Poultry Nutrition

Department of Animal Resource Class 4 Fourth lecture 17.10.2022

The Energy

The energy is not a chemically identifiable nutrient but is a property that is realized when nutrients, such as carbohydrates, lipids and amino acids oxidized during metabolism. The birds require the energy for maintenance, growth of body tissues, egg production, physical activities and control of body temperature.

Identification, definition and calculation:

Energy Terminology

A calorie (cal) is the heat required to raise the temperature of 1 g of water from 16.5° to 17.5° C. Because the specific heat of water changes with temperature, however, 1 cal is defined more precisely as 4.184 joules.

A kilocalorie (kcal) equals 1,000 cal and is a common unit of energy used by the poultry feed industry.

A joule (J) equals 10^7 ergs (1 erg is the amount of energy expended to accelerate a mass of 1 g by 1 cm/s) (The **erg** is a unit of energy equal to 10^{-7} joules) . The joule has been selected as the preferred unit for expressing all forms of energy. Although the joule is defined in mechanical terms (that is, as the force needed to accelerate a mass), it can be converted to calories. The joule has replaced the calorie as the unit for energy in nutritional work in many countries and in most scientific journals. However, calorie is used because it is the standard energy.

Calculations:

1 calorie (cal)= energy to raise 1 g H2O 1° C

1000 cal = 1 Kcal

Motives of the need for energy:

1. This process may be linked to some extent to a blood glucose level.
2. The effect of sugar level with some of other compounds on the mechanism of appetite regulation associated with visual neural lobe (hypothalamus).

The partition and losses of food energy in the body

The bird use most of the energy consumed with the feed for maintenance and metabolic reactions. Food energy may be lost from a bird by:

1. Excretion in urine and feces and
2. Through heat produced in metabolism.

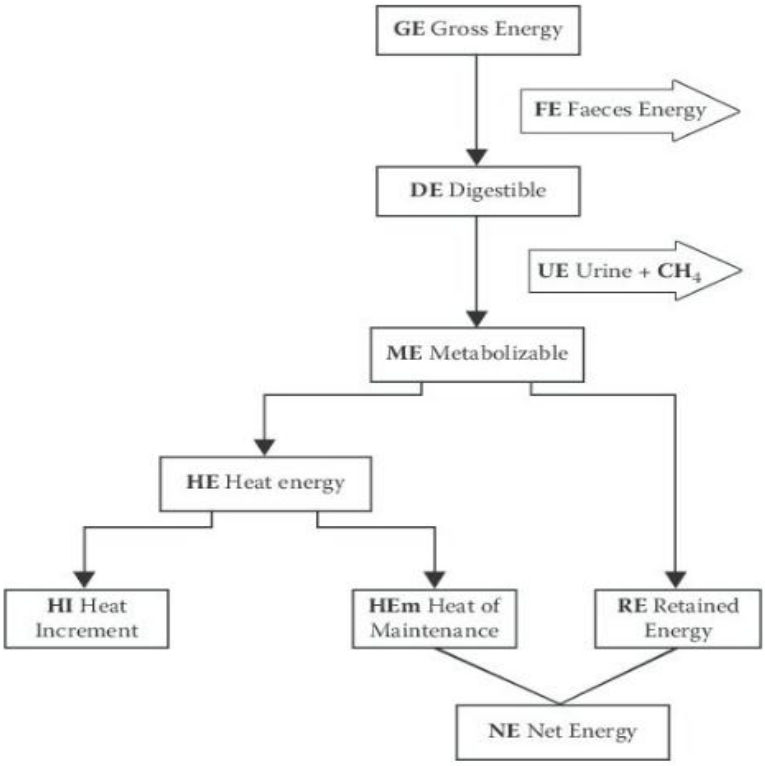
Some of the consumed nutrients are not oxidized but rather are retained in tissues or eggs.

Gross Energy includes all the energy in a feed. It is determined by how much heat is liberated upon combustion. It is not all available to the animal.

Digestible Energy (DE): Portion of gross energy that is digested and absorbed. It is how much energy does not end up in the feces. It is not all used by the animal, some is lost. (DE= GE in the feed – GE in the feces and urine)

Metabolizable Energy (ME): Portion of Digestible energy that is useful for metabolism. It is still not all available for the animal to use.

Net Energy (NetE): Portion of metabolizable energy that is useful for maintenance and productive functions.



When the ME considered in the feed is more accurate than the gross energy, because of the amount of the determination inaccuracy is (±2-3%) for ME but (±20%) for GE (gross energy).

The ME content of each feed ingredient depend on the quality of the individual ingredient or the quality and the type of the lipid content, fat and oil possess higher value of ME compared to other ingredients.

The ME value of plants oil is higher than animals fat, because the plant oil mostly composed of unsaturated fatty acids, while the animal fat composed mostly from saturated fatty acids. Feed ingredients with high levels of fiber are considered as low source for energy?

Further losses in dietary ME occur due to inefficiencies in intermediary metabolism, which are necessary to digest, transport, excrete wastes from, and transform nutrients

into usable forms. These losses are referred to as the **heat increment**. The size of the heat increment varies with the composition of the diet. The heat increment is lowest for dietary lipid, because:

1. Lipids require minimal enzymatic digestion,
2. Few energy-requiring transformations prior to use
3. No waste-product synthesis.

Conversely, the heat increment for protein is high, because of:

1. The need for extensive digestion,
2. The high cost of protein synthesis,
3. The energy needed to synthesize uric acid when amino acids are oxidized to provide energy.

In chickens, the heat increment generally considered to be about 30% of ME for protein, 15% for starch, and 10% for lipids. The overloaded ME is deposited in the body as fat deposit, because the bird cannot excreted out of the body.

In other hand the use of amino acids as source of energy leading to management problems because the amino acid will convert to glucose through metabolism, this reaction release the nitrogen to the body, thus the body excreted it through the kidney and this action require consumption of more water by the bird consequently result in liquefying the feces and increase of moisture in the litter and increase of microbial contamination.

The feed consumption and the energy

There are many factors affect the amount of feed consumption which are mainly:

1. The environment
2. Diet composition
3. Bird type

Usually the bird consumes the diet up to their requirements of the energy, thus the energy level in the diet affect the quantity of the food consumed. And the net amount of the feed consumption depends on:

1. The body mass of the bird
2. Bird's activity (maintenance, growth or egg production)
3. Environmental temperature

The deleterious effects of high environmental temperature on the performance of broilers are well documented. As temperature increases above the upper critical limit of the bird’s zone of comfort, heat stress is initiated. In avian species, sweat glands are lacking and feathering limits heat loss. In order to reduce metabolic heat production, feed intake is reduced and consequently growth rate decreases due to impaired nutrient digestion and absorption

The appetite and energy

Appetite is amount of feed consumed when offered in free to the bird. In adult birds controlling of the appetite aims to create a balance between the amount of energy consumed and the body requirements.

Factors affect the appetite

1. Breed or strain
    A. Body size: bigger bird require higher energy, thus consume more feed.
    B. Average weight gain in growing chicks
    C. Rate of egg production in laying hens.
2. Age of the bird
3. Nutrient balance of the diet
    A. Energy content of the feed
    B. Physical appearance and feed form (mash or crumbled or pelleted). Pelleted or crumbled feed resulted in higher feed consumption by 6-8%.
    C. Habituation

    Fact: The optimum concentration of nutrients in the diet is inversely proportional to the rate of consumption of feed or bird's appetite
4. Ambient temperature

    The main environmental factor affecting the appetite is temperature. The high temperature reduced feed consumption rate. Increasing the environmental temperature to higher than 30^0 C result in quick falling in feed consumption (optimum temperature 20 – 27^0 C). When environmental temperature rises up by 1^o C of the normal ranges (+7 to $+35^0$ C) reduce the feed consumption up to 1.7%.
5. Lighting density and lighting period
6. Humidity and air flow (very few effects)
7. Health and welfare status of the birds
8. Accessibility of the feed

Energy requirements

Requirements of young chickens

Usually younger chicks cannot adjust their feed consumption due to their requirements of energy. This resulting in a higher fat retains in the body when fed with diets contain high energy level.

Effects of environmental temperature on ME requirements in birds

There is several facts should be considered:

1. With high temperature the requirement will reduce and the opposite is true
2. The maintenance requirement reduces when the temperature is high till 30^o C.
3. Over 30^o C, the requirement increases to get rid of convectional heat.

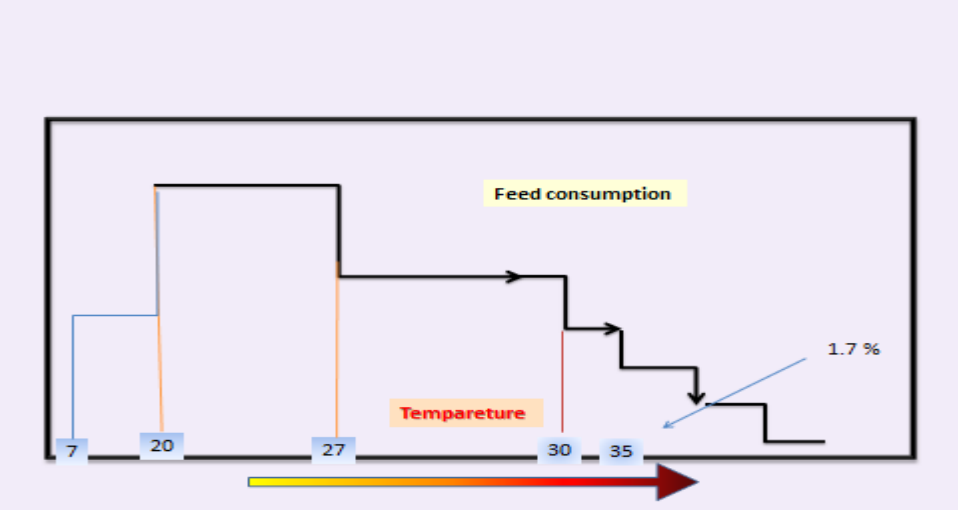


Figure 2 : The flow of reduction in feed intake under the influence of high temperatures

The requirements of chickens for energy differ from face to face of feeding or due to their age, for instance, examples:

Breed	Broilers	Layers
	Energy requirements (Kcal /kg feed)	
Feeding phase		
Starter (0 – 10 d)	3025	
Grower (11 – 24 d)	3150	
Finisher[1] (25 – 42)d	3200	
Finisher[2] (43 – marketing)	3225	
		At ambient temperature 20 ^{o}C
Starter (0 – 4 w) or (day old – 300 g of BW)		2950
Grower (5- 10 w) or (from 300 – 850 g of BW)		2850
Pullet (11 – 16 w) or (after 850 g of BW)		2750
Pre-lay (Transfer between 16 and 17 w)		2750
		At ambient temperature 28 ^{o}C
Starter (0 – 4 w) or (day old – 400 g of BW)		2950
Grower (5- 10 w) or (from 400 – 850 g of BW)		2850
Pullet (11 – 16 w) or (after 850 g of BW)		2750
Pre-lay (Transfer between 16 and 17 w) or (112 days to 2% lay)		2750

Energy restriction in poultry nutrition

During the breeding period (Growth) of the egg - laying strains rationing of energy aims to:

1- Savings in the amount of energy required during growing period until reach the laying period.
2- Reduce live weight upon the arrival of the chicken to the age of sexual maturity.
3- Delaying the age of sexual maturity.
4- Rationing energy consumption may increase the mortality during this period, but during the lay the mortality reduces.

The benefits of energy-rationing process during the production of eggs:

A. Improving the efficiency of feed consumption
B. Reduce the rate of increase in body weight

The feed restriction during the egg production must not exceed 5 – 7 %.

Energy rationing during the breeding period (growth) for the meat-producing strains (broiler parent stock).

Methods of growth restriction of broiler parent pullets:

A. Restriction of provided feed weight per chicken per day
B. Skip-a-day feeding program, starving day and feeding the next day
C. Starving for two days in a week
D. Dilution of the diet with a material non-digestible (cellulose and sawdust) or providing a diet with a low level of energy, protein, and to allow the free consumption of birds.

Energy rationing during the laying period of the meat strains parents:

The restriction of feeding rate by 12 - 13% during the production period resulting in improvement in egg production, but when increases to 18-20%, result in lower egg production**.**

When the feed formulated, for adjustment of the energy in the diet some information's should be considered:

1. Amount of energy required at all stages of the growth
2. Accurate data on the ME included in each ingredient

Usually nutritionists consider the amount of the ME obtained from the feedstuff, while scientists consider the amount of the energy utilized (digested) from the starch, sugar, lipids and proteins from each feed ingredient.

Dr. Kamaran Abduljalil Abbas