

Modern mineral management in broilers

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The incorporation of essential trace elements and vitamins into the diet of animals is a common management tool for optimising zootechnical parameters and welfare status.

Organic trace minerals have been used in broiler feeds for some time now, showing promising advances in improving live performance, bird health, processing yield and meat quality characteristics. Another important point is that the use of organic minerals reduces mineral levels in litter on land, due to a reduction in the mineral excess in litter. The most commonly used organic minerals include zinc, manganese, selenium, copper and iron.

Organic vs inorganic minerals

In general, the use of inorganic minerals can produce interactions with other compounds in the diet. These interactions include:

- Lower bioavailability of minerals for the animal.
- Lower absorption of other nutrients like calcium.
- Inorganic minerals, such as sodium selenite, have a documented pro-oxidant influence.

Minerals**	NRC 1994	Leeson	Bioplex TR Se*
Iron	80	80	5
Copper	8	10	5
Manganese	60	70	20
Zinc	40	80	20
Selenium	0.15	0.3	0.3

* Composition: Bioplex Zn, Bioplex Mn, Bioplex Fe, Bioplex Cu, Sel-Plex and potassium iodide

Table 1. Requirements of trace minerals (mg/kg of feed) for broilers compared to inorganic levels of Bioplex TR Se.

In addition, in large scale commercial live-stock production systems, many environmental concerns have arisen surrounding the excess mineral concentrations in



Good quality skin. Organic zinc prevents skin damage like cellulitis and skin tearing.

manure, which can lead to mineral deposits that exceed crop nutrient levels.

The National Research Council (1994) gives the minimum levels necessary for optimum productivity. In practice, feed manufacturers use much higher concentrations than those specified by NRC (1994), to achieve maximum performance, which can produce more pollution in the field.

When we work with organic minerals we can decrease concentrations without getting worse zootechnical results and produce less pollution (Table 1).

Main roles of organic minerals

The main roles that minerals have, with respect to poultry physiology and more specifically broilers, are:

- To play a vital role in various metabolic, enzymatic and biochemical reactions.
- Cellular and humoral immunity.
- Feathering.
- Skin quality.
- Meat yield.

Importantly, the use of organic selenium (Sel-Plex) is justified by the fact that the use of sodium selenite in feed has a narrow margin between nutritional requirement and toxicity (Table 2).

In addition, it is necessary to take into account that inorganic selenium demonstrates poor absorption and availability. The use of an organic form of selenium, such as Sel-Plex helps avoid this problem. Sel-Plex is obtained from enriched yeast. Yeast utilises selenium to form selenomethionine (Se-met), which can be absorbed as an amino

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Table 2. Summary of acute oral toxicity trials comparing Sel-Plex and sodium selenite.

Test substance	Species/strain	LD ₅₀ (mg/kg/bw)	GHS category	EU symbol/risk phrase
Sel-Plex	Rat (CHS Sprague-Dawley)	>2,000	5	None
Sodium selenite	Rat (CHS Sprague-Dawley)	5-50	2	T/R25
Sel-Plex	Rat (Sprague-Dawley CD)	>2,500	5	None
Sodium selenite	Rat (Sprague-Dawley CD)	30-50	2	T/R25
Sel-Plex	Mouse (CHS Swiss)	>2,000	5	None
Sodium selenite	Mouse (CHS Swiss)	5-50	2	T/R25

T=Toxic; R25= Toxic if swallowed (Council directive 78/631/EEC)

Farms	Bird numbers	Placement date	Slaughter date
1	24,480	02/04/2012	15/05/2012
2	82,212	10/04/2012	27/05/2012
3	21,930	12/05/2012	01/06/2012
4	36,006	12/05/2012	25/06/2012
5	24,000	25/05/2012	05/07/2012
6	82,000	29/05/2012	12/07/2012
7	37,000	29/05/2012	12/07/2012
Total	307,628	29/05/2012	12/07/2012

Table 3. Number of chicks and dates.

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acid and can be used by any tissue that utilises methionine. Organic selenium is

known to be retained in the body at two to three times the rate of its selenite form. In the case of manganese, in trials in which

chicks were fed with Mn methionine, the Mn was 74.4% more available than the inorganic source (MnO).

Zinc, a structural element, is involved in enzymatic proteins. There are different trials which show that chicks which were fed organic Zn feathered earlier, with a more fully developed feather cover.

Iron is a micromineral involved in pigmentation in the feathers and is a constituent of blood. Under normal physiological conditions the excretion of iron is quite minimal. However, iron salts can be formed from insoluble phosphates in the digesta. Organic forms of the mineral do not have this problem. Copper is involved in iron metabolism and is also important for normal bone formation – in particular cartilage formation. It also helps in the maturation of erythrocytes.

A review on comparative intestinal absorption of metal-amino acid complexes shows improved intestinal uptake of copper, magnesium, iron, and Zn-amino acid complexes versus inorganic forms (SO₄, O₂, CO₃) of the same metal ions.

On farm: a practical example

After reviewing the advantages of the use of organic minerals and what role they have in broiler nutrition, we are going to focus on analysing a practical case from a broiler company which was interested in seeing the impact that organic minerals could have on broiler production.

The objective of the current study was to examine the improvement with the use of Sel-Plex and Bioplex in a European-type broiler company. A total of 307,628 one-day-old, male Ross 308 broilers were fed from April to July (Table 3).



Problems in feathering (above) and then improvements in the feathering process after supplementation with Bioplex and Sel-Plex (below).



This European broiler company had problems of feathering on farm and a high level of second quality carcasses due to skin injuries. The main goals of this study were:

● **Improve feathering.**

The use of organic Zn enhances the feathering of the animals and improves the capillary fragility, improving the carcass appearance.

The pictures on page 8 were taken on the same farm and show broilers before and after being fed with Bioplex and Sel-Plex. An improvement of feathering can be seen.

● **Decrease the amount of second quality carcasses due to skin injuries.**

Optimum carcass quality in broilers requires intact skin, free of sores, scabs, scratches, tears and other defects that require trimming (ie, cellulitis). For this reason, decreasing the amount of second quality carcass, due to skin injuries, was one of the main objectives of this trial.

To achieve a good carcass quality one of the most important points is to achieve a reduction in capillary fragility.

Economic losses, due to poor carcass quality in market grade meat, includes efficiency loss, yield, and product wholesomeness in the plant. One solution is to use Sel-Plex and Bioplex for improving carcass commercial value (Table 4).

Skin lesions.



Poultry groups	Carcass weight (71% Rto) (g)	First quality carcass (%)	Second quality carcass (%)	Carcass average price (€/kg)	Carcass economic value improvement (%)
May average	1832	86.92	13.08	3.15	
Bioplex+ Sel-Plex May	1872	87.66	12.34	3.23	102.5
July average	1751	79.95	20.05	2.98	
Bioplex+ Sel-Plex July	1833	82.26	17.74	3.14	105.4

Table 4. Economic impact due to the decrease in the amount of second quality carcasses.

● **Improve breast yield.**

Breast meat has had greater value and use than other poultry meat. The amount of breast meat at the time of slaughter is a function of age and weight, as influenced by nutritional and environmental conditions. It should be recalled that inorganic minerals like sodium selenite have a negative pro-oxidant influence on breast meat quality. For this reason the importance of replacing inorganic with organic minerals must be stressed.

In the case of Sel-Plex and Bioplex in this trial it was shown that they help improve breast yield results. During this trial there was a comparison between broilers which were fed with Sel-Plex and Bioplex and historic data breast yield (Table 5).

The first quality breast yield average improvement in broilers which were fed with Sel-Plex and Bioplex was +2.79% (in weight, 14.95g).

In addition, a meticulous review was done on farm and in the slaughterhouse to modify management guidelines which could be implicated in these problems.

Conclusions

- Chelated minerals can be utilised at a much lower concentration in the diet than inorganic minerals, without a negative impact on production performance.
- Bioplex improves feathering cover. Earlier and more fully-developed feather cover reduces injuries on broilers due to scratches and other problems on the slaughter load.
- The inclusion of Sel-Plex and Bioplex consistently improves meat quality in modern broilers.
- Percentage breast performance is improved with the use of Sel-Plex and Bioplex. ■

Table 5. Breast yield comparison between treated poultry and the historic data.

Group	Breast total yield (%)	Breast first quality yield (%)	Breast second quality yield (%)
Average birds on Bioplex + Sel-Plex	29.95	27.30	2.642
Average control birds, period January-May	29.69	26.57	3.13
Improvement index on the treated poultry	+ 0.88	+ 2.79	- 15.6
P- value	0.001	0.001	0.001

Historic data of the breast yield during the period January to May: Total breast yield 29.69%; First quality breast yield 26.57%; Second quality breast yield 3.13%