Theoretical lectures /second stage in college of vet. medicine.

Animal nutrition Lecture (5-6) Dr. Mohammed Karim (2021- 2022) .

Evaluation of Energy Value of Feed in Animal Nutrition:

1-Energy is defined as the capacity to do work. As we know, heat is measured in some units known as calories which may be defined as follows:

1. Calorie (Cal): The amount of energy as heat required to raise the temperature of 1 gram of water to 1 °C (precisely from 14.5'C to 15.5"C). One cal is equal to 4.184 Joule.
2. Kilocalorie (Kcal): The amount of energy as heat required to raise the temperature of 1 kg of water to 1°C (from 14.5°C to 15.5°C). Kilocalorie is equivalent to 1000 calories.
3. Megacalorie (Mcal: Equivalent to 1000 kilocalories or 1000.000 calories, formerly referred to as a therm.
4. British thermal unit (BTU): The amount of energy as heat required to raise the temperature of 1 pound of water to 1°F. It is equal to 252 calories.
5. Joule (J): The International Union of Nutritional Sciences and the nomenclature ^ "committee of the International Union of Physiological Sciences have suggested the Joule (J) as the unit of energy for use in nutritional, metabolism and physiological studies.

The Joule is defined as 1 Newton metre, and 1 J 0.24 cal. kilojoule (KJ) and mega joule (MJ), are also explained similarly.

The simplest method for measuring the value of any feed is to determine the amount of digestible nutrients that is supplied to the animals. For expressing the energy value of feeds and requirements of animals, following systems are used:

1. Energy
2. Gross energy (GE)
3. Digestible energy (DE)
4. Metabolizable energy (ME)
5. Net energy (NE).
6. Total digestible nutrients (TDN).

1-Gross energy (GE): Gross energy is the total heat of combustion of a material as determined with a bomb calorimeter and expressed as mega joule/kg diy matter. The gross energy value of a feed has no relationship to the feeds digestible, motabolizable

or net energy values, except that the latter can never exceeded the GE. Certain products such as coal, mineral oil and lignin have high gross energy values but, because of their indigestibility have no energy value to the animal. Roughages have high gross energy values comparable to those of concentrates, but the two differ greatly in digestible, metabolizable and net energy values.

2-Digestible energy (DE): This is that portion of the gross energy of a feed which does not appear in the faeces. It includes metabolizable energy as well as the energy of the urine and methane. Considerable quantity of heat of the digested food is eliminated in the faeces. The apparent digestible energy of the food is the gross energy of the feed less the energy contained in faeces.

3. **Metabolizable energy (ME):** It is that portion of gross energy not appearing in the faeces, urine and gases of fermentation (Principally methane). It is digestible energy minus the energy of the urine and methane. It is comparable to the energy of TDN minus the energy of the fermentation gases.

metabolizable energy = Gross energy - (energy lost in faeces + energy lost in combustible gases + energy lost in urine).

Normally about 8 % of the gross energy intake is lost through the methane production. Metabolizable energy can also be calculated from the digestible energy by multiplying with

0.82 which means that about 18 % of the energy is lost through urine and methane. In poultry, metabolizable energy is measured more easily than digestible energy because the faeces and urine are voided together.

Factors affecting the Metabolizable energy values of foods.

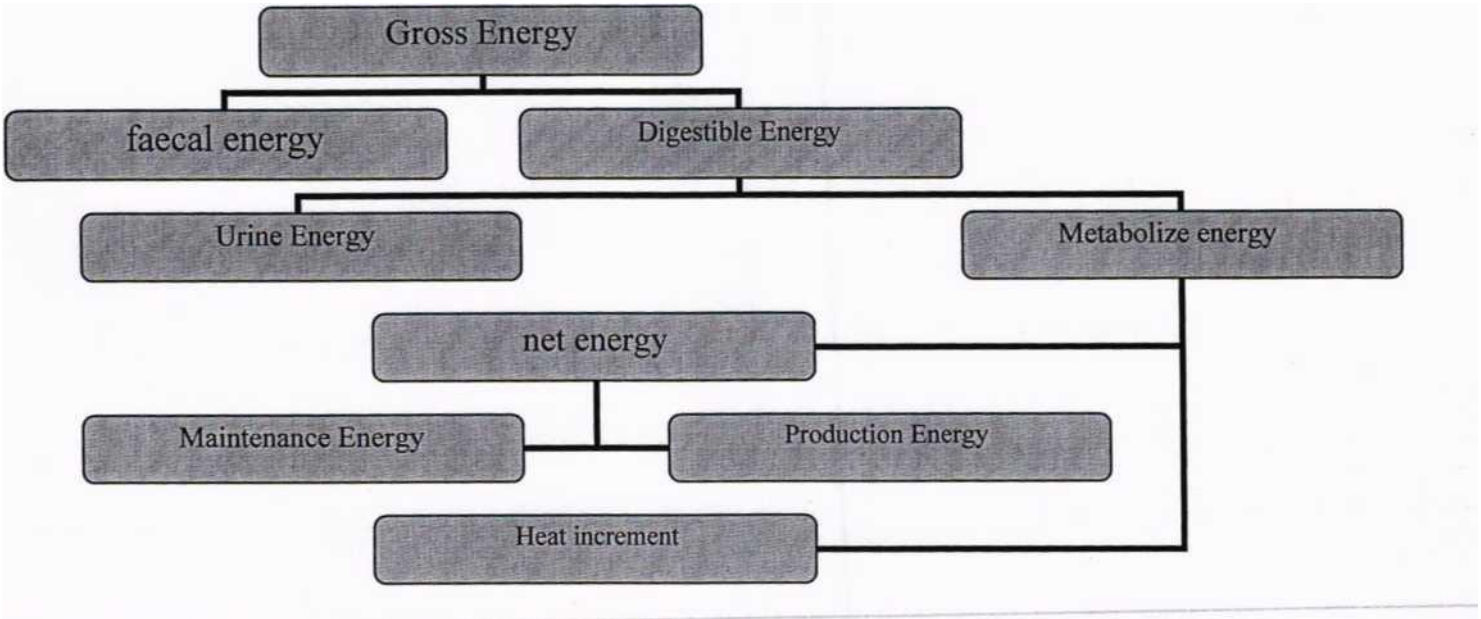
1. **Species of animals:** The metabolizable energy of feeding stuffs varies according to the species to which it is being fed. In the ruminants about 8-10 % losses of energy are in the methane production while in the non-ruminants there are no such losses. Therefore, the ME values are higher in non-ruminants than ruminants. This gap is more in the feeding stuffs rich in the crude fibre.
2. **Composition of feed:** Chemical composition of the feed also affect the ME values of food. If the crude protein present in the food is unbalanced then the majority of the amino acids will be deaminated and

greater proportion of nitrogen will be excreted as urea. One gram of urea excreted will be equivalent to 23.00 KJ of energy, therefore generally the ME values are frequently corrected to zero nitrogen balance. For ruminant a factor of 31.17 KJ per gram of nitrogen has been used; for poultry the factor is 34.39 KJ per gram. The crude fibre level also affect the ME value of feed.

3. **Processing of food:** Processing of food also affect the ME values since it affects the losses of nutrients in faeces and methane production.

4. **Level of feeding:** the level at which feed is being led affect the ME value of the feed. At high level of feed intake ME values are reduced.

Net energy (NE):This is that portion of metabolizable energy which may be used by the animals for work, growth, fattening, foetal development, milk production, and/or heat production. It differs from metabolizable energy that net energy does not include the heat of fermentation and nutrient metabolism or the heat increment The fate of the gross energy of food is summarised as:



Heat increment of metabolizable energy and net energy used in maintenance is summarized as total heat production of the animal. The heat increment is also known as specific dynamic effect of food, This heat is useful only for keeping an animal warm during very cold weather. At other times the energy represented by this heal is not only a complete loss but also may actually interfere with production by causing

the animals to be too warm.

1. Total digestible nutrients (TDN): is simply a figure which indicates the relative energy value feed to an animal. It is ordinarily expressed in pounds or kilograms or in percent (pound or kg of TDN per 100 pound or kg of feed). It is arrived at by adding together the following:

TDN = digestible crude protein + digestible crude fiber + digestible nitrogen-free

extract (starch and sugars) + 2.25 digestible ether extract (fat).

[The ether extract is multiplied by 2.25 in an attempt to adjust its energy value to

reflect its higher caloric density (fat = 9.1 cal/g and carbohydrates = 4.1 cal/g).]

% TDN = % DCP + % DCF + % DNFE +(% DEE x 2.25).

Fat on oxidation provides 2.25 time more energy as compared to carbohydrates, hence the figure is multiple by 2.25.The protein in this equation has been included because of the fact that excess of protein eaten by the animals serve as a source of energy to the body.

Limitation of the TDN System:

1. It over estimates the value of roughages because more energy spent in chewing of such feeds remains unaccounted.

2. Only the loss in faeces is accounted.

3. If feeds are high in fat content will some time exceed 100 in percentage of TDN.

Factors affecting the TDN value of a food:

1. **The percentage of the dry matter.** The more water present in feed, the less there is of other nutrients, and lowers the TDN value.

2. **The digestibility of the dry matter.** Unless the dry matter of a feed is digestible, it can have no TDN value Only digestible dry matter can contribute TDN. lignin has a high energy value but it cannot be digested by the animals so has no digestible energy or TDN values.

3. **The amount of mineral matter in the digestible dry matter.** Mineral contribute no energy to the animal though mineral compounds are digestible but have no TDN value. The more mineral mailer a feed contains, other things being equals, the lower will be its TDN values.

4. **The amount of fat in the digestible dry matter.** Fat contributes 2.25 times as much as energy per unit of weight as do carbohydrates and protein. The feeds high in digestible fat some time TDN value exceed 100%. In fact, a pure fat which had a coefficient of digestibility of 100 percent would theoretically have a TDN value of 225% (100 * 2.25 = 225).

Thus we find that the digestibility data obtained from the simple digestion trial is of a very limited application, but the animals shall have to feed on the basis of some standard. The Morrison feeding standard is based on the total digestible nutrients, obtained from carefully conducted digestion trials.