

Improved Profitability with More Saleable Eggs

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Importance of Eggs:

Eggs are an amazing self-contained food source. Each one represents the most complete source of protein available in a single form. That's why it is so important to meet the needs of a growing population by consistently providing eggs that are of the highest quality, both internally and externally.



Dr. Koushik De

The eggshell quality is very important for the profitability of the layer operations. The target is to have the best eggshell quality during the whole life of the layers for having the biggest number of saleable eggs. Having a premium eggshell quality will allow to have more saleable eggs. For a good egg production, we need to produce the best pullet quality. The optimum characteristics of a premium pullet quality is the body development and good immunity status.

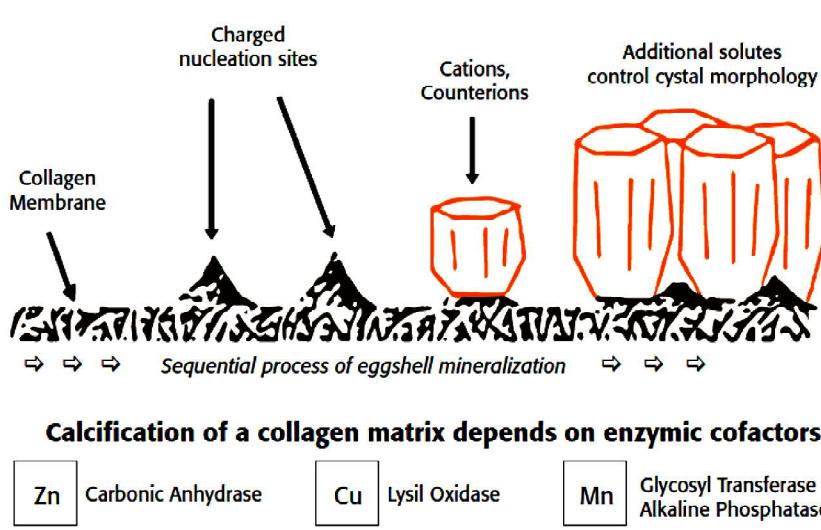
Whether they are bound for the table or a hatchery, high quality eggs begin with a well-structured hen nutrition program. Maintaining mineral balances supports shell strength, the internal structure of the

egg and tissue integrity of the unhatched chick. And, as laying hens age, mineral nutrition plays an increasingly important role, ensuring continued production of plentiful, high quality eggs and the overall well-being of the hen. Optimal nutrition means optimal performance.

Trace Mineral in eggshell formation:

The stages of eggshell mineralization are consecutively progressed in the distal portion of the isthmus (or red isthmus/tubular shell gland) through calcification at charged nucleation sites on the surface of the outer eggshell membrane. Then, organic aggregates are deposited on the surface of the outer eggshell membranes, where calcium carbonate spontaneously begins to precipitate in the form of calcite, and then microcrystals of calcite are arranged to form the shell attached to the outer membrane. When these processes complete, the eggshell has a well-orientated structure that is described as the mammillary cone layer, the palisade layer of the mineralized shell with the main component of calcium carbonate, and the cuticle composed of glycoprotein.

If we see the Calcification process of the Egg shell it has two parts, the calcium shell, and the collagen membrane where the calcium shell will be deposited on. The strength and the structure of the collagen is influenced by the Zn, Cu and Mn. Using MINTREX in the diet will improve the structure of the collagen, making a better



"basement" for the calcium crystal that will be deposited on top. The amount of Ca in small and big eggs is similar, so this collagen membrane will be more and more important as the eggs get bigger and the amount of Ca/cm² decreases.

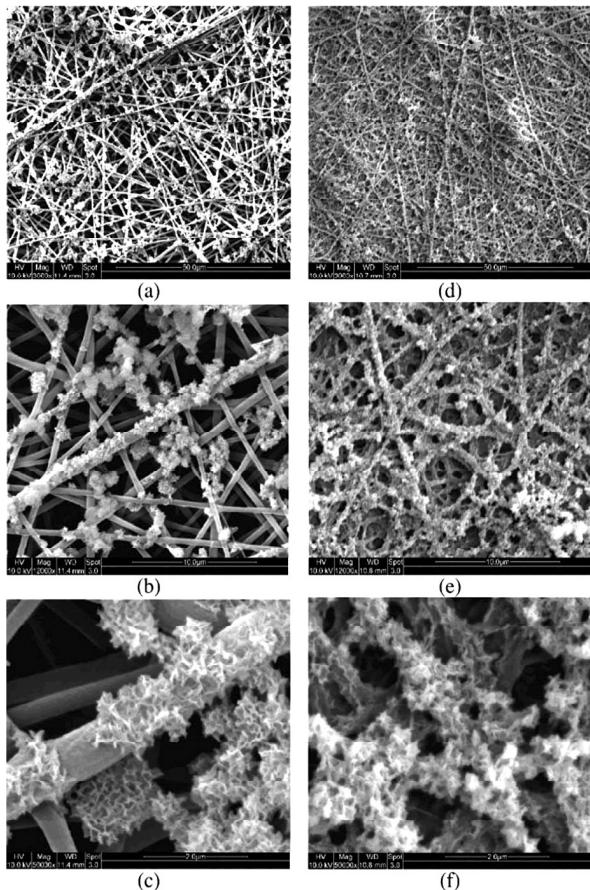


Fig. 2. Mineralization of n-HA on nanofibers after Ca-P treatment. (a) to (c) denote n-HA deposition on PLGA nanofibers. (d) to (f) represent n-HA deposition on PLGA/Col nanofibers.

The calcium amount will depend on the balance of Ca/P/Vitamin D of the diet and the deposition of the Ca will depend on several enzymes where the co-factors are Zn, Cu and Mn. A highly Bioavailable Chelated Mineral will provide the right levels of trace minerals for the activity of these enzymes.

Trace Mineral in Bone Structure:

Bone has basically two Matrix. Organic Matrix which is the basal structure of the bone and

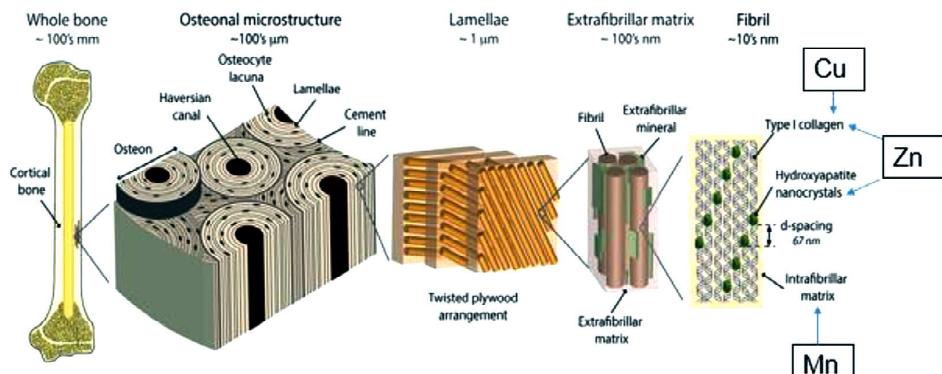
is a bonding of multiple fibers, mainly collagen fibrils (fine fiber, approximately 1 nm diameter). The collagen fibrils are **type I collagen**; produced by the osteoblast, a specialized fibroblast. Collagen represents approximately 80 to 90% of the organic matrix

- Inorganic part: it gives the strength to the bone. It's composed by **hydroxyapatite crystals** ($\text{Ca}_{10}[\text{PO}_4]_6[\text{OH}]_2$). These crystals are produced due to the osteoblast activity.

During the bone development Ca and P are very important but also the trace minerals play a key role in this process:

| | |
|------------------------|--|
| Zn Zinc | <ul style="list-style-type: none"> Micromineral involved in enzyme function for eggshell deposition Critical cofactor for calcium metabolism enzymes Necessary for deposition of eggshells Zinc nutrition becomes increasingly important late in lay |
| Cu Copper | <ul style="list-style-type: none"> Important micromineral for crosslinks of microstructure An important cofactor in cartilage forming enzymes Important for shell membrane formation, the foundation of a quality eggshell |
| Mn Manganese | <ul style="list-style-type: none"> Important in the synthesis of mucopolysaccharides Mucopolysaccharides are critical for bone and cartilage formation Inadequate Manganese nutrition can lead to eggshell thinning and reduced hatchability |
| Se Selenium | <ul style="list-style-type: none"> Integrally involved in the hen's oxidation defense system Can have a positive effect on egg interior quality and Haugh Units A key mineral for a functioning immune system |
| Ca Calcium | <ul style="list-style-type: none"> Eggshell is composed of Calcium in the form of Calcium Carbonate Calcium is derived from the diet and medullary bone reserves Inadequate consumption results in reduced production, eggshell quality and overall bird health |
| P Phosphorus | <ul style="list-style-type: none"> Macro minerals play important support role for Calcium mobilization Imbalances can result in caged layer fatigue and end eggshell production |

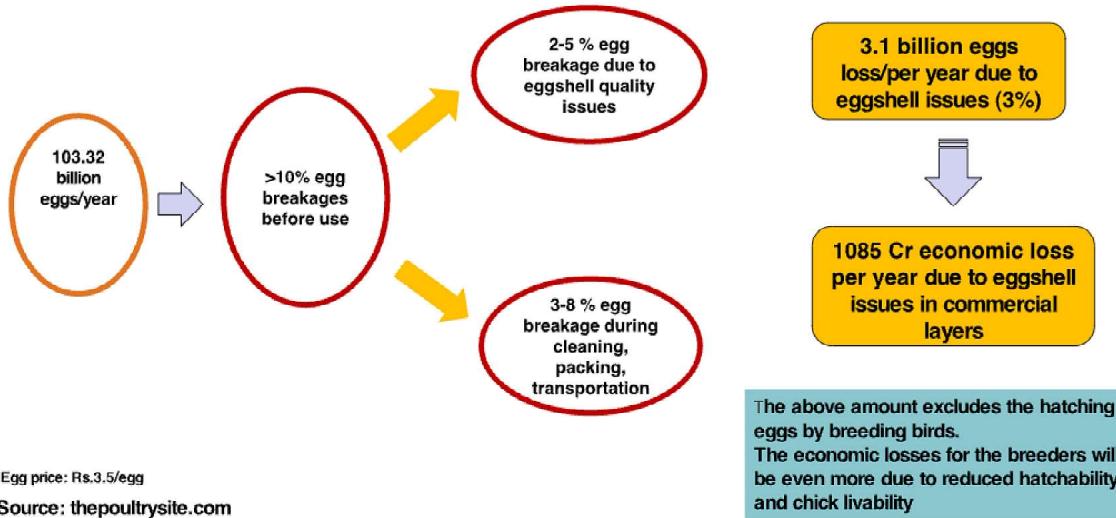
Highly Bioavailable trace mineral helps improving the collagen cross linking and ossification in bone tissue matrix.



Common Problems in Eggshell



Economic Losses due to Poor Egg Shell quality & Egg Breakage



Egg price: Rs.3.5/egg

Source: thepoultrysite.com

if we split it down the bone structure in smaller components, at the end we will see a matrix formed by collagen & intrafibrillar matrix and areas where Ca & P are deposited in the spots. Cu & Zn are important for development of collagen and nanocrystals and Mn for IFB matrix. A highly bioavailable chelated mineral will ensure proper formation of Collagen and intrafibrillar matrix and thereby ensure proper Ca & P deposition.

How Much Trace Mineral is squeezed by Egg?

The feed of commercial layer and breeder can easily cause trace mineral deficiency in bird. Normally these diets contain high amount of Ca &

phytate Phosphorus which is around 0.4-0.5% considering usage of bran in layer diet.

Let's see below example,

- Egg yolk 30% egg white 58% egg shell 12%
- Trace mineral in yolk: Zn 38-60mg/kg Cu 2-2.5 mg/kg Mg 1.1-1.2mg/kg
- Trace mineral in egg white: Zn 0.5 mg/kg Cu 0.02 mg/kg Mg 0.04mg/kg
- Every 100g eggshell content 3-4mg Zn and 8-10mg Fe

| Trace mineral | Zn | Cu | Mn | Iron |
|---------------|--------------------|-------------|---------|--------------|
| Egg yolk | 0.68-1.06 mg | 0.04-0.05mg | 0.02 mg | |
| Egg white | 0.02 mg | 0.001 mg | 0.001mg | |
| Egg shell | 0.02-0.03 mg | | | 0.06-0.07 mg |
| Total | 0.72-1.11mg | 0.04-0.05mg | 0.02 mg | 0.06-0.07 mg |

Now let's take Zn as an example and see how much of Zn is getting excreted and Absorbed through feed.

Zn as sample:

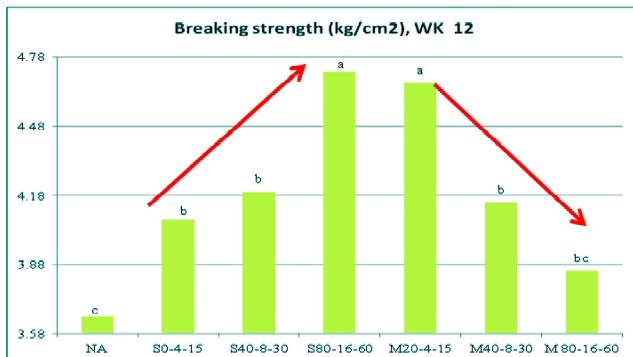
| | |
|-------------------------------|---------------|
| Layer feed intake | 110g |
| Zn in layer feed | 85ppm |
| Zn intake very day | 9.35mg |
| Zn bio-efficacy in Zn sulfate | 20% |
| Zn absorption | 1.87mg |

➤ Zn excreted by egg **0.72-1.11mg**, it is about **38%-59% of Zn intake in body!**

From the above example we can analyze a significant amount of Zn is getting excreted in the environment.

Bis Chelate in Improving eggshell breaking strength:

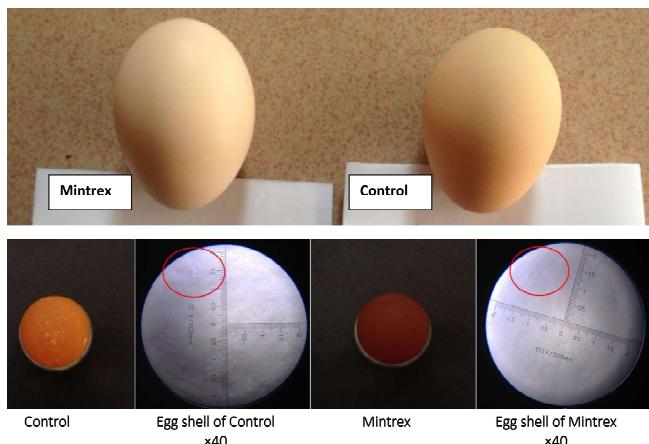
MINTREX Chelated trace mineral is the only globally available bis chelate having 2:1 metal to ligand ratio and a neutral charge ensuring the metal has maximum protection. Novus experience has shown that when we use MINTREX minerals at reduced dosage (Zn: Cu 20:4) it can improve the eggshell breaking strength and can replace high level of ITM (Zn: Cu 80:16)



Low dosage of MINTREX improve eggshell breaking strength (kg/cm²)

A trial comparing a diet supplemented with MINTREX and a normal feeding program showed improved eggshell quality late in lay, as well as improved egg weights without compromising shell strength. Comparisons with both inorganic trace minerals and other organic trace mineral sources indicate MINTREX improves tissue supply of zinc,

Egg Shell Surface is smoother in MINTREX Group & denser than Control group.



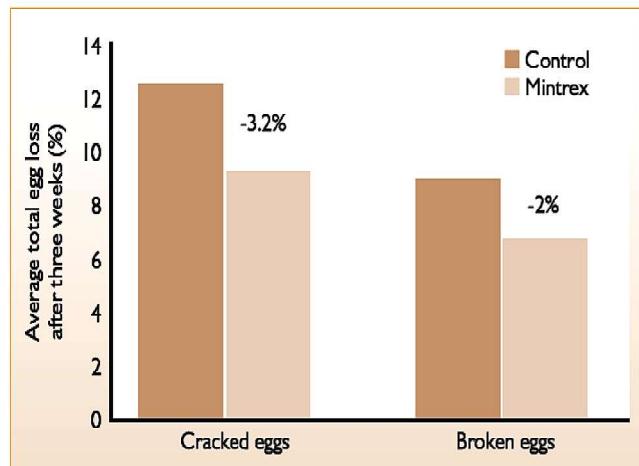
Denser Eggshell in MINTREX Group

MINTREX improves eggshell strength and eggshell thickness in layer.

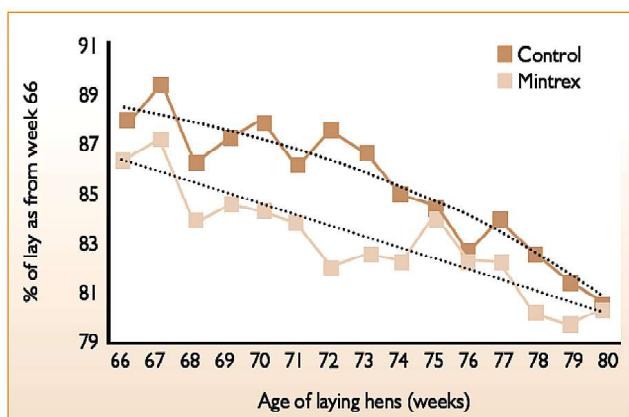
| Treatment | Eggshell strength (kg/m²) | Eggshell thickness (mm) | | |
|-----------|---------------------------|-------------------------|---------------|---------------|
| | | Sharp side | Middle | Blunt side |
| Control | 3.99 ± .72 | 0.35 ± .03 | 0.34 ± .02 | 0.33 ± .02 |
| Mintrex | 4.39 ± 1.04 ** | 0.37 ± .02 ** | 0.38 ± .02 ** | 0.36 ± .03 ** |

** p<0.01

copper, and manganese, and has a direct beneficial effect on connective tissue and bone development in poultry.



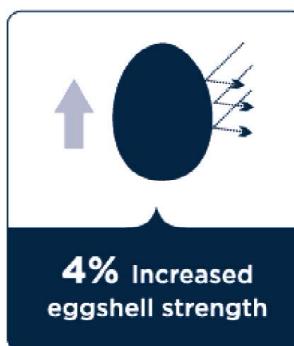
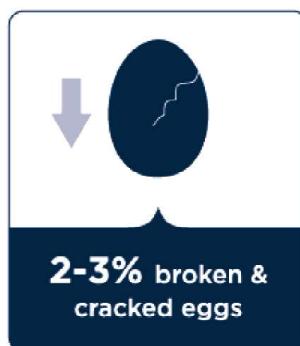
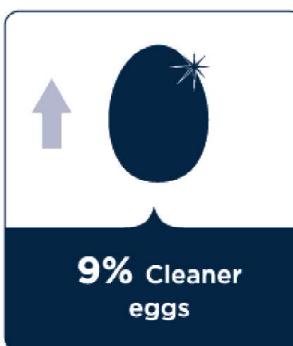
Improved eggshell quality in commercial layers 72-81 weeks of age.



Increased laying rate, especially in late lay. After 66 week laying rate remain higher for MINTREX birds.

In layers, these effects support improved bird health, eggshell strength and egg quality factors which are critical to today's industry performance parameters.

Novus meta-analysis of various research globally have shown that inclusion of MINTREX improves Egg shell quality by



*Results based on meta-analysis of various research trials done globally

Conclusions:

Egg quality, both internal and external, determines the degree of profitability in commercial layer operations. Trace minerals play an important role in enzyme activities that are responsible for maintaining eggshell formation and membrane quality. The risks associated with trace mineral deficiency include reduced egg mass and poor eggshell quality.

For any layer operation, getting more saleable eggs is the key to increasing profitability. Challenges such as dirty eggs, broken and weak shells can lead to

poor interior quality, due to potential contamination from external pathogens. The most effective way to achieve the highest production possible is by boosting flock performance through optimal nutrition.

In addition to performance improvements, feeding layers a special mineral enriched diet can enhance the mineral content of eggs they produce. Zinc, copper, and manganese can be passed on to the egg in higher levels, provided the animal is fed a highly bioavailable source of those trace minerals. Consumers eating these eggs will then have the added benefit of consuming more healthy minerals in their diet. Only MINTREX chelated trace minerals consistently deliver more essential trace minerals to the bird, while also minimizing mineral excretion. That translates into healthier layers, more efficient production and ultimately, improved profitability for the producer.

Novus International, Inc. is a leader in scientifically developing, manufacturing and commercializing nutrition and health solutions for the animal agriculture industry. Novus's portfolio includes ALIMET® and MHA® feed supplements, MINTREX® chelated trace minerals, CIBENZA® enzyme feed additives, NEXT ENHANCE® feed additive, ACTIVATE® nutritional feed acid, and other feed additives. Novus is privately owned by Mitsui & Co., Ltd. and Nippon Soda Co., Ltd. Headquartered in Saint Charles, Missouri, U.S.A., Novus serves customers around the world. For more information, visit www.novusint.com.