.

Current Diet Specifications – The nutrient specifications that must be met by the diet being calculated in the *Feedstuffs Specifications* box. Only values for the pertinent nutrients need to be entered.

Diet Name – The name of the diet being calculated (optional). If desired, this name is entered in the *Batch Sheet* box and will appear on the summary printout.

Fixed % of Diet DM – Percentage of each ingredient to be used in the diet on a dry matter basis. The user can enter a percentage for any ingredient; the remainder will be calculated.

High/Low Flag – A "low" flag appears next to the nutrient(s) that is deficient if the desired diet specifications are not met by the diet entered in



11/12/2008

Iowa Beef Center

Ingredient Value & Cost Calculator for Livestock & Poultry Diets

Ration Name: **Beef 40% DG**

Feedstuff Specifications

Ingredient Library Number	Name	Batch Wt. As-Fed	Scale Wt. As-Fed	Fixed % of Diet DM	Percent of Diet DM	Percent of Diet As-Fed	Utilization Price
17	Distillers dried grains	800.0	800.0	40.0%	40.0%	38.7%	
47	Corn, dry	870.0	1670.0	43.5%	43.5%	44.5%	
38	40-20 dry						$205.05
64	Calcium carbonate	8.0	1678.0	0.4%	0.4%	0.4%	
78	Salt	2.0	1680.0	0.1%	0.1%	0.1%	
66	Dicalcium phosphate						
106	Alfalfa, late bloom	320.0	2000.0	16.0%	16.0%	16.4%	
		2000.0		100.0%	100.0%	100.0%	

Diet Specifications

	Current Diet Specifications	Results Specifications
$/Ton	210.00	193.52
TDN %		83.95
NE m Mcal/lb		0.92
NE g Mcal/lb	0.62	0.63
ME Mcal/lb		1.34
Cr.Pro %	13.00	18.75 high
DIP %		57.77
Lysine %		0.52
Methionine %		0.29
Threonine %		0.67
Tryptophan %		0.17
NDF %	15.00	26.72 high
NFC %		41.39
Fat %		6.27
Calcium %	0.45	0.47
Phosphorus %	0.20	0.52 high
Sulfur %		0.39
Sodium%	0.10	0.17 high

Feed Price Evaluation

Ingredient Library Number	Name	Use Price per unit	per lb	Purchase Price $ per unit	lb / unit	Storage %	Handling %	Markup %
17	Distillers dried grains	$224.490	$0.112	$200.000	2000.00		2.0%	10.0%

Maximum Purchase Price per Unit $214.69

Maximum Use Price per Unit $240.97 good opportunity to use at current price

Figure 8.11. Summary printout for example used in Steps 1 through 6

the *Feedstuff Specifications* box. A "high" flag appears when the resulting diet exceeds a given nutrient specification by more than 15%. The user can decide whether deficiencies or excesses will present a problem.

Ingredient Library Name – The name assigned to each ingredient in the Ingredient Library. The ingredient library name will automatically appear when an ingredient library number is entered into the calculator.

Ingredient Library Number – The pre-set number assigned to an ingredient in the Ingredient Library. This number is entered for each ingredient that will be factored into the calculated diet, as selected by the user from the first column of the Ingredient Library. The ingredient library name will automatically appear when the corresponding ingredient library number is entered into the calculator.

Maximum Purchase Price per Unit – The maximum price to be paid for an ingredient in the *Feed Price Evaluation* box based on the utilization rate in the diet and the pricing of the other ingredients.

Maximum Use Price per Unit – The maximum price per unit that can be charged for the feed ingredient when it is included in the diet entered in the *Feedstuff Specifications* box. This price is a factor of the initial purchase price after adjusting for storage shrink, handling shrink, and margin requirements (as entered in the Ingredient Library). If no adjustments are made in these three categories, the maximum purchase price per unit and the maximum use price per unit will be the same.

Example: Assume that wet distillers grains can be delivered to a custom beef feedlot at $40.00 per ton. The feed is stored on a slab and used up in two weeks. Based on previous research data, there is 3% shrinkage in the quantity purchased compared with the quantity delivered. This shrink occurs from loading, delivery, and unloading. Then, based on storage time, an additional 10% shrinkage can be observed when measuring the weight delivered to the feedlot versus the weight delivered to the pens of cattle. Therefore, the use price must cover this 13% loss in product up front in the billing procedure by increasing the use price by 13% above purchase price. A margin can then be added to this price to cover the costs of providing this ingredient in the ration. If we set the margin at 10% for this example,

the maximum use price per unit totals $50.57 per ton fed. Because not all feeds have the same handling shrink, storage shrink, and margin requirements, the user can enter these values in the Ingredient Library for each individual ingredient. The purchase price and use price are then evaluated in the context of the ration provided to arrive at the maximum purchase and maximum use prices. If these maximums are less than the current pricing, the calculator indicates that the product is not a good buy.

Percent of Diet As-Fed – Percentage of the diet each ingredient contributes on an as-fed basis. The Batch Sheet used for mixing feed ingredients is based on these percentages, multiplied by the desired batch size.

Percent of Diet DM – Percentage that each ingredient contributes to the diet on a dry matter basis. These values should match the amounts in the column labeled *Fixed % of Diet DM* once the diet is complete.

Results Specifications – The nutrient specifications for the diet entered in the *Feedstuff Specifications* box.

Use Price – For the distributor, the use price is the price per pound that must be charged on the outgoing ingredient to satisfy shrinkage losses and provide the necessary margin to maintain the business. For the producer, the use price is the price per pound that will be paid for the ingredient plus the cost of shrinkage.

Utilization Price – The price to which a given feed ingredient must be reduced before the program will consider using it in the diet formulation.