



Tikrit University
College of Veterinary Medicine

Lecture Title: Determination Of Gross Energy By Calculated Method

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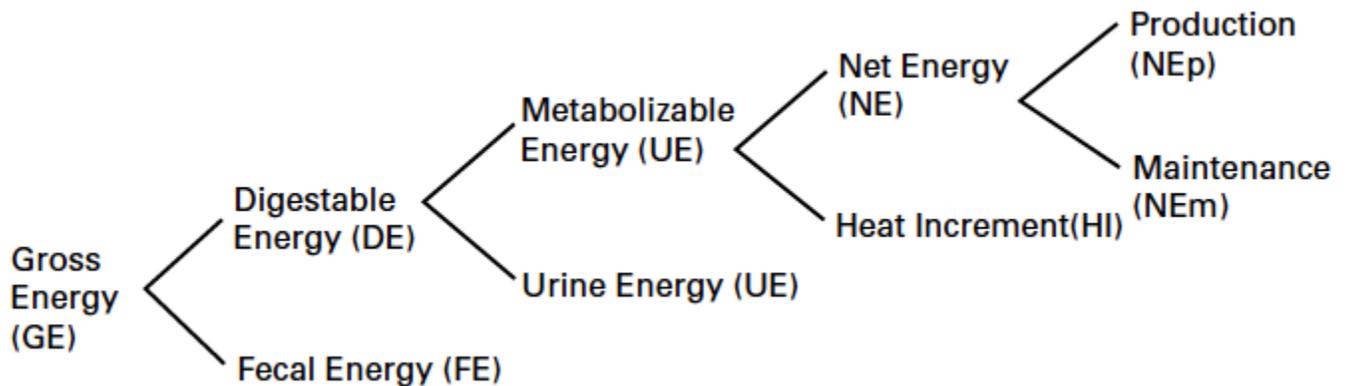
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Determination Of Gross Energy By Calculated Method

When the feedstuffs are oxidized inside or outside animals body, gross energy is released which may be used for maintenance and keeping constant temperature of the animal's body. The excessive part of gross energy can be used for production (such as growth, reproduction, draft "beast of burden").



The energy of feedstuff is measured by unit called "calorie". Calorie is defined as the quantity of heat required to elevate the temperature of one gram of water one degree centigrade from 14.5- 15.5C°. other unit's may involve " Kilo Calorie" which is denoted as " Kcal". Kilo calorie is equivalent to 1000 calories.

Also, there is mega calorie which is denoted as " Mcal" and equals to 1000000 calories. • The chief resources of energy in feedstuffs offered to farm animals are the following compounds: fat, protein, carbohydrates of either types i.e. soluble and nonsoluble carbohydrates.

Energy produced from these nutritional compounds is variant due to the variation in their chemical structures. More heat energy is produced at the oxidation of fat which is more than that produced by the oxidation of proteins and carbohydrates successively. Oxidation of fat produces energy about 2.25 times than that produced by carbohydrates.

Such high production of energy from fat oxidation is due to the increase number of carbon atoms as compared with those of carbohydrates and proteins. Due to the

fact that, the carbohydrates form the largest percentage of nutritional compounds of feedstuff, so most of farm animal ration contains about 4.4 mega calories of total gross energy.

The gross energy of the feedstuffs can be estimated by two methods:-

- 1. The calculation method
- 2. Bomb calorimetry method.

Determination of gross energy of feedstuffs by chemical analysis method:-

(The calculation method) • The nutritional constituents that hold energy " as mentioned earlier" are fat, protein and carbohydrates {of two types i.e. soluble and nonsoluble carbohydrates (crude fibers)}.

Hence, after the determination of percent of these compounds of the feedstuff either " as fed basis" or "on dry matter basis", it is possible to estimate the gross energy of this sample following the steps:-

A. Determination of calorific value of each nutritional compounds as follows:

Nutritional Compounds	Caloritic valuc
Crude fat	9.4 kilo calorie/1gm
Crude protein	5.65 kilo calorie/1gm
Carbohydrates (of both types)	4.15 kilo calorie/1gm

B. The percentage of each nutritional compound holding energy is multiplied by calorific value of the nutritional compound.

C. the gross energy of sample (100gm) is the summation of the addition of all energies produced from the step B.

Example:

The percentage of nutritional compounds of the feedstuff sample "as fed basis" is as follows: 10% moisture, 15% crude protein, 7% ash, 10% crude fiber, 3% crude fat. Estimate the gross energy for (1kg) of this sample according to " on a dry matter basis".

· **The solution:** At the beginning, the percentage are converted into the analysis "on dry matter basis"

· **Percent of dry matter** = $100-10=90$

· **Percent of crude protein %** = $15 * \frac{100}{90}$ = 16.67

· **Percent of ash %** = $7 * \frac{100}{90}$ = 7.78 %

· **Percent of crude fibers %** = $10 * \frac{100}{90}$ = 11.11%

· **Percent of crude fat %** = $3 * \frac{100}{90}$ = 3.33%

· **Soluble carbohydrates "As fed basis"**

· = $100-(10+15+7+10+3)=100-45=55\%$

· The carbohydrates "on dry matter basis"

· = $55 * \frac{100}{90}$ = 61.11%

The gross energy is estimated by multiplication of the percent of each nutritional compound holding energy by its calorific value:

· crude protein = $16.67 * 5.65 = 94.40$

· crude fibers = $11.11 * 4.15 = 46.11$

· soluble carbohydrates = $61.05 * 4.15=253.61$

· crude fat= $3.33 * 9.4 = 31.30$

· gross energy= 425.42 kilo calorie/100 gm. of feed = $424.78 * 10$

· = 4247.8 kilo calorie / kg of feed " on dry

. The solution of the other method :-

· Crude protein = $15 * 5.56 = 84.75$

· Crude fiber = $10 * 4.15 = 41.5$

· Soluble carbohydrates = $100 - (10 + 15 + 7 + 10 + 3) = 100 - 45 = 55$

· Soluble carbohydrates = $55 * 4.15 = 228.25$

· Crude fat = $3 * 9.4 = 28.2$

· Summation of energy from compounds =

$= 84.75 + 41.5 + 228.25 + 28.2 = 382.7$

· Dry matter = $100 - \text{moisture (\%)} = 100 - 10 = 90$

· Energy dry matter

382.7 90

X 100

$X = \frac{382.7 + 100}{90} = 425 \text{ kcal/100gm}$

· $= 425 * 10$

$= 4250 \text{ k Cal / 1000 gm. (kg)}$