Artal
SMART AGRICULTURE | 1895-2020
125 years

Technical information

# CHELATES & COMPLEXES

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GENERATION 4
LA CALIDAD DE LA EXPERIENCIA

## Trace elements

**Microelements** are required elements for plant metabolism in very small amounts.

They are found in proportions between 5-200 ppm to 0,02% of plant dry matter.

These elements are considered microelements:

**Chloride (Cl), Iron (Fe), Boron (B), Manganese (Mn), Magnesium (Mg), Zinc (Zn), Copper (Cu), Molybdenum (Mo) and Nickel (Ni).**

Some chemical elements play an important role in all living beings. They are known as **Nutrients**.

They are divided into four groups:

a) **CHO elements:** Acronym for Carbon, Hydrogen, and Oxygen. They are the major elements in all living beings.

b) **Macroelements:** Elements that are found in large quantities in plants. They are key for their survival. Nitrogen, Potassium and Phosphorus are included here.

c) **Secondary macroelements:** Macroelements presents in lower concentrations that the primaries. Sulphur (S), Calcium (Ca) and Magnesium (Mg)are included here.

d) **Microelements**: Nutrients present in plants in really low concentrations. Chlorine (Cl), Iron (Fe), Boron (B), Manganese (Mn), Zinc (Zn), Copper (Cu), Molybdenum (Mo) and Nickel (Ni) are included here.

## Nutrient's application

To avoid or correct a deficiency of the mentioned nutrients crops are applied:

### Mineral Compounds

They are natural minerals: **oxides**, **nitrates**, **chlorides** and **sulphates**. The widest used compounds are sulphates and nitrates. These elements, since they are solo, they can react freely with soil ions, making them precipitate.

### Complexes & Chelates

Nutrients attached to a molecule that avoid them precipitating as an inorganic salt and makes their assimilation by the plant easier. There are two kinds of molecules, or agents: **Complexing** or **Chelating** agents.

## Agents

An agent is the molecule with the ability to attach itself to elements with an ionic valence of +2 or +3. We classify them into **complexing** or **chelating** agents, and from **natural** or **synthetic** origin.

## Chelates

**Chelating agents** are molecules with the ability to attach to nutrients (Zn, Cu...) forming **VERY STABLE** bonds. They are all synthetics. The most common agents are **EDTA**, **HEDTA** and **EDDHA**. They are not biodegradables, so they leave residues in the ground.

## Complexes

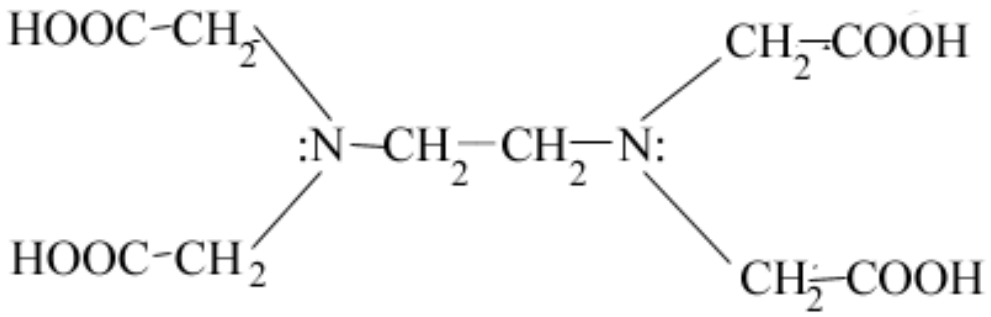
**Complexing agents** are molecules from synthetic and natural origin that form **fewer stable bonds** with nutrients than the chelating agents. In return, they are fully biodegradable and easier to produce.

Among **synthetic** complexing agent we find gluconic and heptagluconic acids, and among the **natural** ones, lignosulphonates, amino acids, reducing sugars, humic and fulvic matters...

Chelating

## EDTA

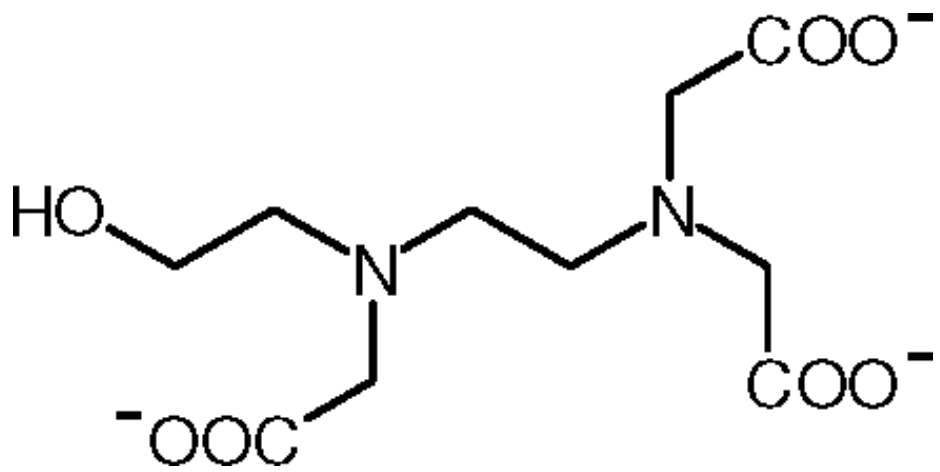
This is the most widespread agent in the market, and it is used along all microelements. It shows a higher affinity (chelating constant) slightly superior to HEDTA.



Chelating

## HEDTA

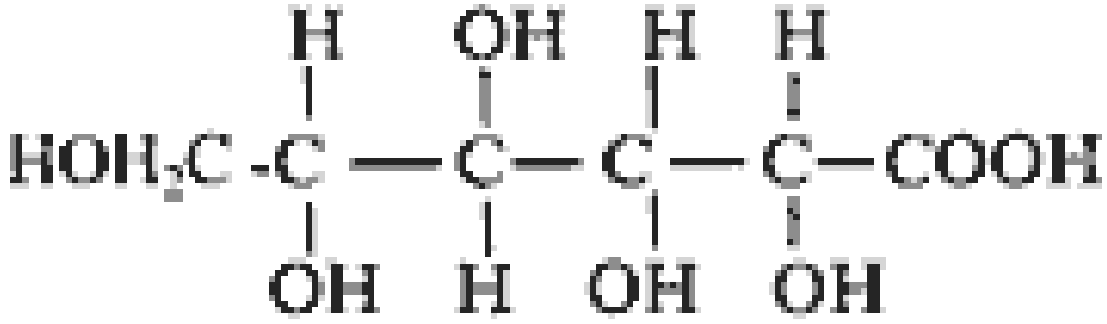
This chelating agent is similar but different to EDTA. It shows less affinity for some microelements than EDTA, but its extra Hydrogen makes these compounds **more water-soluble** and **less photosensible**, making them more suitable as foliar application products than EDTA chelates.



## Complexing (synthesis)

### Gluconic Acid

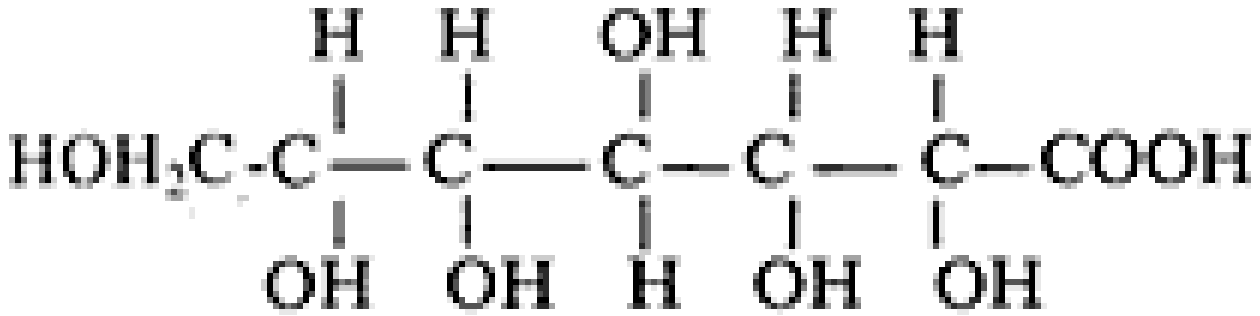
This complexing agent shows a good affinity for ions, but this affinity is lower than any chelating agent. It is a completely biodegradable agent, leaving no residues in the soil.



## Complexing (synthesis)

### Heptagluconic Acid

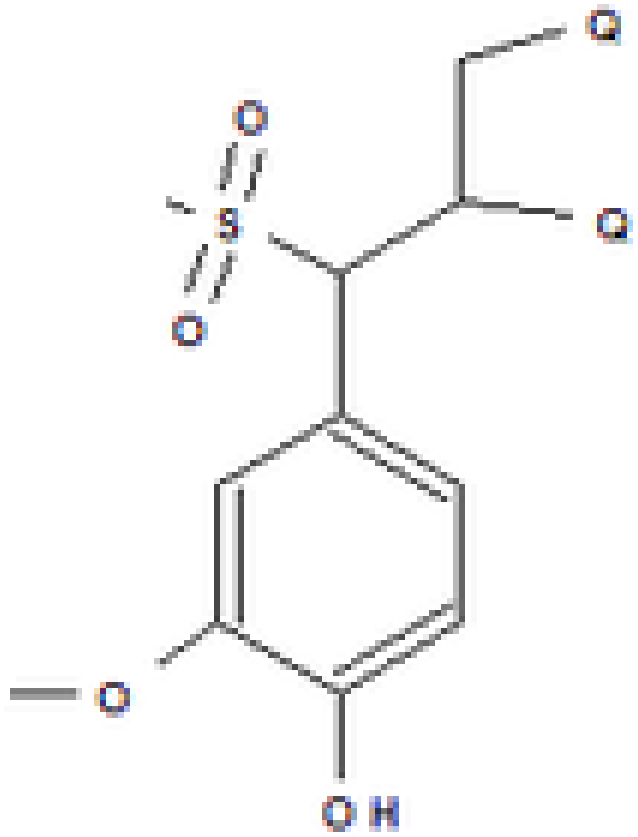
This complexing agent is similar to the gluconic acid but it has more anchoring points, and a single agent can complex several nutrients. Also it shows great affinity for nutrients at basic pH, making it suitable as a complexing agent in limestone soils.



## Complexing (organic)

### Lignosulfonates

These compounds, extracted from wood, are completely natural, so besides its complexing power they act as organic matter when they are applied. They are fully biodegradable and complex macro and microelements.



## Boron & Molybdenum

Both boron and molybdenum cannot be chelated/complexed **because of their ionic valence.** Their application is **exclusively mineral.**

Boron is often reacted with ethanolamine, producing the compound **Boroethanolamine** that improves the formulation of Boron-containing products since they increase the quantity of Boron that can be solved in the formula.

What to use

## Mineral compounds

**Benefits**

- Mineral compounds (nitrates, chlorides…) are the cheapest fertilizer products.

**Drawbacks**

- They react freely with soil ions, precipitating as insoluble salts if soil pH favours the precipitation.
- Less affinity for the plants. Mineral elements don't present as much affinity for toots and stomata as complexes/chelates.

# Chelates & Complexes



## What to use

### Chelates

**Benefits**

- The elements are strongly attached to the agent, that avoids them to precipitate in the soil at a **wide pH range**.
- They favour root and foliar assimilation of the elements.

**Drawbacks**

- They are more expensive than the complexes.
- They are not biodegradables, leaving residues in the soil.
- They are not recommended for foliar products since their high stability is not required because the product **will not be in touch with the soil.**

What to use

## Complexes

**Benefits**

- They leave no residues in the soil.
- They favour foliar and root assimilation of the nutrients.
- Cheaper than chelates.
- Recommended for foliar application.

**Drawbacks**

- Less stability of the bonds, which limits their utility in products of radicular application.

The Choice

## Mineral compounds

If there is no other choice. They are cheaper but larger quantities of product have to be applied because of their tendency to precipitate as salts.

## Chelates

Recommended for root application of microelements.

## Complexes

Recommended products for the application of secondary macroelements and foliar application of nutrients.

## Summary

Chelates and complexes are nutrients bonded with agents that:

- **Improve the assimilation** of the microelements since they change them to a more favorable ionic state for them to be absorbed by the plant.
- **Avoid** microelements to **react** with soil ions that will make them **precipitate** as inorganic salts.

# CHELATES & COMPLEXES



## MICROPONIC

**MICROPONIC** is a microelement chelate with Boron, Copper, Iron, Manganese, Molybdenum and Zinc, chelated with HEEDTA


It acts as a deficiency corrector due to its wide microelement variety.

Its application is recommended during active metabolism period, like sprouting or fruit production.

# CHELATES & COMPLEXES



## FLOWAL

**FLOWAL** products are **chelates** and **simple complexes** (of Calcium, Zinc, Magnesium, Manganese and Iron) chelated with **heptagluconic acid** or with **HEEDTA**.

They are microelements **nutrients** and/or **deficiency correctors** that work in wide ranges of pH.

# CHELATES & COMPLEXES



## NUTRIARTAL

**NUTRIARTAL** range of products are microelement complexed that contain Manganese and Zinc with gluconic acid as complexing agent. Also they can contain Iron (**NUTRIARTAL Fe**) or Magnesium (**NUTRIARTAL Mg**).

They act as **Zinc** and **Manganese** sources to prevent and/or correct deficiencies that delay and reduce production.