# Exercise 4 Energy Calculations

***15 points***

Energy is a very critical nutrient in animal nutrition and it represents the most expensive nutrient to supply in adequate amounts. Additionally, energy is a nutrient which cannot be measured concretely in the laboratory, making it difficult to accurately formulate in livestock rations. Two systems exist for measuring the energy content of feeds: the Total Digestible Nutrients (**TDN**) System and the Net Energy System. The TDN System attempts to measure digestible energy in weight units and essentially is the gross energy of a feed minus the gross energy of feces from animals fed the feed. An animal's TDN requirement can be expressed as an amount required per day (pounds or kg) or as a percent of the ration dry matter that is required, assuming a given level of dry matter intake. The Net Energy System includes expressions for digestible energy (**DE**), metabolizable energy (**ME**) and net energy (**NE**) for maintenance and production. Unlike the TDN System, the Net Energy System measures energy in calorie units (kilocalories or megacalories).

Energy requirements of the Net Energy System may be expressed as calories required per day or as a concentration (i.e., megacalories per kg of dry matter), again assuming a given level of dry matter intake.

This laboratory exercise is designed to:

* Increase the students’ understanding of the expressions of energy
* Increase the students’ skills at calculating nutrient compositions of diets

Helpful Calculations:

* Ration % (DMB) x Ingredient % = Amount of Nutrient (%)
* Ration % (DMB) / Ingredient % (DM) = Ingredient % (as-fed)
* Ingredient % (as-fed) / Total Ingredient % (as-fed) = Ration % (as-fed)
* Ingredient kg (DMB) / Total Ingredient kg (DMB) = Ration % (DMB)
* Ration % (DMB) / Ingredient % (DM) = Ingredient % (as-fed)
* Ingredient % (as-fed) / Total Ingredient % (as-fed) = Ration % (as-fed)

1. A likely feeding situation would be to feed a combination of the hay and grain to growing beef calves. Determine the TDN, NEm and NEg (for beef cattle) of a ration that contains 62% orchardgrass hay, 31.2% barley (Pacific coast), 6.3% soybean meal (seeds, meal, solvent-extracted), and .5% of ground dolomitic limestone. Use table 3-2b and table 3-2f.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Ingredient | Ration DM % | TDN, %  (Book Value) | TDN, %  (Ration) | NEm,  Mcal/kg  (Book Value) | NEm,  Mcal/kg  (Ration) | NEg,  Mcal/kg  (Book value) | NEg,  Mcal/kg  (Ration) |
| Orchardgrass Hay, sun-cured | 62 |  |  |  |  |  |  |
| Barley | 31.2 |  |  |  |  |  |  |
| Soybean meal | 6.3 |  |  |  |  |  |  |
| Limestone | .5 | --- | XXX | --- | XXX | — | XXX |
| Total | 100 | XXX |  | XXX |  | XXX |  |

Ration TDN, % =

Ration NEm (Mcal/kg) = Ration NEm (Mcal/lb) =

Ration NEg (Mcal/kg) = Ration NEg (Mcal/lb) =

If a 300 kg medium-frame steer calf consumed 14.6 lbs (DMB) of this feed (from question 1), use the 4 steps below to determine how much weight would he gain per day? Use the NEm and NEg requirements provided in Table 8-1a.

1. First, how much feed is required to maintain the calf (kg/d and lb/d)? **HINT**: what is the NEm requirement?
2. How much of the 14.6 lbs is left over for gain (kg and lb)
3. How many Mcals of NEg would therefore be available for gain (Mcal)? **HINT**: calculated feed for gain (kg) of 300 kg steer x ration NEg (Mcal/kg)
4. How much would the calf gain (kg/d and lb/d)? **HINT**: use table 8-1a to determine gain via amount of NEg Mcals available (use proportion to calculate exact amount
5. You have timothy grass hay (fresh, late vegetable, table 3-2a) to feed to large-breed growing heifer calves (550 lb), and they are eating 11.7 lbs of hay DM per day.

What is the CP intake from the hay alone? **HINT**: first convert 11.7 lbs of intake to kg

Intake (kg of CP/d) =

How much weight gain will this much CP provide (kg/d)? **HINT**: use proportion to determine exact weight gain. Use table 9-4.

You want the heifers to gain 1.8 lbs per day. How much additional CP is needed to achieve this amount of gain per day?

Additional CP (g of CP/d) =

How much cottonseed meal (CSM, solvent extracted, 41%, table 3-2a) would be required to meet this need (assume added CSM would not change hay intake)?

CSM (kg) =

Give the ration (hay and CSM) expressed as kg of DM per day.

How much NEm and NEg is in this ration of hay and CSM (table 3-2b)?

NEm (Mcal/kg of ration) =

NEg (Mcal/kg of ration) =

Does this ration (and the amounts to be fed) have enough NE to support a gain of 0.8 kg/d? How many Mcals of NEg are deficient? **HINT**: You will need to determine 1) the amount of feed toward NEm, 2) the amount of feed toward NEg, 3) the amount of NEg in the feed, and 4) the NEg excess or deficiency (Requirements on table 9-4)

How much kg/d of corn grain (Use Maize, dent yellow, Zea mays indentata, table 3-2b) would be required to make up this deficiency? **HINT**: what is the NEg of corn grain?

Give the complete ration:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Ingredient | Kg of DM | Ration %, DMB | Ingredient DM % | Ingredient %, As-fed | Ration %, As-fed |
| Timothy hay |  |  | 86 |  |  |
| Corn |  |  | 89 |  |  |
| CSM |  |  | 92 |  |  |