Nutrient requirements for reproduction

The reproductive cycle may be considered to consist of three phases:

- The first phase, which is important to both the sexes, comprises the production of ova and spermatozoa. Nutrient requirements for these processes in mammals are small compared with the egg production in birds.
- The second phase of the cycle is pregnancy
- The third phase is lactation.

In the female mammal, the quantities of nutrients required in excess of those needed for maintenance are small for the first phase, moderate for the second and large for the third.

Methods adopted for arriving at energy and protein requirement for production of sperm or ova

- Methods used for determining energy and protein requirement for ova or sperm production is similar to that of methods adopted in determining maintenance requirement.
  - In mammals, the spermatozoa and ova and the secretions associated with them represent only very small quantities of matter.
  - Nutrient requirements for the production of spermatozoa and ova are likely to be inappreciable compared with the requirements for maintenance and for processes such as growth and lactation.
  - Hence adult male animals kept only for semen production require no more than a maintenance ration appropriate to their species and size, but in practice such animals are given food well in excess of that required for maintenance in female of the same weight.
  - Animals given a sub-maintenance ration eventually show some reduction in fertility.
  - In males this may be brought about by a decreased output of spermatozoa or by a smaller output of the accessory secretions.
  - In females continued underfeeding leads to a cessation of ovarian function.

Methods adopted for arriving at energy and protein requirements for pregnancy

- Can be determined only through slaughter studies carried out during various stages of pregnancy.
- During pregnancy nutrients are required for **Growth of the foetus, uterus and placenta**
  1. Foetal growth
  2. Uterus growth

3. Placental growth
4. Mammary gland development
5. Pregnancy anabolism

- In the early stage of pregnancy the amounts of nutrients required for growth of foetus, uterus and placenta is small, and it is only in the last third of pregnancy that nutrient requirements for growth of the foetus uterus and placenta increases.
- Even in the later stages the net energy needed growth of the foetus uterus and placenta is small in relation to the maintenance requirement of the mother herself, but net requirements for protein and for calcium and phosphorus are quite appreciable in the last stage of pregnancy.

Mammary gland development

- Mammary development takes place throughout pregnancy
- It is only in the later stages that it proceeds rapidly enough to make appreciable nutrient demands.

Pregnancy anabolism / Extra-uterine growth during pregnancy

- The live weight gains made by pregnant animals are often considerably greater than can be accounted for by the products of conception alone.
- For example, a litter of 10 piglets and its associated membranes may weigh 18 kg. at birth, but sows frequently gain over 50 kg during gestation.
- The difference represents the growth of the mother herself, and sows may in their own tissues deposit 3 – 4 times more protein and 5 times more calcium as that was deposited in the tissues on conception.
- This is called *pregnancy anabolism*.
- Frequently much of the weight gained during pregnancy is lost in the following lactation.

Consequences of malnutrition in pregnancy

Malnutrition - meaning both inadequate and excessive intakes of nutrients - may affect pregnancy in several ways.

- The fertilized egg may die at an early stage (i.e. embryo loss)
- Later in pregnancy the foetus may develop incorrectly (teratogenicity) and die and then be resorbed in uterus or expelled before full - term (abortion) or carried to full term (still birth).

- Less severe mal nutrition may reduce the birth weight of young and the viability of small offspring may be diminished by their lack of strength or by their inadequate reserves (eg. of fat).

Egg production

- Good flocks of layer produce an average of about 250 eggs per bird per year (i.e. 70% production).
- Their eggs weigh on average 57 g.
- Birds usually start to lay at around five months (20-21 weeks) of age and continue to lay for 12 months (52 weeks) on average, laying fewer eggs as they near the moulting period.
- The typical production cycle lasts about 17 months (72 weeks)
- On average a bird produces one egg per day.
- Not all birds start to lay exactly when they are 21 weeks old.
- In areas where the climate is hot and humid, commercial hybrid laying birds produce on average between 180 and 200 eggs per year.
- In more temperate climates birds can produce on average between 250 and 300 eggs per year.

Methods adopted for arriving at energy requirement for egg production

Energy requirement for egg production depends on production percentage and egg size

Energy requirement

- Good flocks of layers produce an average of about 250 eggs per bird per year (i.e. 70% production).
- Their eggs weigh on average 56 g and have an energy value of about 0.375 MJ
- Metabolisable energy is used only at an efficiency of 80 % for egg production.
- A hen weighing 2 Kg has a fasting metabolism 0.60MJ / day.
- Energy required for 1 g per day body gain is 0.014 MJ.
- This information can be used as the basis for a factorial calculation of the nutrient requirements of layers.
- Metabolisable energy requirement for egg production = (fasting metabolism + Energy required for production of egg + energy required for body gain) x 0.8.

Estimates of Metabolizable Energy Required per Hen per Day by Chickens in Relation to Body Weight and Egg Production (kcal)

Body Weight (kg)	Rate of Egg Production (%)					
	0	50	60	70	80	90
1.0	130	192	205	217	229	242
1.5	177	239	251	264	276	289
2.0	218	280	292	305	317	330
2.5	259	321	333	346	358	371
3.0	296	358	370	383	395	408

Source NRC

Methods adopted for arriving at protein requirement for egg production

- Protein requirement for egg production is also calculated by the factorial approach.
- A sum of protein required for maintenance plus that required for egg production and that required for body gain will give protein required for egg production.
- Here also the factors to be considered are 70 %t production and utilisation of protein only at an efficiency of 80 %.

Protein requirement egg laying = (maintenance requirement + protein content of 1 egg) x 100/efficiency %

Methods adopted for arriving at energy requirement for meat production

Energy requirement

- The energy requirement for meat production can be determined by the factorial method.
- The factorial method can be expressed by a model:

$$\mathbf{NI} = \mathrm{N}\,m + \mathrm{N}\,l + \mathrm{N}\,f$$

- where NI is the nutrient intake, and N *m* , N *l* , and N *f* are the requirements of nutrients for maintenance, lean tissue, and fat deposition, respectively.
- The N *m* depends on body and carcass composition.

- The N *l* is limited by the genetic potential, and NI and N *f* are affected by environmental and genetic factors

Protein requirement

- The protein requirement for meat production can be determined by the factorial approach taking into consideration maintenance requirement of protein to which is added protein deposited in lean body mass.

Methods adopted for arriving at energy requirement for work

Energy requirement

- Mathematical models are used to predict the energy requirements for work.
- The energy required for work depends on
    - The amount of work
    - The time spent working
    - The intensity of the work
    - The nature of terrain were work is performed
    - Weight of the rider
    - Ability of the rider
    - The level of training of the horse
    - Environmental factors.

Energy requirement for work can also be calculated if the maintenance requirement of the horse is known.

- For light work the animal requires 20% more than the maintenance needs.
- For moderate work the animal requires 40% more than the maintenance needs.
- For heavy work the animal requires 60% more than the maintenance needs.
- For very heavy work the animal requires 100% more than the maintenance needs.

Protein requirement

- The protein requirement for working horses is determined by the factorial approach taking into consideration endogenous urinary nitrogen, metabolic fecal nitrogen, nitrogen losses in sweat, dermal loss of nitrogen, nitrogen deposited in tissues.