Energy Content of Food and Partition

Demand For Energy

An animal requires energy for both maintenance and production. The energy requirement for maintenance represents the energy required for the vital body processes that are essential for life, for example the work associated with essential muscular activity (beating of the heart), the work associated with active transport (movement of dissolved substances against the concentration gradient), and the energy associated with the synthesis of essential body constituents such as enzymes and hormones. An animal deprived of food continues to require energy for these processes, otherwise it will die. In a starved animal, the energy required for vital body processes is obtained from the catabolism of body reserves, initially glycogen, but then body fat and protein. In a fed animal, the primary demand for energy is to meet this maintenance requirement and to prevent the catabolism of body tissues.

When the energy in food is used for maintenance, the animal does no work on its surroundings. In a fasting animal, the amount of heat produced is equal to the energy derived from tissue catabolism, which, when measured under specific conditions, is known as the animal's basal metabolic rate or fasting metabolism. Energy supplied by food in excess of the maintenance requirement is used for production. In young growing animals, energy is stored in new tissues primarily as protein. However, as animals mature, an increasing proportion is stored as fat. In pregnant and lactating animals, energy is stored in the products of conception (foetus and placenta) and in milk constituents, respectively. Other forms of production include the energy required for activity or exercise and the energy required for the synthesis of wool or eggs.

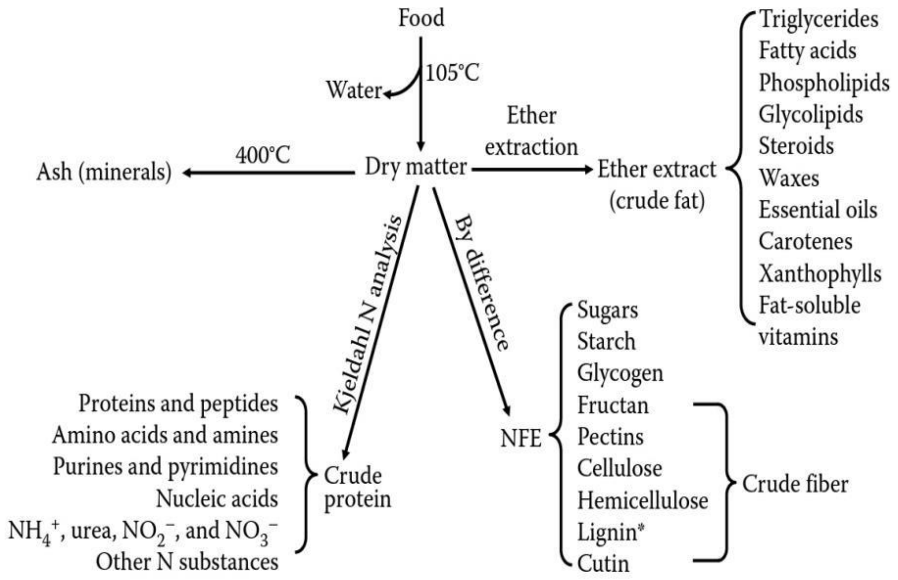
Supply Of Energy

Gross energy (GE)

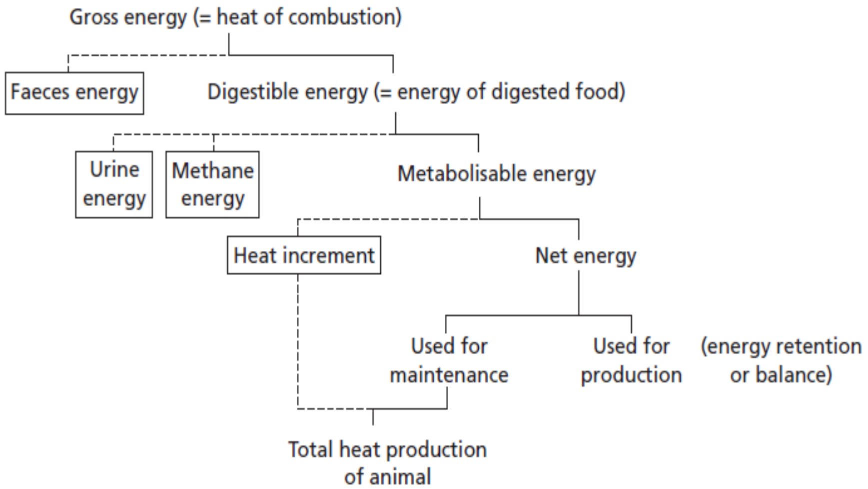
Energy is stored in the chemical components of food as chemical energy. The amount of chemical energy in a food is measured by converting it to heat and determining the heat production. This is carried out by oxidizing the food by burning. The amount of heat arising from the complete oxidation of a unit weight of food is known as its gross energy (GE) value or heat of combustion .

In spite of the differences in GE content between different food components, the fact that carbohydrates are the predominate component in the food of most farm animals means that in reality GE values vary very little. Only foods rich in fat such as full-fat soya bean meal, which contains 222 g/kg DM ether extract, have significantly higher values, and those rich in ash, which has no nutritional value , have significantly lower values. Most common foods have a GE content of approximately 18.4 MJ/kg DM.

The proximate analysis of nutrients in feedstuffs and animals' tissues is :



The partition of food energy in animals. Losses of energy are shown as the boxed items on the left :



Not all of the GE in foods is available for use by the animal. Some is lost from the animal as various solid, liquid or gaseous excretory products, and some is lost as heat. These sources of energy loss are illustrated in last Fig. above . The subtraction of these energy losses from a food's GE content produces further descriptive measures of food energy supply; for example , subtracting the GE lost in faeces from the GE in food gives a measure of digestible energy.

Digestible energy represents energy absorbed by the animal. Apparent digestible energy is calculated as the GE provided by a unit of food minus the GE content of the faeces resulting from the consumption of that unit of food.

Metabolisable energy (ME)

In addition to energy lost in faeces, energy is also lost as energy-containing compounds in urine, and as combustible gases such as methane produced as a consequence of microbial fermentation in either the rumen or hind gut . Metabolisable energy represents energy that is available for use by the animal and is calculated as DE minus energy lost in urine and combustible gases. The energy lost in urine is present as nitrogen-containing compounds such as urea, hippuric acid, creatinine and allantoin, and in non-nitrogenous compounds such as glucuronates and citric acid.