SDSU Extension

BEEF

Chapter 15

Computerized Ration Balancing for Beef Cows

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Introduction

Least cost ration development is an economical way to evaluate a feeding program and determine the best alternatives for an operation. This is a multiple step process that can help ranchers make feed and nutrition management decisions based on the most economically viable choice for their operation. This process includes determining the nutritional value of their feedstuffs, the nutrient requirements of their cattle, and then designing a feeding program using these feeds that meets the nutrient needs of the animal.

Feed Analysis

The first step in the process is to inventory feedstuffs that are currently available and being considered for feeding to cattle. This can include hay or silage that you have produced or purchased, as well as concentrate feeds such as cereal grains (e.g., corn, oats), byproducts such as distiller's grains, and so forth. Collect samples from each of these feeds and have them analyzed to determine nutrient content. For more information on proper sampling techniques and laboratories that conduct the analysis, see Chapter 16, Feed Testing and Interpreting the Results. When evaluating the feed analysis results for cows, the key components include protein (crude protein, [CP]), energy (total digestible nutrients [TDN], net energy for maintenance [NEm], and net energy for gain [NEg]), fiber (acid detergent fiber [ADF] and neutral detergent fiber [NDF]), minerals (Ca, P, Mg, K, and possibly trace minerals), and dry matter (DM). Once the existing inventory of feeds or forages have been analyzed, the results can be used in a ration balancing program to develop balanced rations or determine potential nutrient deficiencies or excesses (potential toxicity) that may require additional feedstuffs to overcome. If necessary, a nutritionist should be consulted to ensure accurate interpretation of results.

Other factors affect how well the feeds within the ration will work to meet nutrient requirements of the cows. For example, when working with high moisture or low quality feed, animals may

Key Points

- Least cost ration balancing is important to ensuring economic viability of cow-calf producers.
- Multiple tools are available to assist with ration balancing.
- Feeds need to be compared on an equal dry matter basis to determine the feed or supplement that is the most economical choice for the situation.

not be able to physically consume enough feed in a 24 hour period to meet requirements. Other examples include consideration of potentially toxic levels of compounds or negative effects on digestibility when certain feeds are mixed (Chapter 18, Supplementation of Beef Cows and Chapter 21, Plant Toxicities, Defensive Chemical Compounds, and Other Feed Concerns).

Nutrient Requirements

The next step in the process is to consider the nutrient requirements of the cow. The main question is will the protein, energy, and other nutrient needs be met? What stage of production is she in and are the protein and energy levels high enough to maintain digestibility and performance? Are calcium and phosphorus levels adequate and are there other mineral considerations or concerns? For further information, see Chapter 14, Nutrient Requirements of Beef Cows. Resources are available that provide tables that list nutrient requirements (NRC, 1996), however computer ration balancing programs contain formulas that compute requirements based on inputs that describe characteristics of the cows, such as size, breed, stage of production, and level of milk production.

Once the needs (requirements) are determined, alternatives to meet the needs can be evaluated. In developing rations, either protein or energy will most likely be the most limiting nutrient. Therefore it is critical to identify available feedstuffs to use as protein or energy feeds, based on need. Examples of protein feeds include distillers' grains, soybean meal, range cubes, alfalfa hay, or high protein cooked tubs. Examples of energy supplements are corn, grass hay, small grains, distiller's grains, or sugar beet pulp. Energy supplements are divided into fiber-based and starch-based supplements. The fiber-based supplements are a safer alternative to the starch-based supplements in the rumen environment (see Chapter 18, Supplementation of Beef Cows).

Ration Balancing

Once feeds have been analyzed and animal performance goals set, a computer ration-balancing program should be used to ensure that all nutrient requirements are met and performance is at the desired level. By utilizing such a program, producers ensure that the management decisions being made are based on a detailed analysis of the feeds available to the operation and the associated costs. Multiple software programs are available for free through university websites or for purchase from companies. Despite the convenience of these programs, a strong nutrition background is needed to accurately interpret results ensuring that necessary precautions are taken, and that all feeding factors are considered. Most ration balancing programs work through three steps: describing the cow so that requirements can be set by the program, listing feeds with their nutrient contents, and then feedstuffs are chosen based on the best combination to meet the requirements.

In general terms, there are two kinds of computerized ration balancing programs, least-cost ration balancing and ration analysis. As the names imply, the first kind focuses on cost control and the second kind focuses on analyzing the nutrient balance of a ration.

Least-cost ration programs are designed so that once the cows are described, the nutrient requirements are set, and feedstuff nutrient contents are listed, the program uses computerized linear programming to pick the feed levels that meet or exceed the minimum level for each nutrient using the most inexpensive (least cost) combination of feeds possible. While this approach is great for minimizing cost, a least cost program does not consider the implications of ruminant nutrition beyond meeting minimum requirements. For example, if corn grain is cheap and hay is expensive, the program is likely to balance a ration that is entirely corn grain without considering the need for roughage to maintain rumen function and health. They also focus on exceeding minimum requirements without concern for staying below toxic levels, which can be a dangerous issue with some of the trace minerals. The better quality least-cost ration balancing programs allow setting thresholds such as a minimum amount of roughage feedstuffs or maximum levels of minerals. However, a certain amount of nutritional wisdom is needed to ensure that a least-cost ration is also safe and viable to feed.

In contrast, ration analysis software typically includes another step. After setting requirements

and listing feeds, the computer user inputs the level of each feed that they would like to use and then the program indicates if these feed levels will meet nutrient requirements. Typically, these programs also show predicted levels of performance. If nutrient requirements and performance goals are not met, then inputs can be adjusted until goals are met. In a cow-calf operation since a producer will want to make optimal utilization of any base forage or feedstuff that is raised on the farm or ranch, the ration analysis approach works great. A producer can start by using just the farm- or ranch-raised feeds in the program to maximize their use and only add purchased feeds as needed to meet nutrient requirements and performance goals.

Example Ration Analysis Program: OSU Cowculator

One example ration analysis program is Oklahoma State University's CowCulator which is a software program designed to assist cattlemen in making informed decisions associated with beef cow nutrition. This program is a Microsoft Excel spreadsheet program that can be downloaded for free from the OSU Beef Extension website. This program is relatively user friendly making it easy to determine whether or not nutrient needs are being met to reach desired performance goals. However, some basic guidelines and general nutrition knowledge is needed for successful use of the program. Operating instructions for this program can be downloaded at the OSU website.

After the program has been downloaded, the user should become familiar with its layout and have an understanding of inputs needed and how to interpret results. The CowCulator program is divided into five screens, which are accessed by clicking on the appropriate tab at the bottom of the screen. These tabs include Conditions, Feed List, Balancer, Summary, and Forage Value. The only areas in any of the screens that information can be entered into and edited have a red background.

The first screen to open is "Conditions". This screen allows the user to define the feeding period and type of animal being considered. This information is used to calculate the animal's nutrient requirements. In the first section at the top of the screen, enter the situation to help track multiple rations. The second area is labeled "Management and Stage". In this section, the number of cows, average calving date, weaning date, and stage of production for a specific ration are entered. Nutrient requirements change based on stage of production (NRC, 1996) (See Chapter 14, Nutrient Requirements of Beef Cows). Therefore, rations need to be adjusted for those changes. Based on calving date and weaning date, the program generates a table suggesting dates that should be closely related to the four different stages of production: mid gestation, late gestation, early lactation, and late lactation. Based on the stage of production that the producer wants to evaluate a feeding program for, the user will then enter the appropriate code or number (1, 2, 3, or 4) in the blank labeled Stage of production. The next section of the screen that needs to be completed is labeled "Feeding Period". This can be specific dates, or a stage of production can be selected based on the timeframe of focus by selecting the corresponding dates. Please note: The program calculates nutrient requirements based on the stage of production code entered (1, 2, 3, or 4) not the entered feeding period. The final section in the "Conditions" screen is labeled "Description of the Cows". This section includes body weight, current body condition score, desired body condition score, and calf birth weight. The accuracy of this information will increase the accuracy of the overall ration in meeting nutrient requirements. The difference between the Initial and Desired Body Condition Score will determine the amount of weight gain or loss targeted during the feeding period. Breed composition and milk production are also included in this section. In most cases, select "2" for average milk production, unless you are specifically selecting for high or low milk production within the breed.

The next screen to work with is the "Feed List". This screen lists a number of feeds divided into the following categories: forage and roughages; commercial feeds; feed grains and oil seeds; byproducts; and vitamins, minerals, and additives. The number to the left of the Feed Name is used to identify each feed when importing feeds into the Balancer page. These numbers are specific to each row and cannot be changed. However, the Feed name and associated nutrient specifications can be

changed. It is recommended that one have their actual feedstuffs analyzed by a lab as described in the Feed Analysis section at the beginning of this chapter.

This allows the producer to enter actual nutrient analysis for feeds which will increase the accuracy of the ration formulation. Any feedstuffs that you want to evaluate that are not already listed in this screen can be entered in any blank rows. Please note: Nutrient concentrations for columns labeled Protein, TDN, Ca, and P are entered on a dry matter basis. Whereas, entries required for columns labeled #/Unit and $/Unit should be entered on an "as fed" basis. The program automatically calculates and enters the NEm content based on the entered TDN value.

Once the feeds have been edited, take note of the "Feed Number" and open the screen labeled "Balancer". The desired feed numbers will be entered in the left red column on the "Balancer" screen. This will bring up the name of each of the feeds. If a name does not come up correctly, check to make sure you have entered the correct number. Next, enter the amount (lbs on an as fed basis) of each feed to be provided in the right hand red column to determine if the ration is appropriate for the situation. The program calculates an "Intake Ratio", "Protein Ratio", "Estimated Average Daily Gain", "Desired Average Daily Gain", "Days to gain or lose one condition score", and the "Cost/Day". All of these provide valuable information, and the key is to adjust the amounts of each feedstuff while making sure to use the following "rules" to meet nutrient requirements for your animal production goals.

1. Base forage (e.g., crested wheatgrass hay, winter range) use should be maximized, as this is likely the cheapest feed source and is likely to have been produced from the land assets that support the cow herd.

2. Keep starch-based feed (e.g., grain) utilization within limits (generally ≤ 10% of ration DM). Too much starch can lead to a decrease in the rumen pH, resulting in fewer fiber digesting microbes and decreased efficiency (see Chapter 18, Supplementation of Beef Cows).

3. Intake ratio must be less than or equal to 1.0. This is the ratio of actual to predicted intake. If this number is over 1.0, expected actual intake exceeds the prediction of what the animal can possibly hold in its rumen, and the animal likely cannot consume enough of the feed to get the performance the program is predicting.

4. Protein ratio must be greater than or equal to 1.0. This is the ratio of actual protein intake to the animal's protein requirement. This is best slightly higher than 1, such as 1.02 to ensure that adequate protein is available for the rumen microbes as well as the cow herself.

5. Non-protein nitrogen, such as urea, can be utilized as a protein supplement for high forage diets, however there are limitations to the level of inclusion. Research has indicated that the maximum recommended inclusion of urea in protein supplements for low quality forage diets is 30% of the supplemental protein (Clanton, 1978, also see Chapter 18, Supplementation of Beef Cows).

6. Energy balance must provide appropriate ADG and BCS change. This will be determined by comparing Estimated ADG to Desired ADG. If the Estimated ADG is below the Desired, then the energy in the ration is lower than needed. The value provided for the days to gain or lose one body condition score also provides a valuable measure of adequacy of energy intake to meet the goals for the cattle.

7. Daily cost of the ration must be minimized. Multiple feed options are available, but the key is to determine the most economical and easy to use feedstuffs for a specific operation.

Once the ration that is going to work best has been determined, select the screen labeled "Summary" to get a breakdown of costs and quantities of feeds needed for the feeding period. This can be printed out to know how much of each feed is needed daily and for the entire feeding period, along with their associated costs.

Example Rations

Here is an example of using the CowCulator program for a winter cow feeding scenario with step by step directions to walk through developing a ration for the Sample Ranch.

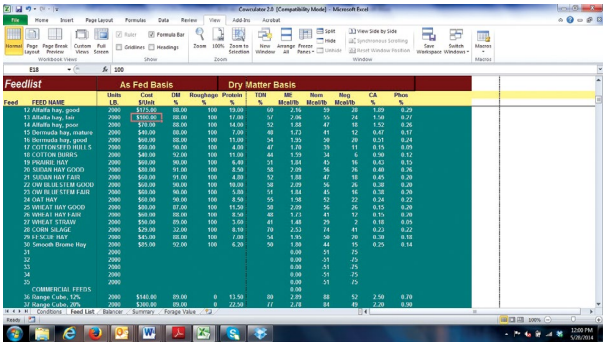
1. Feeds: Begin by entering the feed ingredients being considered for feeding to your cattle on the "Feed List" screen. This can include raised feeds and others feeds that could be purchased as supplements. First, you have produced some smooth brome hay on which you have had nutrient analyses done. Enter in feed number 30 the following nutrient values:

   Dry matter = 92%
   TDN = 50%
   Crude protein = 6.4%
   Ca = 0.25%
   P = 0.14%

Enter the following prices on the "Feed List" screen for your hay and possible supplemental feeds in the column labeled "Cost $/unit. Please note: The Units column indicates (in pounds) the units in which feed is priced in the $/Unit column. For example, if corn is priced on a bushel basis, the user enters 56 in the Units column (56 lbs per bushel) and the price per bushel in the $/Unit column. If corn is priced per ton, the user enters 2000 in the Units column.

Feed 30, smooth brome hay: $85/ton
Feed 12, alfalfa hay (good): $175/ton
Feed 37, Range Cube 20%: $300/ton
Feed 47, corn grain: $4.77/bu or $170.36/ton
Feed 61, corn distillers grains: $240/ton

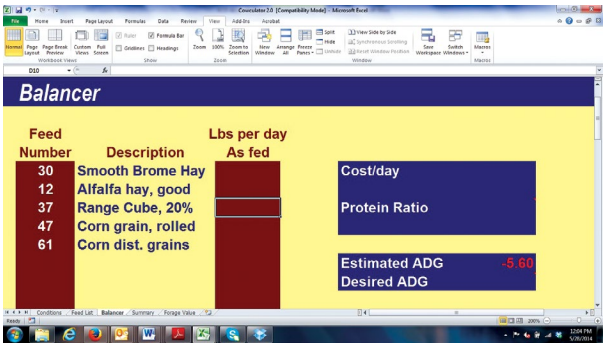
The following screen shot shows what the "Feed List" screen looks like.



Choose the feeds from the "Feed List" screen that you want to consider using and enter the number for these feeds in the Feed Number column on the "Balancer" screen. The feeds to use on the "Balancer" tab include:

Smooth brome hay (Feed 30)
Alfalfa hay, good (Feed 12)
Range cube 20% CP (Feed 37)
Corn grain (Feed 47)
Corn distiller's grains: (Feed 61)

This is illustrated in the screen shot.



2. Balance (analyze) rations to feed mature cows in the following weights and body condition scores from calving to breeding.

   a. 1300 lb mature weight cow, BCS = 5, late gestation (50% Angus X 50% Hereford)

   b. 1300 lb mature weight cow, BCS = 4, late gestation (50% Angus X 50% Hereford)

   c. 1300 lb mature weight cow, BCS = 4, early lactation (50% Angus X 50% Hereford)

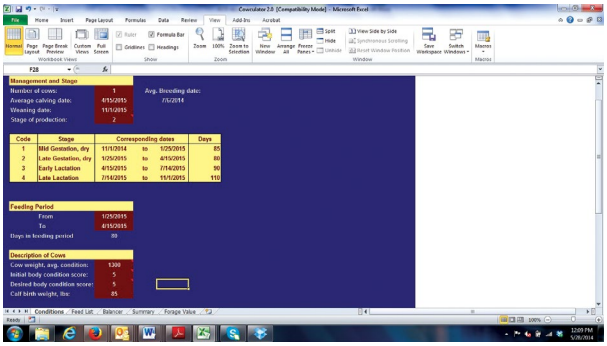
   d. 1700 lb mature weight cow, BCS = 4, early lactation (75% Simmental X 25% Angus)

To do this you will need to use the "Conditions" screen.

- The number of cows is 1 (just to make this example simple)
- Average calving date will be April 15, 2015.
- Weaning date will be November 1, 2015.
- The feeding period for late gestation cows will be the entire 80 days of that stage of production

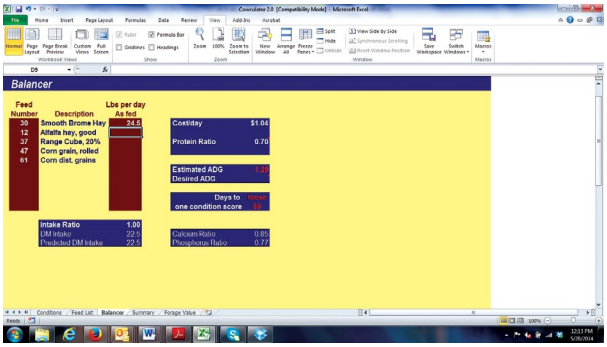
- The feeding period for early lactation will be first 60 days of that stage of production
- Expected calf birth weight is 85 lb for Angus X Hereford cows and 95 lb for Simmental X Angus cows
- All cows have average milk production

The following screen shots will be for scenario "a". described above. The other scenarios (b, c, and d) are examples to work through on your own.

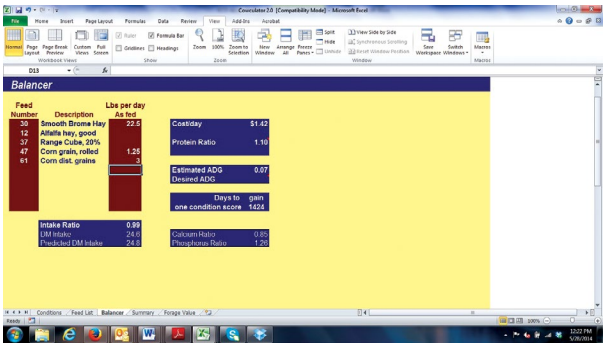


Adjust the amount of feed on the "Balancer" screen until you meet the animal's requirements. ***Remember, your objectives are to optimize utilization of your base forage (smooth brome hay), keep the ration as inexpensive as possible, and meet the nutrient requirements of both the rumen microbes and the cow. Keep the rules outlined above in mind as you work through the examples.***

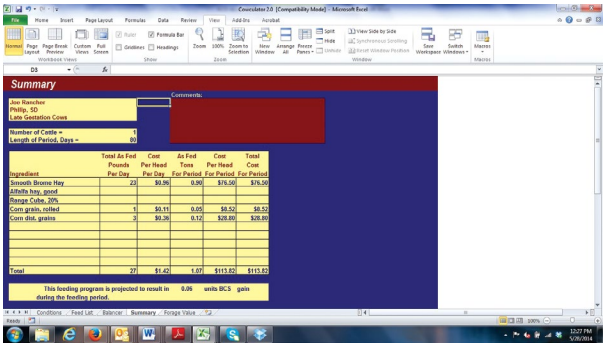
This ration is using only Smooth Brome Hay. Notice "Protein Ratio" and "Estimated Average Daily Gain". The ration needs additional protein to meet the cow's requirements (i.e., with a protein ratio of 0.70, only 70% of the protein requirement is being met).



This ration is balanced at a maintenance diet for $1.42/head/day. "Intake Ratio", "Protein Ratio", "Estimated ADG" and "Days to change one BCS" are all within the range needed without exceeding the maximum amount of starch added to the ration.



From this point, the "Summary" screen will bring all the information together regarding quantity of feed needed and cost per head for the feeding period.



Summary

Ration balancing is key to ensuring that nutrient requirements are met and least cost rations help ensure the continued economic viability of the ranch. Always test feeds first to determine the need for a supplement and whether protein or energy is needed. Once the supplements have been determined, multiple tools are available to calculate rations on a least cost basis. Find a program that is user friendly, providing the information needed to help reach animal performance goals. If there is a challenging situation, seek professional assistance to help work through the situation.

References

Clanton, D.C. 1978. Non-protein nitrogen in range supplements. J. Anim. Sci. 47:765-779.

NRC. 1996. Nutrient Requirements of Beef Cattle. 7th rev. ed. Washington, D.C., National Academy Press.