

# Mineral mixture for poultry

## Sustainable way towards maximizing production potential

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*Poultry sector has surpassed all other agricultural sector in terms of growth rate throughout the world including India. In India, the livestock sector contributes more than a quarter of agricultural GDP and 4.9% of the national GDP. Infectious diseases and nutritional deficiencies are always a matter of great concern for profitable, viable poultry and livestock production because diseases are the foremost reason for economic losses. The disease conditions can be subdued by antibiotics, vaccination, and dietary nutrient composition manipulation. The easiest one among them, dietary manipulation, involves supplementation of vitamins and minerals, which are responsible for improving the immune, antioxidant, and nutrient status of birds.*

**Keywords:** Egg, Mineral mixture, Poultry

**M**INERALS are the inorganic substances required for maintaining the immune, antioxidant, and nutrient status and osmotic balance *vis-a-vis* formation of the skeleton in birds. The essentiality of the trace-minerals is due to their integral presence in the cofactors responsible for these body functions. Moreover, minerals, if deficient in the diet cause impairment in digestion and metabolism of nutrients leading to reduced feed efficiency and thereby increased nutrient losses. The use of organic minerals (minerals bound with the organic molecule) instead of inorganic minerals is a better alternative for improving the bioavailability of minerals so as to reduce environmental pollution due to excess minerals excretion. Minerals are known to interact with each other, so, excess of any particular mineral will lead to the deficiency of other interacting minerals. Therefore, supplementation of minerals in adequate quantity and proportion to poultry diet is imperative for obtaining maximum production with minimum input in a sustainable way.

### Mineral mixture and its advantages

The minerals that occur and are required for body functioning in higher amounts are regarded as macro-minerals (e.g. Calcium, phosphorus, potassium, sodium, chloride, sulfur, and magnesium). Macro-minerals are known to have a role in structural functions *viz.* bone ossification, tissue growth, and physiological functions *viz.* body fluid maintenance, homeostasis, blood clotting, impulse transmission, vital organs contraction, and egg formation. Nevertheless, trace minerals, are required and present at a low quantity in the body tissues and, are added to feed in mg per kg DM (ppm). Micro/trace minerals due to their principal role as a cofactor for enzymes is imperative for blood synthesis, hormone structure, normal reproduction, vitamin, enzyme synthesis, and for maintaining the immune and antioxidant status of the body.

Minerals deficiency signs are exhibited within a few weeks because of excessive drain of the deficient minerals from the body reserves like

skeleton, muscles, and liver for carrying out vital body functions. The deficiency signs start to appear as these body reserves start to deplete after a while. Deficiency disorders are one of the major challenges faced by animal nutritionists and poultry farmers. Some of the important functions of macro and trace minerals are depicted in Table 1.

### Need for supplementation of mineral mixture

India is showing consistent improvement in egg and poultry meat production. To sustain and augment this production, feeding has a vital role, wherein, energy, protein, vitamin, and minerals are the most important components. Modern poultry birds have a faster growth rate and high egg production potential. The feeds of fast-growing broilers and high egg-producing layers should be concentrated with every required nutrient to provide nutrients in adequate quantity and to achieve better feed efficiency. High egg production and fast growth have led the poultry birds prone to many

deficiencies and metabolic disorders that can be prevented by dietary manipulation. Mineral deficiencies are one among such deficiency disorders that can be prevented by supplementing minerals in adequate quantity and proportion. Minerals required for different production purposes of chickens are given in Table 2 and 3.

### Macro- and Micro- minerals for broiler and layer birds

Macro-minerals viz. calcium, phosphorus, sodium, and chloride have always received a great deal of attention and therefore vast studies have been conducted for estimation of their requirements. Common salt (NaCl) is added to the diet of chickens to suffice the requirement of macro-minerals sodium and chloride. Shell grit and ground powder of dicalcium phosphate and monocalcium phosphate are added to the chicken diet as a source of calcium and available phosphorus. Due to the abundance of potassium in the plant-based feed ingredients used for chicken's feed manufacture, potassium requirement is met from these ingredients itself.

Micro-minerals as discussed elsewhere in this context are crucial for the maintenance of vital body processes and growth purpose but are given less emphasis compared to macro-minerals. Contrarily, they may not be present in the required quantity and proportion in the feed prepared by poultry farmers at their farm. Hence, they need to be given special attention while preparing a mineral mixture or during the purchase of locally available mineral mixture to suffice the micro-mineral requirement of poultry. Most of the millers and farmers add mineral and vitamin premix containing the trace minerals required for chickens to the chicken feed having shell grit, dicalcium/ monocalcium phosphate, and common salt as a source of macro-minerals. Representative mineral premix composition to be added to the chicken feed is depicted in Table 4. It is recommended to add 1 kg of premix per quintal of feed adequate in macro-minerals.

Egg production needs high

**Table 1.** Important functions of minerals

| Mineral                   | Functions                                                                                                                                                                             |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Calcium                   | Essential for growth and structural integrity of bones; egg shell formation; nerve conduction; muscle contraction and relaxation                                                      |
| Phosphorus                | Participates in carbohydrates and fat metabolism; growth and structural integrity of bones and muscle                                                                                 |
| Sodium Chloride Potassium | Essential for nerve impulse conduction; muscle contraction; fluid balance; and for normal heart function; nutrient absorption                                                         |
| Magnesium                 | Essential for nerve impulse conduction; muscle contraction and relaxation; enzyme activation; skeletal growth                                                                         |
| Sulphur                   | Essential for feather growth, synthesis of amino acids, insulin, glutathione                                                                                                          |
| Copper                    | Essential for activation of enzymes; haemoglobin synthesis; help in improving immune and antioxidant status; have antibacterial and antifungal activity; have role in bone metabolism |
| Zinc                      | Essential in metabolism; enzyme activation                                                                                                                                            |
| Iron                      | Essential for haemoglobin synthesis, antioxidant status                                                                                                                               |
| Selenium                  | Essential for optimum performance of immune and antioxidant system; body metabolism                                                                                                   |
| Iodine                    | Essential for body metabolism                                                                                                                                                         |
| Cobalt                    | RBC formation and maintenance of nerve tissue; synthesis of vitamin B <sub>12</sub>                                                                                                   |
| Manganese                 | Acts as enzyme activator; essential for bone metabolism; helps in regeneration of RBC's                                                                                               |

Source: Compiled from Scott et al., 1969; Suttle, 2010.

**Table 2.** Macro-mineral requirement of broiler and layer chicken during different stages.

| Minerals (% DM)          | Broiler chicken |          |          | Layer chicken |            |               |                |
|--------------------------|-----------------|----------|----------|---------------|------------|---------------|----------------|
|                          | Pre-starter     | Starter  | Finisher | Chick         | Grower     | Layer Phase I | Layer Phase II |
|                          | 0-7 day         | 1-3 week | 4-6 week | 0-8 weeks     | 9-20 weeks | 21-45 weeks   | 46-72 weeks    |
| Calcium                  | 1.00            | 1.00     | 1.00     | 1.00          | 1.00       | 3.00          | 3.50           |
| tPhosphorus <sup>#</sup> | 0.70            | 0.70     | 0.70     | 0.70          | 0.65       | 0.65          | 0.65           |
| aPhosphorus <sup>*</sup> | 0.45            | 0.45     | 0.45     | 0.40          | 0.40       | 0.40          | 0.40           |
| Sodium                   | 0.20            | 0.20     | 0.12     | 0.15          | 0.15       | 0.15          | 0.15           |
| Chloride                 | 0.20            | 0.20     | 0.12     | 0.15          | 0.12       | 0.15          | 0.12           |
| Magnesium                | 0.06            | 0.06     | 0.06     | 0.06          | 0.05       | 0.04          | 0.05           |

<sup>#</sup> tPhosphorus- total phosphorus; <sup>\*</sup> aPhosphorus- available phosphorus

Source: Bureau of Indian Standards, 2007, and Indian Council of Agricultural Research, 2013

**Table 3.** Micro-minerals requirement<sup>†</sup> of broiler and layer chicken during different stages.

| Minerals (% DM) | Broiler chicken |          |          | Layer chicken |            |               |                |
|-----------------|-----------------|----------|----------|---------------|------------|---------------|----------------|
|                 | Pre-starter     | Starter  | Finisher | Chick         | Grower     | Layer Phase I | Layer Phase II |
|                 | 0-7 day         | 1-3 week | 4-6 week | 0-8 weeks     | 9-20 weeks | 21-45 weeks   | 46-72 weeks    |
| Manganese       | 100.0           | 100.0    | 100.0    | 70.0          | 60.0       | 60.0          | 60.0           |
| Zinc            | 80.0            | 80.0     | 80.0     | 60.0          | 60.0       | 60.0          | 60.0           |
| Iron            | 80.0            | 80.0     | 80.0     | 70.0          | 60.0       | 60.0          | 60.0           |
| Copper          | 12.0            | 12.0     | 12.0     | 12.0          | 9.00       | 9.00          | 9.00           |
| Iodine          | 1.2             | 1.2      | 1.2      | 1.00          | 1.00       | 1.00          | 1.00           |
| Selenium        | 0.15            | 0.15     | 0.15     | 0.15          | 0.15       | 0.15          | 0.15           |

Source: Bureau of Indian Standards, 2007

nutrient requirements that include protein, carbohydrate, fat, vitamins and minerals. Calcium and phosphorus have crucial role during laying phase wherein, majority of the

calcium is deposited in the egg-shell in the form of calcium carbonate, and phosphorus is concentrated in yolk in the form of phospholipids and few portions in the eggshell.

Bioavailability of calcium is 55% up to 45 weeks of age and thereafter it reduces to 40-45%, therefore, the calcium level of phase II layer diet is increased after 45 weeks of age. Modern broiler chicken grows at a faster rate and the skeletal growth is rapid during the first three weeks of life. Skeleton formation needs minerals in higher quantity so proper care should be taken while formulating a diet and mineral mixture for broiler chicken.

Mineral mixtures available in local markets can be purchased or can be manufactured if required in large quantities. Benefit in the latter lies in the fact that it can be manipulated as per the need, availability, and cost of ingredients in a particular geographical area. It is not always possible to prepare a mineral mixture at the farm level; hence the available mineral mixture can be supplemented to the poultry birds. Supplementation of organic minerals in adequate quantity and proportion will lead to minimum interaction between the minerals and thereby reducing the losses. Furthermore, it also improves nutrient utilization, feed efficiency, egg production, and hatchability in chickens. Supplementation of minerals will lead to efficient utilisation and reduced excretion of nutrients compared to the non-supplemented chickens and thereby reduces environmental pollution.

**Table 4.** Representative mineral premix composition for chicken.

| Ingredients             | kg/100kg |
|-------------------------|----------|
| Ferrous sulphate        | 26.7     |
| Zinc sulphate           | 24.2     |
| Manganese sulphate      | 32.3     |
| Copper sulphate         | 6.20     |
| Pottassium iodide       | 0.340    |
| Sodium selenite         | 0.095    |
| Limestone <sup>††</sup> | 10.1     |

<sup>††</sup>Limestone is used as a carrier.

### Organic Minerals in poultry

Organic minerals are the minerals bound to an organic compound, regardless of the type of bond between mineral and organic substances. Amino acids, peptides, and carbohydrates are most often used for organic mineral combinations. Organic minerals have major components as the organic substance, hence, they follow absorption mechanisms similar to the organic molecules and are not prone to interact with other minerals and anti-mineral compounds *viz.* phytate and oxalate. Organic minerals can bypass the solubilisation step in mineral absorption that is otherwise reduced in the alkaline condition of the intestine. For instance, phytate and oxalate bind the inorganic phosphorus and calcium respectively and render it unavailable to birds. Several scientists have demonstrated a clear trend of better utilisation and

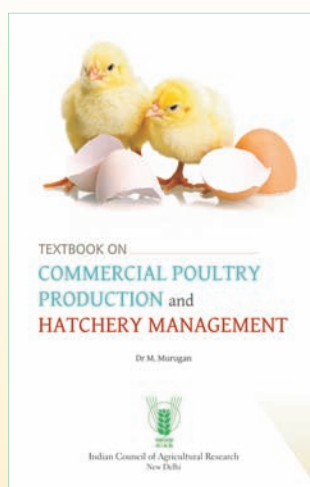
higher bioavailability of minerals by feeding organic mineral supplements. Therefore, organic minerals can be employed for improving the bioavailability of minerals along with other nutrients.

### Conclusion

Feed deficient in minerals affects the normal body and immune system functioning, and production potential of birds. Supplementation of minerals deficient in the diet of poultry birds improves feed digestibility, efficiency, growth performance, egg production, and immune status of poultry birds. The addition of organic minerals will enhance the bioavailability of minerals along with the utilisation of other nutrients. This improved bioavailability and nutrient utilisation will reduce environmental pollution due to the reduction in the excretion of minerals in the environment. Therefore, supplementation of minerals in adequate quantity and proportion is beneficial for improving the health status, production potential, and thereby the economic status of poultry farmers in a sustainable way.

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