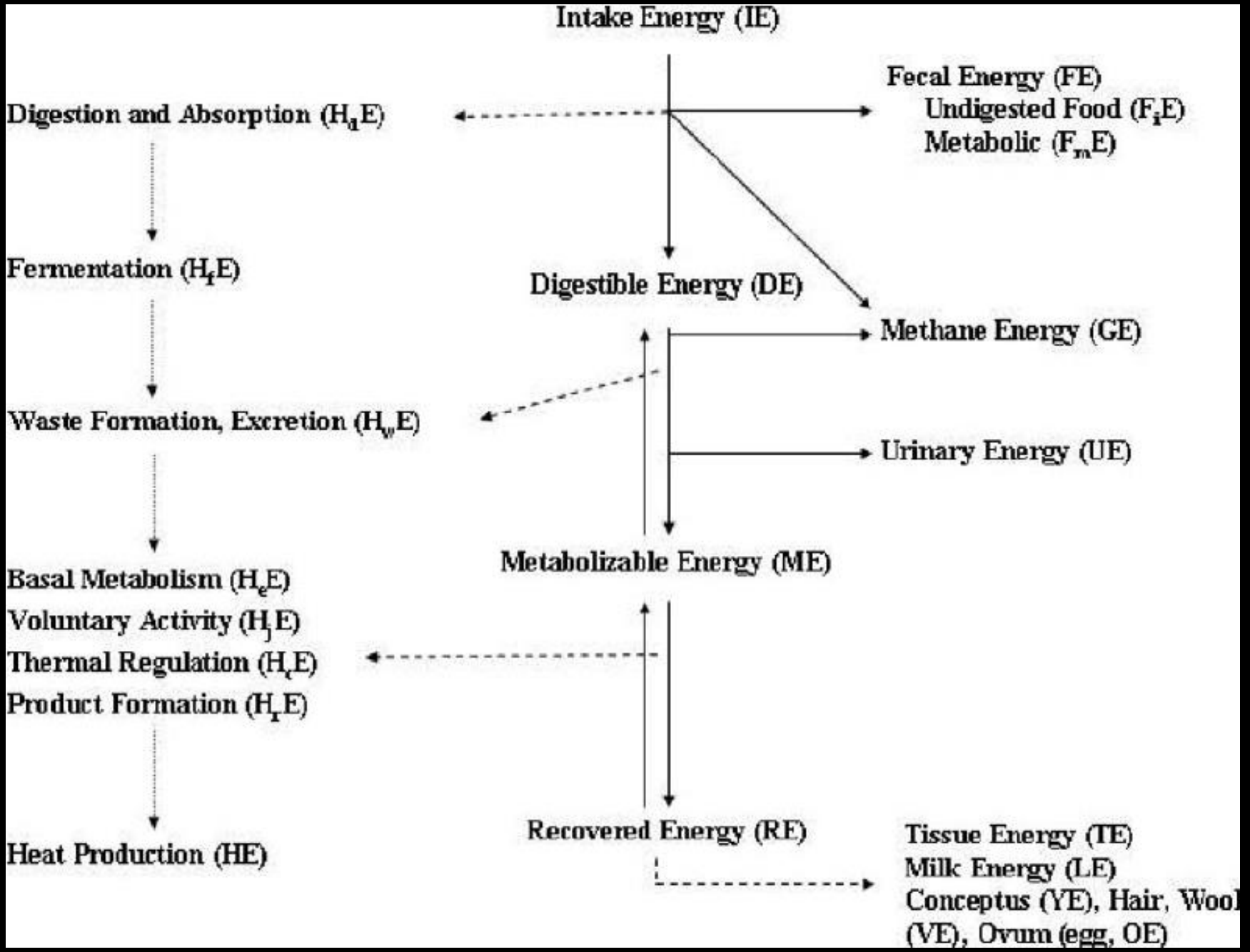
PARTITIONING OF FOOD ENERGY

DEPARTMENT OF ANIMAL NUTRITION

MJFCVAS

PARTITIONING OF FOOD ENERGY WITHIN ANIMAL

- GROSS-ENERGY (GE)- the amount of energy in the feed.
- DIGESTIBLE-ENERGY (DE)- The amount of energy in the feed minus the amount of energy lost in the faeces.
- METABOLIZABLE-ENERGY (ME)- the amount of energy in the feed minus the energy lost in the faeces and urine.
- NET-ENERGY (NE)- The amount of energy in the feed minus the energy lost in faeces and urine and heat-production through digestive and metabolic process, i.e heat increment.


Intake Energy (IE)
Fecal Energy (FE)
Undigested Food (F_iE)
Metabolic (F_mE)
Digestion and Absorption (H_dE)
Fermentation (H_fE)
Digestible Energy (DE)
Methane Energy (GE)
Waste Formation, Excretion (H_wE)
Urinary Energy (UE)
Metabolizable Energy (ME)
Basal Metabolism (H_eE)
Voluntary Activity (H_jE)
Thermal Regulation (H_tE)
Product Formation (H_pE)
Heat Production (HE)
Recovered Energy (RE)
Tissue Energy (TE)
Milk Energy (LE)
Conceptus (YE), Hair, Wool
(VE), Ovum (egg, OE)

Systems for expressing Energy Value of Foods in Ruminants, Pigs and Poultry

- Food evaluation systems are based on digestible, metabolic and net energy.

1. Gross energy
2. Digestible energy
3. Metabolizable energy
4. Net energy
5. TDN
6. Starch equivalent

GROSS-ENERGY (GE)

- It is defined as the energy liberated as heat when feed, faeces or any other substance is fully oxidized by burning a sample completely in a bomb calorimeter. Ordinarily expressed as kilocalories per kilogram of feed or mega joule/kg dry matter.
- Fat, because of their greater proportion of carbon and hydrogen, yield 2.25 times more gross energy per kg than carbohydrates and protein.
- Energy supplied by the food in excess of that needed for maintenance is used for the various forms of production. A young growing animal will store energy principally in the protein of it’s new tissue, a fattening animal will store energy in fat, and a lactating animal will transfer food energy into milk.

DIGESTIBLE ENERGY (DE)

- It is the energy of the feed less the faecal energy.
- Energy lost in the faeces accounts for the largest loss of energy, which ranges between 20-40%.
- It does not take into account losses of energy in urine and as combustible gases and during metabolism of feed. These losses vary among feedstuff.

METABOLIZABLE ENERGY (ME)

- It is the digestible energy less the energy lost in urine and combustible gases leaving the digestive tract, chiefly methane.
- It can also be defined as ingested gross energy minus faecal energy minus urinary energy minus gaseous energy.
- It is the portion of energy available for metabolism.
- ME is commonly used to evaluate feedstuff for poultry because the birds void urinary and faecal loss together.
- Urinary losses of energy is quite stable in given species and is usually 2-3% of GE. The losses are more in ruminants.

NET-ENERGY (NE)

- This is that portion of metabolizable energy which may be used as needed by the animals for work, growth, fattening, fetal development, milk production and heat production
- Net energy is obtained from ME by subtraction of heat increment.
- The portion of NE used for maintenance is the energy required to sustain life processes. The other portion of NE is used for tissue gain or milk or egg production.

TDN (TOTAL DIGESTIBLE NUTRIENTS)

- This is the simplest form of energy evaluation wherein the animal requirements and the value of feeds in meeting these requirements are expressed in terms of the weight of digestible material in the feed.
- TDN is simply a figure, which indicates the relative energy value of a feed to animals.
- It is ordinarily expressed in kg or in percent.
- TDN%= % DCP + %DCF + %DNFE + (2.25 x %DEE).

- The digestible ether extract is multiplied by 2.25 because on oxidation fat provides 2.25 times more energy as compared to carbohydrates.
- The principle of determining the TDN on feed is essentially the same as proposed by Henneberg and Stohmann at the Weende's experiment station.
- The feed and faeces are subjected to the proximate analysis namely, CP, EE, CF and NFE.
- The amounts of these nutrients not recovered in the faeces and are considered to be digested.

FACTORS AFFECTING TDN VALUE OF FEED

% Dry matter:

- In high moisture feed the nutrient concentration is less and so TDN value on fresh matter basis will be less.

% Digestibility of dry matter:

- The presence of indigestible substances like lignin, acid insoluble ash will interfere the digestibility of other useful nutrients.
- Hence feeds with high lignin and/or acid insoluble ash will have low TDN values.

Presence of minerals:

Since minerals as such contribute no energy, high mineral containing feeds will have low TDN.

Digestible fat in the feeds:

- The feed containing high digestible fat will have high TDN value because due weightage is given for it's high energy content in TDN system
- For feeds containing more digestible fat the TDN value sometimes exceeds 100%.

MERITS AND LIMITATIONS

MERITS:

- It is easiest to determine the digestible values through digestive trials unlike the ME and NE, which require complicated equipment and procedures.
- The TDN values for most of the feedstuff are obtained from carefully conducted digestion trial and are available in standard books.
- The energy requirements of the ruminant were in TDN values.

LIMITATIONS:

- Only the losses in faeces is accounted for in this method, but looses in combustible gases, heat of fermentation and urine are not considered.
- It over estimates the value of roughages. This is because the losses in methane and heat are relatively larger per unit TDN for roughages than for concentrates.
- The term total digestible nutrients consider only the energy giving nutrients whereas the micronutrients like minerals have not been included.

STARCH EQUIVALENT (SE)

- SE is defined as the number of kg of starch that produces the same amount of fat as produced by 100 kg of respective feed.
- This value is also called as starch value of the feedstuff.

$$SE = \left(\frac{\text{Weight of fat stored per unit of food}}{\text{Weight of fat stored per unit weight of starch}}\right) \times 100$$

- Kellner expressed the energy value of feedstuff by its fat producing ability relative to that of pure starch.

- (Eg). When we say starch equivalent of groundnut cake is 74, it means that 100 kg of groundnut cake can produce as much animal fat as 74 kg of pure starch, when fed in addition to maintenance ration. In other words 100kg of groundnut cake contains as much net or productive energy as 74 kg of the starch.
- Starch value of typical feed stuff has been determined by carbon nitrogen balance experiments.
- For rationings diets, starch values are computed from their content in digestible nutrients.

THANK YOU

REFERENCE:

D.V REDDY. PRINCIPLES OF ANIMAL NUTRITION AND FEED TECHNOLOGY.