Meeting Nutrient Requirements for

Animal production and Health

A- General considerations

1. Practical nutrition is an inexact science because:

(a) A variety of solutions are available for most problems; choice is dictated by pragmatic such as availability and cost of feed ingredients.

(b)There is considerable variation within and among groups of animals.

2- NRC and other tables of animal requirements and feed composition are **approximations** only.

3. Within prior knowledge, tables are needed to estimate **requirements** for:

- Energy
- Protein
- Minerals and vitamins
- Special dietary factors e.g. fiber

4- NRC tables also include values for feed composition but whenever possible, actual feed analysis values should be used.

Energy:-

Energy: define as the ability to perform work; it may be derived from most organic compounds ingested by an animal.The animal derives energy by partial or complete oxidation of molecule's ingested and absorbed from the diet or from metabolism of energy stored in the form of fat, protein, or carbohydrate.

Energy transfer from one chemical reaction to another by means of high energy bonds found in such compounds as ATP (adenosine triphosphate) and other related compounds.

Energy Form:-

In normal body metabolism there are tremendous dynamic movements of energy from one to another form. For example

- Chemical energy to heat (i.e. oxidation of fat, glucose, or amino acid)
- Chemical energy to mechanical energy (i.e. muscular activity).
- Chemical energy to electrical (i.e. glucose oxidation to electrical activity of nervous tissue).

B- Energy Requirements

1. Energy requirements are considered first because:

(a) All dietary constituents except minerals and water contain energy

(b) Feed ingredients mostly fed to supply energy (e.g. corn, forages) account for most of ration in terms of weight and cost

(c) Rate of energy supply and utilization dictates ability to use other nutrients e.g. protein, B-vitamins-energy is pacesetter for requirements of other nutrients.

2. Energy feeding units-why are there so many, and why does their use vary with species and type of production?

a -TDN= (total digestible nutrients)

TDN = DCP+DNFE+DCF+2.25(DEE) where:

DCP=digestible crude protein

DNFE=digestible nitrogen free extract

DCF= digestible crude fiber

DEE=digestible ether extract

- Traditional US energy unit but has several disadvantages especially for feeds varying widely in energy values e.g. forages.
- Major disadvantage is failure to take account of diet – related variation in energy losses in urine, CH4, and heat, which are most apparent in growing /fattening ruminant.

b- Digestible energy (DE):

- Widely used for non-ruminant (pigs, horses) because of very small CH4 losses and relatively constant (therefore predictable) losses in urine and heat.
- Suffers from same disadvantages as TDN when applied to ruminants.

c -Metabolizable energy (ME):

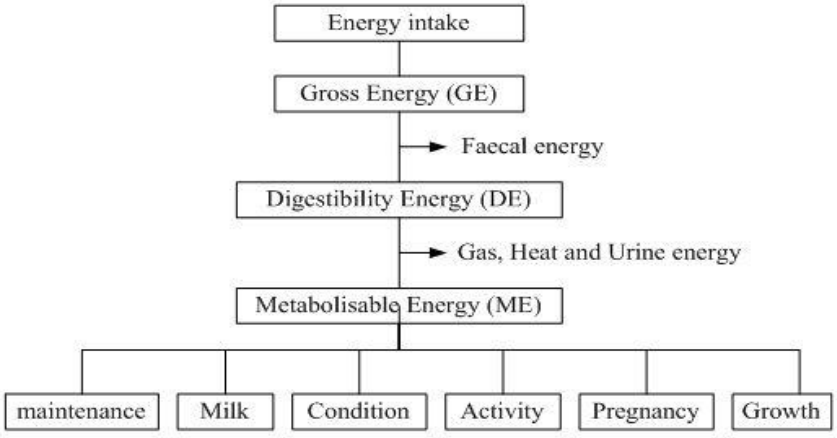
- Widely used for ruminants, mandatory for poultry
- Takes account of losses in urine and CH4 but not heat.

d – Net energy (NE):

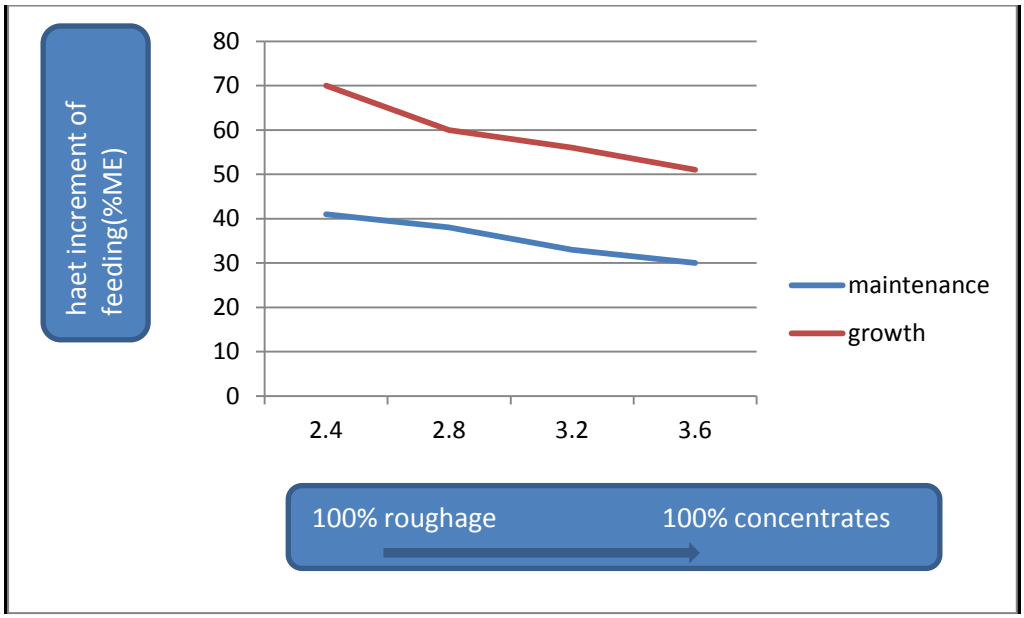
- NE= ME-HIF where HIF =heat increment of feeding

Heat increment of beef steer

- Net energy is considered to be used first for maintenance (NEm)and then, if there is surplus, for energy retention(RE)
- RE may be in body weight gain (NEg), milk (NEl), products of conception (NEc) ….etc.



- HIF is large (usually>30%ME) and can vary widely (30-70%ME) with diet quality, especially in growing /fattening ruminants.



- As a results NE value of feeds varies with purpose for which NE is used.

Net energy values for maintenance, weight gain, and lactation (Mcal/kg DM) of several common feeds (NRC, 1989)

Feed	International feed no.	NEm	NEg	NEl
Alfalfa hay	1-00-63	1.24	0.68	1.30
Corn silage	3-28-245	1.38	0.80	1.40
Cracked corn	4-20-698	1.94	1.30	1.84
Soybean meal 44%	5-20-637	2.06	1.40	1.94

Note: for all feed, NEm _~NEl>NEg

Because values for NEm and NEl are similar, NRC uses a single value (NEl) for all facets of feeding mature dairy cattle. However, different

values for NEm and NEg are used for feeding growing dairy and beef cattle, and sheep.

C. Protein requirements

1. Crude protein

(a) Traditional unit, measured as N × 6.25

(b) Included in table for all species

(c) Takes no account of protein quality, either in terms of amino acid composition for nonruminants or rumen degradability for ruminants

2. Specific essential amino acids

(a) Requirements for essential amino acids by swine, poultry and of lysine by horses are specified in NRC tables.

(b) Not applicable to ruminants

3. Rumen degradable protein (RDP) and rumen undegradable protein (RUP).

(a) Included in dairy and beef cattle tables, applicable only to ruminants.

(b) Rumen degradable protein (RDP) is needed to feed the rumen bacteria and ensure an adequate supply of microbial protein.

(c) Rumen undegradable protein (RUP) passes through the rumen unchanged and some of it can be digested in the small intestine. It complements the microbial protein that is produced and is necessary for cows producing at higher levels of production

(d) Aim is to optimize first, microbial protein synthesis from RDP, then rumen escape protein (RUP) to maximize total protein (= RDP+RUP) reaching the abomasum and small intestine.

	RDP Total	RUP	
Ration, lbs./cow/day	4.85	2.86	7.71
Absorbed, lbs./cow/day	2.20	2.42	4.62
	Microbes	By-pass	
% Absorbed	45	85	60
	RDP Total	RUP	