

Minerals

All forms of living matter require inorganic minerals, for their normal life processes, all animal tissues and all feeds contain mineral elements in widely varying amount and proportions.

Nutritional classification of minerals

Minerals that needed in relatively large amounts are referred to as major or Macro minerals. Its presence in the body and food is relatively high, including Ca, P, Mg, Na, Cl, K and S.

Those that are needed in very small amounts are referred to as trace minerals or Micro minerals. They are necessary for the metabolism including Zn, Mn, Fe, I, Cu and Co.

The macro minerals are required in concentrations of greater than 100 ppm or percentage of the diet, while trace minerals are required at less than 100 ppm or milligram per kilogram (mg/ kg) and are expressed as ppm and sometimes ppb (part per billion).

Minerals function in the biological system

Minerals cannot be synthesized by living organisms. Minerals they act as:

1. Minerals compost 3-4% of chick weight and about 10% of the egg
2. It is involved in the composition of many organic substances such as proteins and lipids, which are part of the formation of blood, muscles and organs (**Structural**).
3. It interferes with the work of most enzymes as cofactors and may enter into the composition of the enzyme molecule itself.
4. The formation of dissolved salts in the blood and body fluids (**as electrolytes**)
5. Regulation of osmotic pressure
6. The pH regulation (**Acid-Base Balance**).
7. It has a great effect on muscle movement and the transmission of nervous effects.
8. It interferes with the synthesis of some hormones (such as thyroxine and insulin).
9. It is related to blood clotting
10. The expression and regulation of genes,
11. Detoxification systems

The most obvious function of minerals in the body is to provide structural support (skeleton) for the body.

The function of minerals in the body of poultry

Minerals	Functions
Hcl	To maintain the pH in the proventriculus
Phosphorus salt and Sodium bicarbonate	To maintain the blood pH
Ca (calcium)	Essential for transportation of nervous pulses Laying hen use calcium to produce egg shell
The balance between minerals Ca, Na, Cl, K	This balance make the heart to function in proper way
P (phosphorus)	Essential nutrient in the cell for metabolic reactions involving energy transfer
P and (Fe, Cr, Ni, Mn and Zn)	Are invariable components of ribonucleic acid (RNA), which is vital to all protein synthesis
I (iodine)	Has a role in thyroid gland function
Mg (magnesium)	Has a role as cofactors of enzymes
Na (sodium)	Is necessary to release the additional K in the diet
Mn (manganese)	Prevention from Slipped Tendon disease
Copper, Zn and Se	In addition to certain vitamins and other nutrients act together or separately to form an active immune response

Distribution of minerals in chicken's body

Mineral	Place of the occurrence
Calcium carbonate	Found in egg shell and composing 90% of the shell
Calcium phosphate and calcium carbonate	They found in the skeletal bon
P (phosphorus)	Found in muscle proteins
S (sulfur)	Included in the egg yolk proteins and the feather
Mn (manganese)	Found in the body liquids and blood and in high level in the liver
Mg (magnesium)	Found in the liver, kidney, muscle proteins and bon
Fe (iron)	Part of the hemoglobin and the egg and act together with other nutrients or separately to form an active immune response
Se	Component of Glutathione peroxidase
Co	Component of vit. B12
I	Component of hormone thyroxin
Zn and S	Contained in insulin hormone
Sodium, K, Ca, p and Cl	Serve individually or collectively in the body fluids

Some recommendations should be considered when minerals used in poultry nutrition

1. Avoiding the random or inaccurate use of the minerals, mainly the micro minerals. Increasing the level of any mineral in the diet more than the requirement resulting in increasing the stress on the kidney. How?
2. Increasing the level of the mineral may be lead to the toxicity, when the body can't release it out
3. Increased minerals level out of the requirement could result in disturb of the optimum balance between minerals in the diet, Why?

Effect of increasing or decreasing mineral content of the diet on the bird

1. Reduction of the growth
2. Leanness (atrophy) of muscle
3. Reduction in the egg production
4. Deterioration of the egg shell
5. Increases mortality

Interrelation between minerals and other nutrients

Minerals are interrelated and balanced against each other, and most often cannot be considered as single elements with independent and self-sufficient roles in the organized bodily processes, examples such as:

- ▶ The relationship of Ca and P in formation of bones and absorption. There is an interrelation between Ca and P before absorption in the digestion tract and after absorption
- ▶ Interrelationship of Fe, Cu and Co (in vitamin B12) in hemoglobin synthesis and red blood cell formation.

Mineral requirements

Mineral requirements are generally represented in two ways:

1. In amounts per day or per unit of product, such as eggs.
2. In proportions of the diet dry matter consumed

The former method is more precise, but expressions as proportions of diet dry matter have obvious practical advantages.

Minimum mineral intakes must be sufficient to ensure the long-term maintenance of mineral reserves of the body and the product (etc.. eggs). Through homeostatic mechanisms, the bird body can make some adjustment to suboptimal intakes by reducing the amount of the mineral in its product. To conserve Ca for egg laying hen, the shell strength can be reduced in order to maintain production.

Factors affecting mineral requirements

Many factors affecting mineral requirements, including:

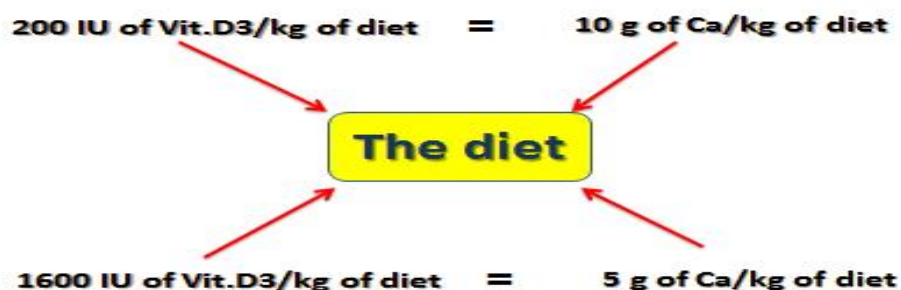
1. Kind and level of production
2. Age
3. Level and chemical form of minerals
4. Interrelations with other nutrients
5. Mineral intake
6. Breed
7. Bird adaptation

Mineral requirements are highly dependent on the level of productivity. The P requirements of laying hens tend to follow a similar pattern with increasing egg production, but those of Ca do not. For example, a non-laying hen can normally meet its Ca needs from a diet containing 0.2% to 0.3% Ca on a dry basis, whereas more than 8 - 10 times this concentration is necessary for a hen approaching the maximum egg production. The level of the Ca and P it's not the same in the diet in different situations. Birds require higher amount

of Ca for bone formation than for normal growth. But for P the requirement is the same for bone growth and normal growth.

Example: The relation of vitamin **D3** level in the diet with **Ca** and **P** requirements

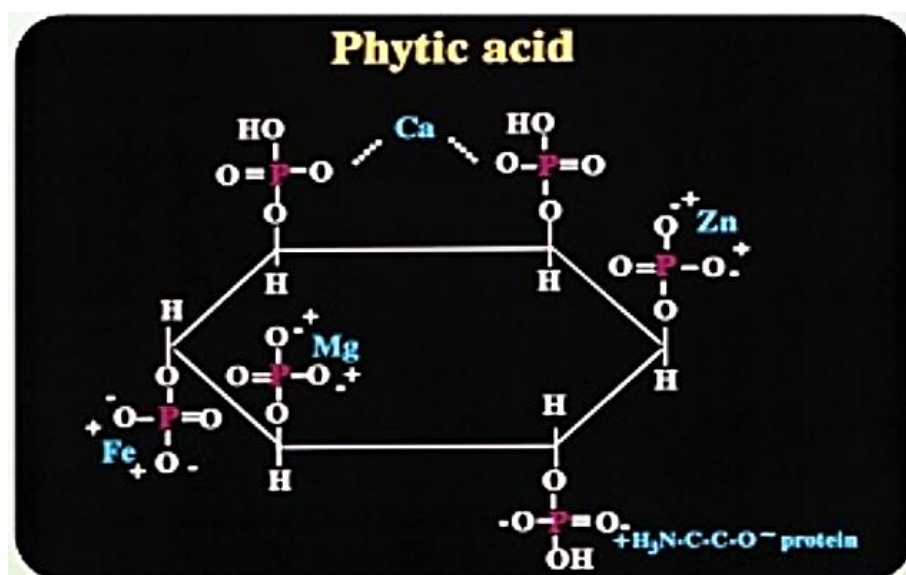
The relation of vitamin **D3** level in the diet with **Ca** and **P** requirements



Effect of Anti-nutritional factors on minerals intake

Those compounds found in the diet which inhibit the optimum utilization from the nutrients. For example most of the P presents in cereals and legumes are found as phytic acid. So, the available P should be concerned when determined the P in the diet.

Phytin salts are bonded with Ca also and make insoluble complex, that cannot hydrolyze with birds digestion tract secretions. Therefore this issue should be taken in consideration by increasing Ca level in the diet, when found that the level of phytic acid is high in the ingredients used for the feed formula.

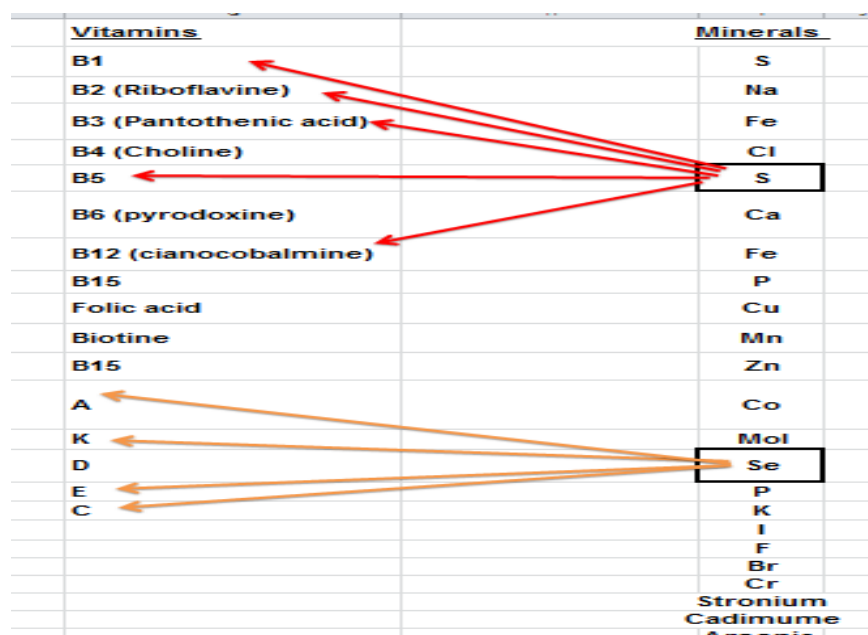
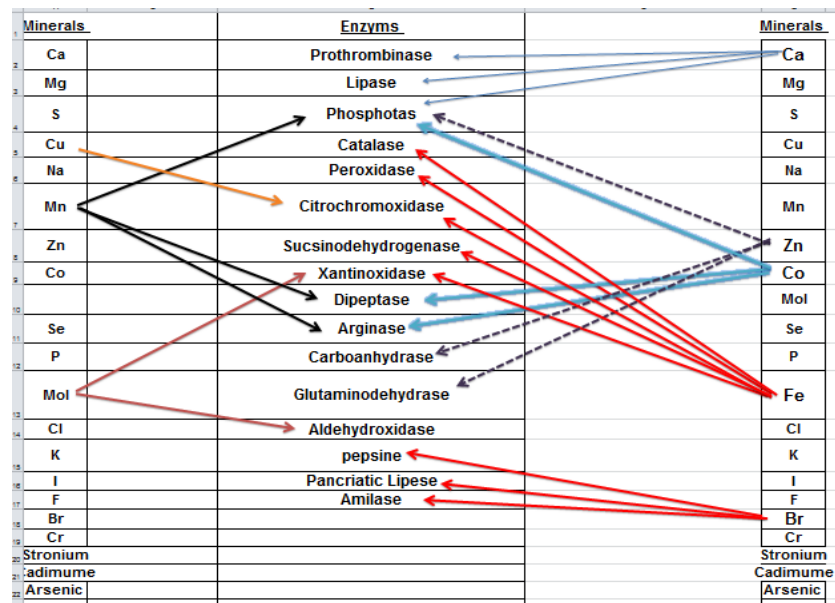


Calcium nutrition and egg shell quality

Shell strength is determined by the calcium metabolism of the hen which is a dynamic flow of calcium from the feed and bone to the uterus. There is a demand of 2–2.5 grams of calcium per egg produced, almost regardless of egg size. This calcium requirement must be principally supplied by the feed, but the hen may also mobilize calcium from medullary bone reserves to form the eggshell. Medullary bone acts as a readily available reservoir of calcium if required during shell formation. The quantity of calcium contributed to the eggshell from these bone reserves will depend on the rate and quantity of calcium absorbed from the

digestive contents during shell deposition. When adequate calcium is supplied by the diet, the bird will replenish and maintain the medullary bone calcium content during periods when no shell formation is occurring. If dietary calcium supply is inadequate, then calcium will be mobilized from cortical bone to meet the required levels for proper shell formation. Continued calcium deficiency will result in the appearance of soft bones and eventually a drop in production, or in acute deficiency, the bird will stop laying. Unless a bird enters into molt and experiences a drop of estrogen levels, the skeletal bone is not replenished with calcium.

Homeostatic: *The tendency of an organism or cell to regulate its internal conditions, such as the chemical composition of its body fluids, so as to maintain health and functioning, regardless of outside conditions*



Rickets and osteomalacia

الكساح ولين العظام

Rickets is the lack of calcification of the bones of the skeletal system. Osteomalacia is caused by several factors, the most important of which is V.D deficiency. Calcium and phosphorous, or as a result of a lack of balance between calcium and phosphorous in the bird's diet, or the lack of exposure to sunlight.

Usually, symptoms of rickets appear in chicks within four weeks, unless the deficiency is severe, then symptoms appear within two weeks. In adult birds, three months pass before symptoms appear on chickens that are given a diet with a deficiency. Its symptoms in chicks start with weak legs, slow or stunted growth, the bird moves with difficulty, and the joints of the legs, especially the knee joint, are swollen and red in color, and touching it causes pain to the bird, so it is unable to walk and lies on the ground and becomes unable to reach the feeders and drinkers. The bones of the legs and the spine, as well as the sternum, as well as softening of the nails, bones of the beak and the upper jaw, and they are easy to bend.

In laying hens, at the onset of symptoms, a decrease in egg production and a large number of eggs with weak shells is observed. The hatching rate decreases in fertilized eggs, as the embryos die on the eighteenth or nineteenth day of hatching. As the deficiency progresses, the beak softens and signs of osteoporosis appear clearly, so the bones lose their solidity and the sternum is twisted. The ribs are bent and their ends swell, as sometimes bone fractures occur, and the amount of calcium is reduced in the bones of the legs, which become cartilaginous. Rickets appears from time to time in young ducks, especially when raised in large numbers.

In order to treat these cases, we avoid the causes of rickets. When V.D is lacking, fish oil or cod liver oil is added at a rate of 1-2%, while exposing the birds to direct sunlight or supplying nurseries with UV-generating lamps (taking into account that ordinary glass and dust particles absorb ultraviolet rays from UV rays). the sun and prevents its access to the body). This is while providing the appropriate ratio of calcium and phosphorous in the diet. It is advisable to put pots containing shell powder or limestone in the basins in front of the birds, in addition to providing vegetables such as alfalfa and alder in front of the birds.

Slipped tendon disease

- For manganese and choline deficiency, there are increase in the tendon slippage in
- chicks, ducks, ducks and small turkeys (4-6 weeks) are susceptible to tendon slippage caused usually by imbalance of calcium and phosphorous in the diet.
- In chicks, twisting of the lower end of the shin bone and the upper end of the foot bone, swelling and severe flattening of the knee joints and slipping
- The tendon passing behind the knee from its normal position, the leg is twisted and the bird is unable to walk.

Manganese (Mn) deficiency

- Manganese deficiency in the diet of laying hens **causes a loss in body weight** and a **drop of egg production**.
- Result in **thin shell** and has **white spots** that are rough to the touch.
- The percentage of **hatching decreases**.
- The **embryos die** on the twentieth or twenty-first day.
- Its **growth is slow** and this can be treated by adding manganese sulfate.
- And corn is poor in manganese, and accordingly, the diets that contain large proportions of corn are likely to appear in them.
- It is also useful in this case to add protein, choline and glycine.

Lack of calcium or Vit. D

- Eggs with abnormal shell composition: This is the lack of calcium or V.D or both in the diet, and then it is useful to give calcium carbonate or to create a balance between phosphorous and calcium in the diet.

Egg eating habit

- It is one of the bad habits in laying birds and it occurs as a result of a deficiency in calcium or vitamin D.

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