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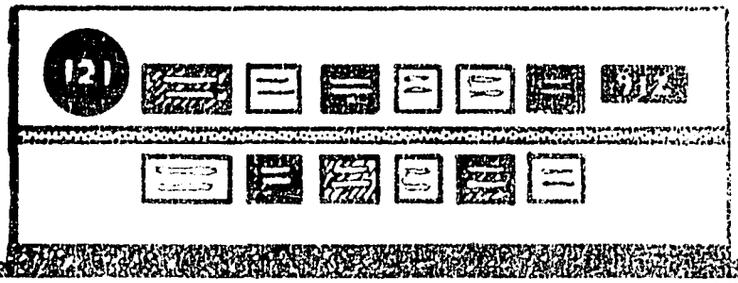
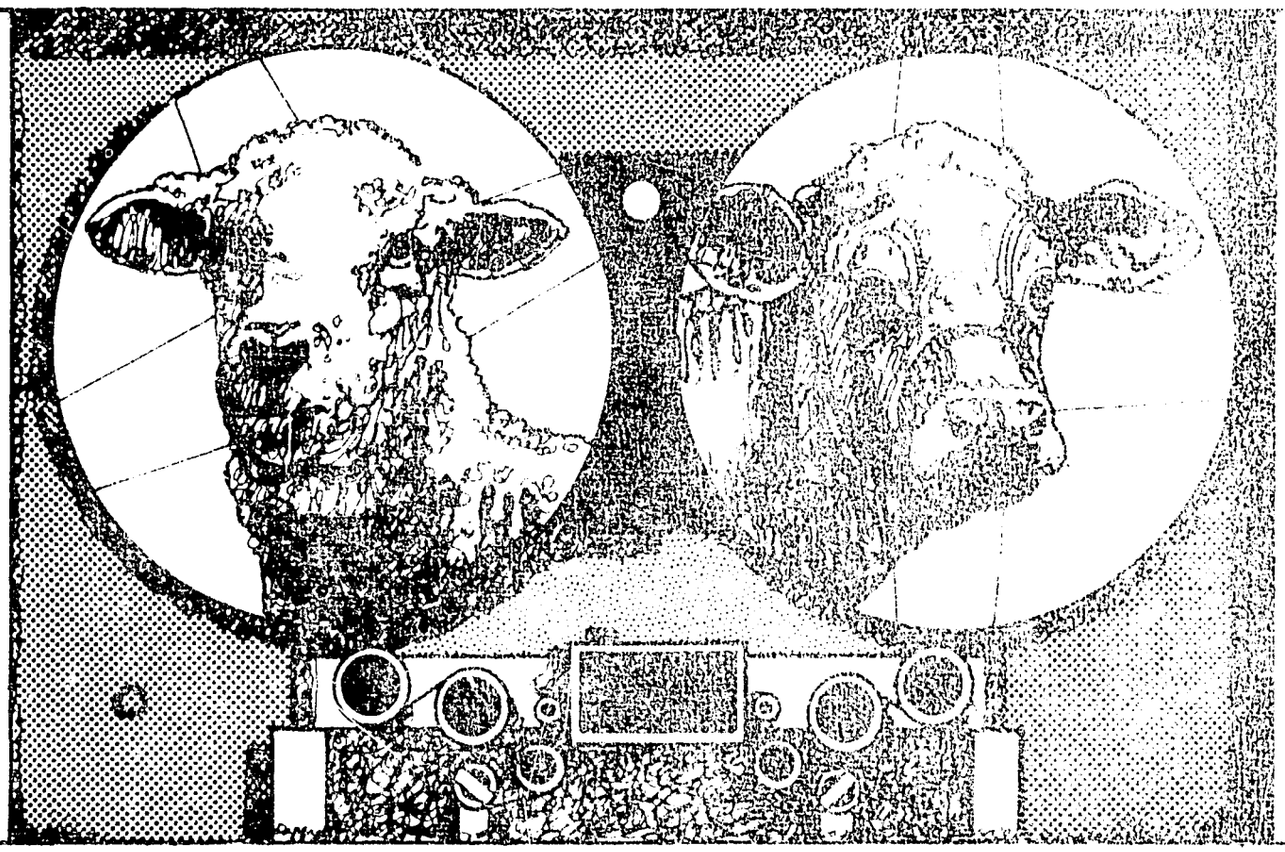
MAXIMIZING PROFITS BY USE OF A COMPUTER TO CALCULATE DIETS FOR DAIRY AND BEEF CATTLE AND SHEEP





Cooperative Extension Service
International Feedstuffs Institute
Departments of Animal and Dairy Sciences

Utah State University
Logan, Utah 84322

1974

Educational and employment opportunities without discrimination

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FOREWORD

In this circular we present information about, and outline procedures for, calculating diets for livestock by computer. The process should be useful to all who are concerned about the nutrient requirements of, and the formulation of, diets for beef cattle, dairy cattle and sheep.

Properly used, the techniques described [illegible] in maximizing profits from dairy and beef cattle [illegible] sheep operations. The circular was prepared by the [illegible] Advisory Committee.

MAXIMIZING PROFITS BY USE OF A COMPUTER TO CALCULATE DIETS FOR CATTLE AND SHEEP

Summary — How You Can Use the USU Computer to Obtain Least-Cost, Balanced Diets for Your Beef or Dairy Cattle or Sheep

You can take advantage of the computer service at Utah State University to save money on feed formulations of diets that will do the job you desire at least cost. This computer service is being made conveniently available to you. As portable remote terminals can be obtained, these will be used by an Extension specialist at your location to feed the necessary information directly into the computer via telephone. The calculated least-cost ration information will be fed back quickly through the terminal that will supply a typed printout for you. In the meantime, you can receive benefit of the computer service, but not so quickly, by phoning or mailing in the information and receiving your computer printout information by phone or mail.

The information you must supply for the USU Computer to calculate the diet you want is indicated on Ruminant Program Forms 1 through 5, for each diet. Note that Form 5 asks for the chemical analyses of your own feeds, if you have this information. (Extension Circular 366A tells how to get it.) If you don't have these analyses, the computer will use generalized feed nutritional information that has been stored in it. When you have the forms completed, phone or mail them to your Extension specialist listed below. He will see that you get the computer-calculated diet information to use in feeding your animals.

Professor John J. Barnard
Department of Dairy Science
Utah State University, Logan, Utah 84322
Phone: 752-4100, extension 7429,

Dr. Norris J. Stenquist
Department of Animal Science
Utah State University, Logan, Utah 84322
Phone: 752-4100, extension 7422.

An example of possible saving is as follows: One rancher stated that this program, used in his feedlot operation for 2500 head of cattle, had reduced his costs by $150 daily, for an annual savings of $54,000.

Introduction

At Utah State University, two new programs have been developed to help farmers, ranchers and feed dealers. In the first, University personnel analyze feed or diet samples. This service is described in Extension Circular 366A. In the second program, described in this circular, the computer facilities at the University can be used to compute economical optimum diets for livestock and thus maximize profits or minimize losses. Livestock men and feed dealers are given access to computer data banks which have cost millions of dollars to research and develop. The cost to each user is only a tiny fraction of the original investment.

This is your invitation to participate in using computers via remote terminals located in the Extension Service offices. The simplicity of submitting data and the ability of the computer to make simultaneous calculations of many complex algebraic equations makes this a useful tool in making livestock management decisions.

The diet-balancing system consists of four major components:

- A computer which may be many miles away
- Computer programs
- Data banks containing both feed composition and animal nutrient requirement data
- Communication facilities

Computer Center

Utah State University has a Burroughs 6700 computer, which can calculate balanced diets, rations or feed mixtures at least cost (Figure 1). The computer can simultaneously handle requests from several sources, such as

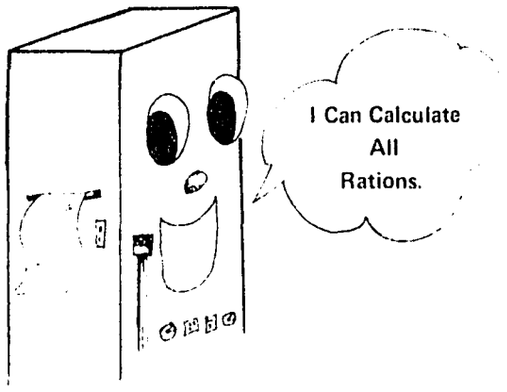

Figure 1
The computer makes all the calculations to make up a diet, ration or feed mixture at least cost given a specified level of animal performance.

farmers living in the various Extension districts in Utah.

A special computer program has been designed to help livestock men by formulating balanced, economic optimum livestock diets. When desirable, several comparable programs developed elsewhere may be used

Data Banks

Feed composition data accumulated at Utah State University over the past twenty-five years form one of the most comprehensive collections of its kind in the world. These data are being used in all the National Research Council nutrient requirement reports. The terminology used at Utah State to describe the feeds has been accepted by the International Network of Feed Information Centers (INFIC). Utah State University is correlating feed composition data for INFIC which includes Australia, Canada, Germany, the Food and Agriculture Organization of the United Nations (FAO), the Agency for International Development (AID), and the United States. If these data do not include the information on a given feed, it can be obtained from other sources.

The nutrient requirements of animals, as established by the Animal Nutrition Committee of the National Research Council, are already stored in the computer or can be calculated from equations. The feed composition and nutrient requirement data banks are available to anyone desiring the service.

If a user has had his feeds chemically analyzed or assayed and wants to use that information, or if he wishes to use specific bits of analytical data that differ from what is stored in the computer, he can fill in Form 5, page 19. For instructions on how to obtain chemical analyses on your feeds see Utah State University Extension Circular 366A.

Communications

Communications between computer and user are by telephone. An extension livestock specialist at an individual farm or feed plant can use a portable terminal to communicate pertinent information directly to the computer via a telephone (Figure 2). The computer can then make the necessary calculations and return the signals to the terminal for a printout of the economic optimum diet, ration or feed mixture.

Information may also be given over any telephone to Extension personnel at Utah State University who in turn will have the formula calculated by the computer and return the recommendations by phone or mail, as desired. The input data may also be sent in by mail, which is usually dependable but time consuming.

Figure 2
A portable terminal may be plugged into an electrical outlet on a farm or at a feed mill. An operator connects the terminal to the central computer at Utah State University by phone. The operator types in the costs of the feeds and codes to designate to the computer the animal nutrient requirements and feeds to be used. The central computer calculates the animal diet and the portable terminal prints out the least cost one.

Instructions for Calculating a Diet, Ration or Feed Mixture

The information needed before the computer can calculate a diet is outlined in Forms 1 to 5. The forms can be obtained from Extension personnel and must be completed before contacting an operator or mailing your request. At the present time, phone or mail data to one of the following:

- Professor John J. Barnard
  Department of Dairy Science
  Utah State University, Logan, Utah 84322
  Phone 752 4100, extension 7429,

- Dr. Norris J. Stenquist,
  Department of Animal Science
  Utah State University, Logan, Utah 84322
  Phone 752 4100, extension 7422

Minimum charges are currently being made for these services. Exact charges will be with the forms you obtain from the Extension Livestock or Dairy Specialist or from County or Area Extension Offices. As experience is gained the charges may have to be revised. The costs will be kept [illegible] to encourage extensive use of the program.

EXPLANATION OF THE COMPUTER PRINTOUT

Section I. Animal and Ration Requirements

A sample computer printout of the data you give to the Extension Specialist is presented below. It can be divided into four main sections. Part 1 of section I gives the ration restrictions and Part 2 gives the ration requirements.

```
LEAST COST RATION SYSTEM (BEEF)          USU - ANIMAL SCIENCE DEPARTMENT
          MILES FERRY 685 LB STEER RATION

* * *  RATION RESTRICTIONS  * * *

ANIMAL TYPE                                          STEER
WEIGHT                          LB                   685.0
GAIN                            LB DAY                2.80
MAXIMUM DRY MATTER INTAKE       LB                   16.64
NET ENERGY FOR MAINTENANCE      KMCAL DAY           5698.5
NET ENERGY FOR PRODUCTION       KMCAL DAY           5771.8

* * *  RATION REQUIREMENTS * * *

                                MINIMUM             MAXIMUM
CRUDE PROTEIN                    12.18               17.00
DIGESTABLE PROTEIN      %         8.04               12.00
CRUDE FIBER             %         8.00               40.00
CALCIUM                 %         0.44                1.24
PHOSPHORUS              %         0.31                0.41
ROUGHAGE FACTOR         %        10.00              100.00
DRY MATTER              LB %     35.00
```

Part 1 states the kind of animal, its weight and pounds of anticipated gain (or pounds of milk and percent butter fat when applicable) and the daily dry matter intake. From this information, the computer calculates the total net energy required for maintenance and production using equations for animal requirements as established by the National Research Council (NRC).

When formulating rations, some acceptable minimum and maximum levels of nutrients must be utilized as reference points (Part 2). Usually NRC standards establish the minimum level and the judgment of the nutritionist will define the maximum amount of a nutrient permitted in the ration. This allows the computer some flexibility in calculating a ration that will meet the nutritional requirements at least cost. If fixed amounts such as the minimum requirements were imposed as absolutes for all nutrients, the computer might not be able to meet those restrictions at least cost, thus defeating the purpose in its use. This program stipulates only the amount of net energy as requisite and permits the other nutrients to float within fixed limits.

Section II. Feeds Considered, Their Cost per Ton, Composition and Restrictions Imposed -- also Feed Ratios

Information about approximately 325 feeds has been taken from the NRC beef cattle, dairy cattle, and sheep reports and stored in the data bank.* When composition data are available from samples of a farmer's home grown feeds, these values are substituted in place of the generalized values in the data bank. You are therefore encouraged to have analyses made on samples of your own products (see Extension Circular 366A).

After these data are defined in the computer, we can impose any desired restrictions on the individual feeds being considered in formulation of the ration. Such restrictions may be necessary due to a feed's limited availability or because excess amounts of it may be harmful to the animal. Instructions may also be inserted into the computer to force a certain amount (e.g., of salt) or to insure that a plentiful feed is used (as desired by the feeder) in the ration. Such restrictions may be imposed in terms of percent, on a "dry" basis, or in pounds on an "as fed" basis. Careful consideration should be given before making such modifications, however, as each restraint adds to the cost of the ration.

In the example below, the cost per ton ("as fed" or as purchased) is given in the first column. The cost on a dry matter basis is given in the second column. The percentage of dry matter in each feed is given in the third column.

Part 1

FEEDS CONSIDERED DURING THIS FORMULATION

FEED	AS IS COST	DRY COST	DRY MATTER		RESTRICTIONS	
CORN,DENT YELLOW 52LBS/	120.00	139.53	86.00		0.00	0.00
BARLEY GRAIN	120.00	134.83	89.00		0.00	0.00
SOYBEAN MEAL, SOLV-EXTD	228.00	256.18	89.00		0.00	0.00
COTTONSEED MEAL SOL 41%	245.00	267.76	91.50		0.00	0.00
BEETPULP/MOL, DEHY	97.00	105.43	92.00	LT	20.00	0.00
SALT	22.00	22.00	100.00	EQ	0.50	0.00
DYNAFUS	183.00	183.00	100.00		0.00	0.00
LIMESTONE, GRND	22.00	22.00	100.00		0.00	0.00
UREA	165.00	165.00	100.00	LT	0.90	0.00
CORN, ENSILED, 30% DM	19.00	73.08	26.00		0.00	0.00
ALFALFA-ORCHARD,EN, 50%	18.00	51.43	35.00	LTLB	3.00	0.00
ALFALFA MID-BLOOM	55.00	65.24	84.30	LTLB	6.00	0.00
LIQUID SUP 29. PR 1.0 P	105.00	161.54	65.00	EQLB	4.00	0.00
OATS, ENSILED	18.00	56.78	31.70	LTLB	2.00	0.00

*USU scientists compiled these data

Part 2

FEED COMPOSITION

	DIG. PROTEIN	CRUDE FIBER	CALCIUM	PHOS.	NEM	NEP
CORN, DENT YELLOW 52LBS/	7.60	2.30	0.02	0.29	1034.8	671.7
BARLEY GRAIN	9.80	5.60	0.09	0.47	966.8	635.4
SOYBEAN MEAL, SOLV-EXTD	43.80	6.70	0.36	0.75	876.0	585.5
COTTONSEED MEAL SOL 41%	36.30	13.10	0.17	1.31	767.0	503.8
BEETPULP/MOL, DEHY	6.50	17.40	0.61	0.11	921.4	608.2
SALT	0.00	0.00	0.00	0.00	0.0	0.0
DYNAFOS	0.00	0.00	24.00	18.50	0.0	0.0
LIMESTONE, GRND	0.00	0.00	33.84	0.02	0.0	0.0
UREA	243.80	0.00	0.00	0.00	0.0	0.0
CORN, ENSILED, 30% DM	4.90	26.30	0.28	0.21	708.0	449.3
ALFALFA-ORCHARD,EN, 50%	9.40	30.50	0.00	0.00	521.9	199.7
ALFALFA MID-BLOOM	12.10	30.90	1.35	0.22	562.8	267.8
LIQUID SUP 29. PH 1.0 P	22.79	0.00	1.00	1.00	785.0	525.0
OATS, ENSILED	5.50	31.60	0.37	0.30	576.4	290.4

The beet pulp was restricted to less than (indicated by "LT") 20 percent (dry matter) of the ration. Salt is restricted to 0.5 percent dry matter (indicated by "EQ") of the ration, urea to not more than 0.9 percent of the dry matter; alfalfa orchardgrass silage to not more than 3.0 pounds (as fed) as indicated by LTLB; alfalfa hay, midbloom to not more than 6.0 pounds (as fed), liquid supplement to ~~not more than~~ equal 4 pounds (as fed) and oat silage to not more than 2 pounds (as fed).

If desired, the amount of one feed can be correlated with that of another. This permits feeds to be blended into the ration on a percentage basis, i.e., 3 pounds of barley to 1 pound of beet pulp, or 10 pounds of alfalfa hay to every 3 pounds of beet molasses.

The second part of this section gives the composition of the feeds available for feeding in terms of digestible protein, crude fiber, calcium, phosphorus, net energy for maintenance (NEM), and net energy for gain (NEG). For dairy cattle this would be net energy for lactating cows (NEL).

Section III. Feeds Rejected from Consideration on the Basis of Cost

FEEDS REJECTED FROM SOLUTION

	PRESENT COST	FEASIBLE COST
SOYBEAN MEAL, SOLV-EXTD	228.00	99.57
ALFALFA-ORCHARD,EN, 50%	18.00	2.14
ALFALFA MID-BLOOM	55.00	24.00
DYNAFOS	183.00	0.00
COTTONSEED MEAL SOL 41%	245.00	80.16
OATS, ENSILED	18.00	10.08
UREA	165.00	0.00
BARLEY GRAIN	120.00	113.58

The feeds not used in the final formulation and their current prices per ton as well as prices at which the computer would consider adding a feed (feasible cost) to the ration are tabulated on the previous page under SectionIII. The value a feed must have in order to enter the diet and not increase the cost of the diet/ton is known as its "feasible cost."

Section IV Ration, Ration Cost, and Ration Composition

Part 1

LEAST COST RATION SYSTEM (BEEF) USU - ANIMAL SCIENCE DEPARTMENT
* * * MILES FERRY 685 LB STEER RATION * * *

FINAL SOLUTION

	FEASIBLE COST RANGE LOW	HIGH	% AS FED	% DRY	LBS. AS FED
CORN,DENT YELLOW 52LBS/	102.27	127.56	21.462	35.964	6.960
BEETPULP/MOL, DEHY	*******	110.72	11.157	20.000	3.618
SALT	*******	*******	0.257	0.500	0.083
LIMESTONE, GRND	-64.82	288.20	0.110	0.214	0.036
CORN, ENSILED, 30% DM	4.18	23.00	54.680	27.701	17.733
LIQUID SUP 29. PR 1.0 P	*******	*******	12.334	15.621	4.000
TOTALS			100.000	100.000	32.430

Part 2

DRY MATTER	51.32	%
COST/TON AS FED	60.00	$
COST/TON DRY MATTER	116.90	$
COST/DAY	97.287	CENTS

Part 3

*** DRY MATTER COMPOSITION ***

NET ENERGY FOR MAINTENANCE	875.2	KCAL./LB
NET ENERGY FOR PRODUCTION	569.7	KCAL./LB
DIGESTIBLE PROTEIN	8.95	%
CRUDE FIBER	11.59	%
CALCIUM	0.435	%
PHOSPHORUS	0.341	%
CALCIUM/PHOSPHORUS RATIO	1.28	

The three parts under section IV of the computer printout indicate the final solution to the problem of feeding a 685 pound steer to achieve a 2.80 pound daily gain. Part 1 lists the feeds and the amount of each used in the final solution (ration). The feasible cost range information provided in the computer output is of value to the feeder. If the cost of the feed goes below the low point of the range, more of the feed will be used and another feed ingredient may be removed from the diet. At the high side of the range, the diet will be changed if the feed cost goes beyond the indicated point. The particular feed ingredient might be priced out of the diet or cause other ingredients to enter the diet. As long as the cost range of a feed remains between the "low" and "high" ranges, the ration need not be changed.

The percent of each ingredient to be used in mixing is given, on an "as fed" basis as well as the percent on a "dry" basis. The right hand column gives in pounds the amount of each ingredient to be fed daily to each animal.

Part 2 gives the dry matter content of the ration, its cost per ton on "as fed" and "dry" basis, the cost per head per day and the cost per pound of gain.

Part 3 gives the dry matter composition of the ration. These data may be compared to the requirements (Section 1), if desired.

• In several cases, we have used "dry" matter basis instead of "as fed" since a feed will vary in its moisture content. Comparisons can only be made on a dry matter basis or on a nutrient basis.

"I WONDER WHICH ONE OF US GOT THE CALORIE"

MEASURES OF ENERGY

You may have noticed that the computer printout section on energy is expressed in kilocalories or mega calories. There is scientific reason for using this measure of energy instead of total digestible nutrients (TDN) as used in the past. Research has demonstrated that energy should be measured in terms of calories which include gross energy (GE), digestible energy (DE), metabolizable energy (ME) and net energy (NE). A brief description of each energy measure follows.

Total Digestible Nutrients (TDN)

By definition, the TDN in 100 units of feed is calculated as the total of:

TDN	digestible protein	× 1
	digestible crude fiber	× 1
	digestible nitrogen free extract	× 1
	digestible ether extract (fat)	× 2.25

Since fat has a greater amount of energy in relation to carbohydrates and protein, it is multiplied by 2.25.

In a sample of corn (maize), the TDN may be calculated as follows:

Digestible protein in corn	6.2 × 1	6.2
Digestible crude fiber in corn	0.7 × 1	0.7
Digestible nitrogen free extract in corn	59.6 × 1	59.6
Digestible ether extract (fat) in corn	3.4 × 2.25	7.4
		73.9% TDN or

73.9 lb of TDN per 100 lb of corn

TDN is not an accurate measure of nutritive energy because:

- It is based on physiological values derived from humans and dogs which are inapplicable to cattle and sheep.
- The factor of 2.25 is not always a constant. Ether extract in feeds may not be true fat.
- It does not measure energy in energy units, i.e., calories.
- It does not measure all losses from the body.
- It overestimates the value of forages and underestimates the value of grains.

The Calorie System

In November 1952, the National Research Council Committee on Animal Nutrition passed a resolution to start using the calorie system in place of TDN to describe the energy value of feeds and the nutrient requirements of animals. All current reports of the National Research Council Committee on Animal Nutrition, as "Animal Nutrient Requirements" or "Feed Composition" contain data in the calorie system.

What happens to the feed energy as it goes through the animal body is shown graphically as follows:

Gross energy of feed (GE)
- → minus fecal energy

Digestible energy (DE)
- → minus urine and methane energy, gaseous products of digestion

Metabolizable energy (ME)
- → minus heat increment energy, energy needed to metabolize food

Net energy (NE_{m+p})
- Net energy for maintenance (NE_m)
  - Basal (as taken in heart beat, breathing, etc.)
  - Activity to obtain food and drink
- Net energy for production (NE_p)
  - Pregnancy (NE_{preg})
  - Growth and fattening (NE_{gain})
  - Milk (NE_{milk})
  - Wool (NE_{wool})
  - Eggs (NE_{eggs})
  - Work (horses) (NE_{work})

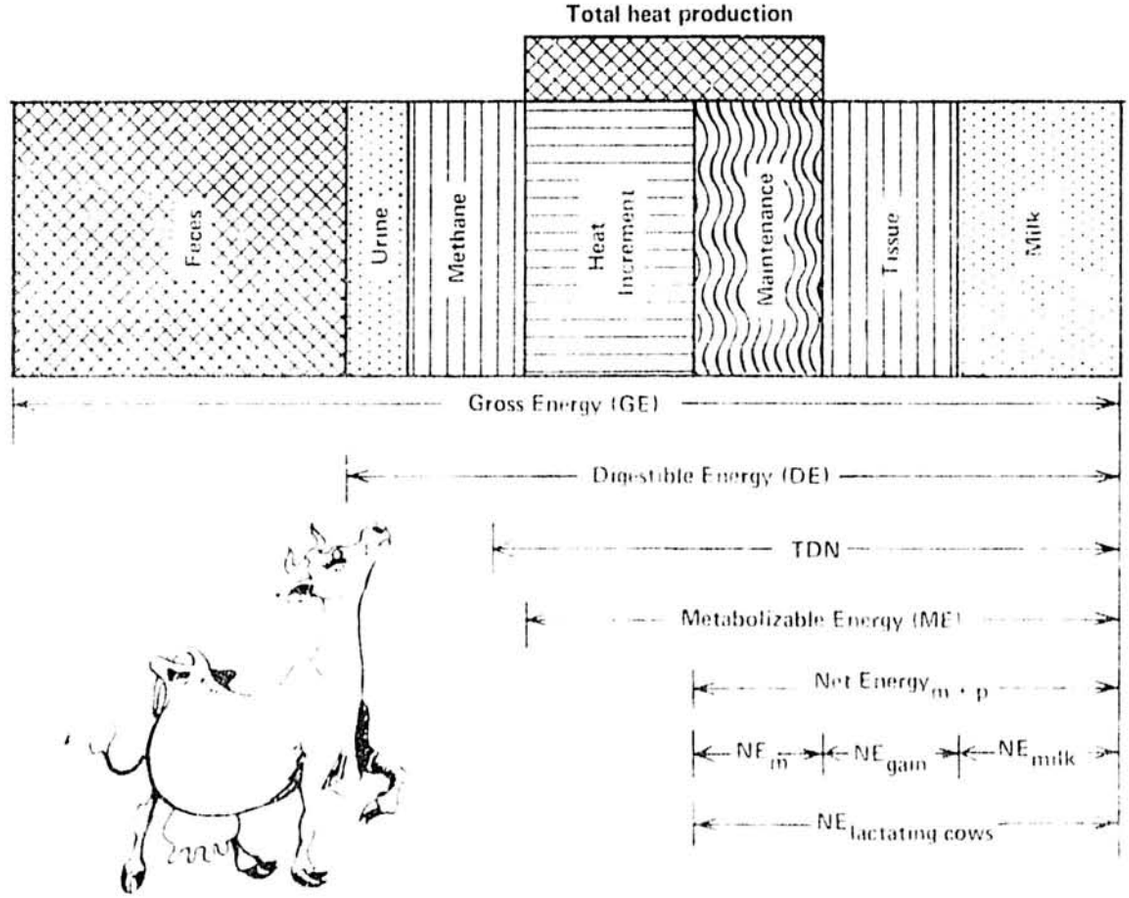

Figure 3
Utilization of energy by the animal

The relative distribution and utilization of energy by a cow is illustrated in Figure 3. It should be noted that TDN is somewhere between metabolizable and digestible energy, depending upon the inaccuracy of the factors used in its calculation.

The metric system of weight is used for some measurements (Figure 4). Where possible we will use pounds, but for some measurements we will have to use the metric system.

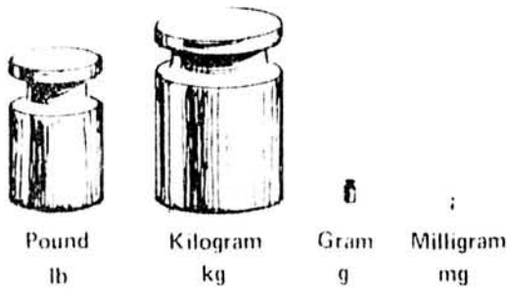

Figure 4
Some of the weight units used in the metric system as compared to the pound (lb). Where possible we will use pounds but for some measurements we will have to use the metric system.

Energy may be used in many forms and is measured by several units such as candle power, kilowatts, foot pounds, and calories. In animals, energy is expended as work or as heat, or is stored (milk or eggs). It would appear, then, that it might be measured in units suitable for these purposes. Total digestible nutrients, expressed in pounds, does not approach any of these units, but a heat unit is an excellent way to measure the potential energy of feeds, animal products, and the heat which results as a by product from body processes. The heat unit is the calorie.

A *calorie* (cal) is the amount of heat required to raise the temperature of one gram of water one degree centigrade. To measure this heat, an instrument called the bomb calorimeter is used, in which various substances are placed and burned with the aid of oxygen (Figure 5).

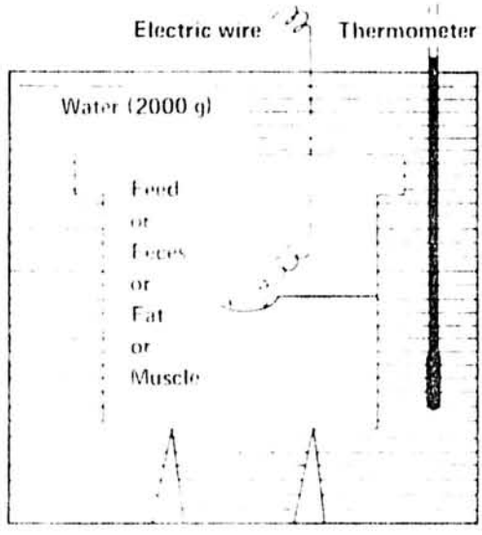

Figure 5
Diagrammatic sketch of a bomb calorimeter used for the determination of the gross energy (GE) value (caloric content) of various materials.

An electric wire is attached to the material so it can be ignited by remote control. Two thousand grams of water are poured around the bomb, after which the material in the bomb is ignited. The heat given off from the burned material warms the water, and a thermometer indicates the change in the temperature of the water. For example, if one gram of material is burned and the temperature of the water is raised one degree centigrade, 2000 calories are given off. Or the material would contain 2,000 calories per gram or 907,200 calories per lb or 907 kilocalories per lb or 0.907 megacalories per lb. We speak of this value as the gross energy (GE) content of the material (Figures 3 and 6).

Thus a *kilocalorie* (kcal) is equivalent to 1,000 calories. Chicken, turkey and swine requirements are usually measured in kilocalories.

A *megacalorie* (Mcal) is equivalent to 1,000 kilocalories. Cattle, horse and sheep requirements are usually measured in megacalories.

Gross energy (GE) is the amount of heat (measured in calories) that is released when a substance is completely burned in a bomb calorimeter containing 25 to 30 atmospheres of oxygen (Figure 6). The gross energy content of one pound of alfalfa hay, sugar and butter is shown in Figure 6.

Figure 6
Caloric content of alfalfa, sugar and butter. If the butter is fat it contains many more calories than sugar.

Digestible energy (DE). Food intake gross energy minus fecal energy (Figure 3).

Metabolizable energy (ME). Food intake gross energy minus fecal energy minus energy in the gaseous product of digestion (methane) minus urinary energy.

Gaseous products of digestion (GPD). GPD include the combustible gases produced in the digestive tract by the bacteria fermentation of the rations. Methane makes up the largest portion of the gases produced. The loss of energy as methane gas reaches significant proportions only in ruminants, i.e., cattle and sheep.

Net energy (NE). The difference between metabolizable energy and heat increment (energy needed to metabolize food). It includes the amount of energy used for maintenance only (heartbeat, breathing, etc.) or for maintenance plus production.

Net energy (NE). The difference between metabolizable energy and heat increment (energy needed to metabolize food). It includes the amount of energy used for maintenance only (heartbeat, breathing, etc.) or for maintenance plus production.

Net energy for maintenance (NE_m). The part of net energy expended to keep an animal in energy equilibrium. An animal in this state experiences no net gain or loss of energy in the body tissues. It includes the energy needed for the beating of the heart, for breathing, for the kidneys, and for eating and drinking.

Net energy for production (NE_p). The part of net energy in addition to that needed for body maintenance that is used for work or for the gain (growth or fat production or both), or for the synthesis of, for example, a fetus, milk, eggs, or wool (page 11). The net energy production fractions are designated as: NE_{egg}; NE_{gain}; $NE_{pregnancy}$; NE_{wool}; NE_{milk}; and NE_{work}.

Moe and Flatt at the United States Department of Agriculture Experiment Station at Beltsville, Maryland, have been doing some energy balance trials with milking cows to overcome the problems of measuring energy in TDN. The energy value they have determined may be used for requirements of maintenance, pregnancy, and milk production for dairy cattle. It is therefore designated as $NE_{lactating\ cows}$ (Figure 4).

SUGGESTED READING

[illegible] Appleton-Century-Crofts, pp. [illegible] 1969.

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National Research Council. [illegible] Nutrition [illegible] Pope, [illegible] Cook, [illegible] G. S. Fonnesbeck, and C. C. [illegible] Committee on Animal Nutrition. W. M. Beeson, H. R. Bird, E. W. Crampton, G. K. Davis, R. M. Forbes, L. E. Hanson, L. E. Harris, J. K. Loosli, J. E. Oldfield, and A. D. Tillman. Nutrient requirements of domestic animals number 5. Nutrient requirements of sheep. [illegible] 1968.

Note: The National Research Council publications may be obtained from:

Printing and Publishing Office
National Academy of Sciences
2101 Constitution Avenue
Washington, D.C. 20418

RUMINANT PROGRAM

Form 1 Description of animals and diet.

Name of owner John Lee Date Oct 20, 1984

Fill in blanks which apply to each group of animals for which a diet is to be calculated. Fill in one set of forms, 2 to 5, for each diet. Forms may be obtained from your Extension Livestock Specialist. **An example of how to fill in the form for a dairy cow follows:**

Kind of animal: beef cattle ____ dairy cattle X sheep ____

Sex: steer ____ wether ____ female X mixed ____ bulls ____

Pregnant cows	____
Lactating cows	____
Lactating cows, last two months of pregnancy	X
Calves (growing)	____
Replacement heifers	____
Backgrounding (growing calves)	____
Backgrounding (yearlings)	____
Finishing calves	____
Finishing yearlings	____
Finishing 2-year olds	____
Lambs not weaned	____
Finishing lambs	____
Lactating ewes	____

Other ____

Avg. weight of animals 1350 lb. Avg age of animals 3 years 5 months

Expected gain per day ____ lb. (Dairy heifers or beef cattle or sheep)

Avg. weight of milk per day 50 lb 3.6 % butterfat

Calculate a complete diet (hay plus grain) X

Calculate a supplement only ____. If supplement, check which forage is being fed?

Alfalfa hay ____ Alfalfa hay plus silage ____ Meadow hay ____

Range forage ____ Other ____

How much forage is being fed per animal per day ____ lb.

Where are animals being fed? Farm X Range ____ Feed lot ____

Pens wet and muddy X dry ____

Season: Spring ____ Fall ____ Summer ____ Winter X

Form 2 Feeds available and cost

Name of owner [illegible] Date [illegible]

List feeds available by inserting price per ton.

Check quality of feed by indicating if it is good, fair or poor. If you do not list prices, current average prices will be used.

Feeds	$/ton	Quality: Good	Quality: Fair	Quality: Poor	International feed reference number
Alfalfa, hay, sun cured, cut 1	[illegible]	[illegible]			1 00 073
Alfalfa hay, cut 2					1 00 075
cut 3					1-00-076
Alfalfa, ensiled					3 00 [illegible]
barley, grain					4 00 [illegible]
Beet, pulp w/ molasses	[illegible]	[illegible]			4 00 672
Beet, molasses					4 00 668
Sugarcane, molasses					4 [illegible]
Corn, ensiled	[illegible]				[illegible]
Corn, grain					[illegible]
Corn, grain, high moisture	[illegible]				[illegible]
Cottonseed, meal, 41% protein	[illegible]	[illegible]			5 04 627
Dicalcium phosphate					[illegible]
give brand [illegible]					
[illegible]					
Limestone (calcite)					6 02 [illegible]
Native plants, hay (meadow hay)					1 03 [illegible]
Salt	[illegible]	[illegible]			6 04 152
Sorghum, grain (milo)					4 04 441
Soybean, meal, 44% protein	[illegible]	[illegible]			5 04 604
Soybean, meal, 50% protein					5 04 612
Urea, 262% protein equivalent	[illegible]	[illegible]			5 05 070
Other, including commercial feeds					
[illegible]					
[illegible]	[illegible]				

Form 3 Feed intake restrictions

Name of owner _____ Date _____

List below any of the feeds checked on Form 1 which you want fed at a certain level.
If you list maximum only, no more will be used.
If you list minimum only, no less will be used.
If you want an exact amount fed per day, list the same amount in both maximum and minimum columns.

Feed	Maximum amount per day (as fed)		Minimum amount per day (as fed)	
	lb	%[a]	lb	%[a]

RUMINANT PROGRAM

Form 4

Name of owner _____ Date _____

If you are using or plan to use any commercial protein or mineral supplements, list the name and price on Form 2 and the known nutrients on this form. Enter only values known; leave others blank. Enclose a tag of the product, if possible.

Nutrient		Number of supplement*					
		1	2	3	4	5	6
Dry matter	%						
ME	Mcal/lb						
NE_m	Mcal/lb						
NE_{gain}	Mcal/lb						
$NE_{lactating\ cows}$	Mcal/lb						
Protein							
Phosphorus							
Calcium							
Magnesium							
Sulfur							
Vitamin A	IU/lb						

*Note: Put names of supplements here, examples are given below.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Form 5 Chemical analyses of feeds

Name of owner [illegible] Date [illegible]

When chemical analyses have been run on farm grown feeds or others, these will be used in place of those in the computer bank. If nutrients were not analyzed, leave blank. Examples are given below:

Name of feed and stage of maturity, if applicable	Dry matter	ME	Protein	Phosphorus	Calcium	Magnesium	Sulfur	Carotene	Vitamin A
	%	Mcal/lb	%	%	%	%	%	mg/lb	IU/lb
Alfalfa hay, [illegible]									
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]		[illegible]	[illegible]					

*If possible describe the feed in detail. A detailed description of the feed helps to obtain better data for the computer. Describe stage of maturity for hay and silage (see back of page for descriptive terms). Use two lines if necessary. However, if a detailed description is not available, put in what is known about the feed.

Stage of maturity terms used in the International feed names

Preferred term	Definition	Comparable terms
Germinated	Stage in which the embryo in a seed resumes growth after a dormant period.	Sprouted
Early vegetative	Stage at which the plant is vegetative and before the stems elongate	Fresh new growth, before heading out, before inflorescence emergence, immature, prebud stage; very immature, young.
Late vegetative	Stage at which stems are beginning to elongate to just before blooming; first bud to first flowers	Before bloom, bud stage; budding plants, heading to in bloom; heads just showing, jointing and boot (grasses), prebloom, pre flowering, stem elongated
Early bloom	Stage between initiation of bloom and stage in which 1/10 of the plants are in bloom, some grass heads are in anthesis	[illegible]
Mid bloom	Stage in which 1/10 to 2/3 of the plants are in bloom, most grass heads are in anthesis	[illegible]
Late bloom	Stage in which 2/3 or more of the plants are [illegible]	[illegible]
Late bloom	Stage in which blossoms begin to dry and fall and seed begins to form	15 day after [illegible]
Milk stage	Stage in which seeds are well formed but soft and [illegible]	[illegible]
Dough stage	Stage in which the seed are of dough like [illegible]	[illegible]
Mature	Stage in which plants are normally harvested for [illegible]	[illegible]
Post ripe	Stage that follows maturity, seeds are ripe and plants have begun to weather (applies mostly to range plants)	Late [illegible]
Stem cured	Stage in which plants are cured on the stem, seeds have been cast and weathering has taken place (applies mostly to range plants)	Dormant, mature and weathered, seeds cast
Regrowth early vegetative	Stage in which regrowth occurs without flowering as in early vegetative crop aftermath, regrowth in stubble (applies primarily to fall regrowth in temperate climates), early dry season regrowth	Vegetative recovery growth
Regrowth late vegetative	Stage in which stems begin to elongate to just before blooming, jointing and boot in grasses, first bud to first flowers, regrowth in stubble with stem elongation (applies primarily to fall regrowth in temperate climates).	Recovery growth with stems elongating, jointing and boot (grasses).