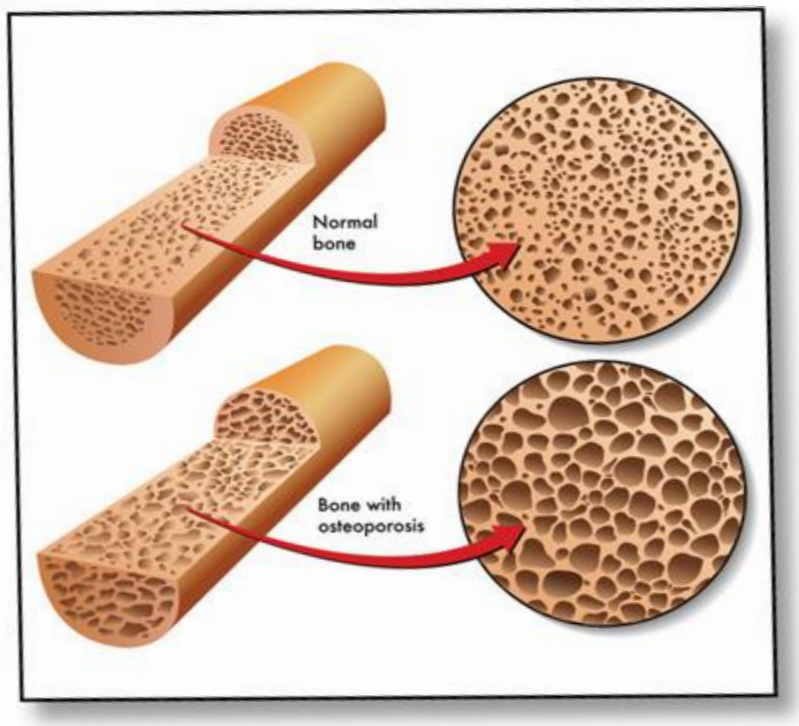
Determination of Calcium in Milk

Calcium an important mineral for the body:

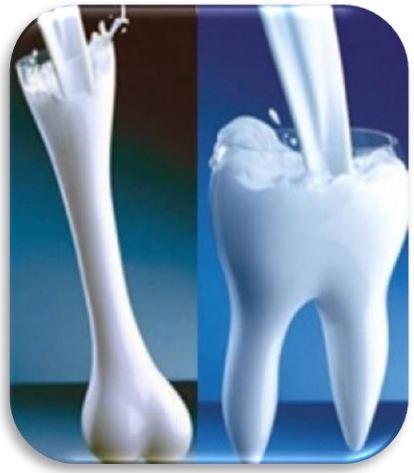
- Calcium is an important component of a healthy diet and a mineral necessary for life.
- It is a mineral that people need to build and maintain **strong bones and teeth**.
- It is also very important for other physical functions, such as muscle control and blood circulation.

- If we do not have enough calcium in our diets to keep our bodies functioning, calcium is removed from where it is stored in our bones.

➔ Over time, this causes our bones to grow weaker and may lead to **osteoporosis** (a disorder in which bones become very fragile).



Milk and calcium:



- Milk is a heterogeneous mixture of proteins, sugar, fat, vitamins and minerals.
- Milk and milk products are some of the natural sources of calcium.
- Cow's milk has good bioavailability of calcium (about 30 to 35%).

- Milk is an excellent source of dietary calcium for those whose bodies tolerate it because it has a **high concentration** of calcium and the calcium in milk is **excellently absorbed.**
- It is estimated that without milk and milk products in the diet, less than half of the calcium requirements would be met.

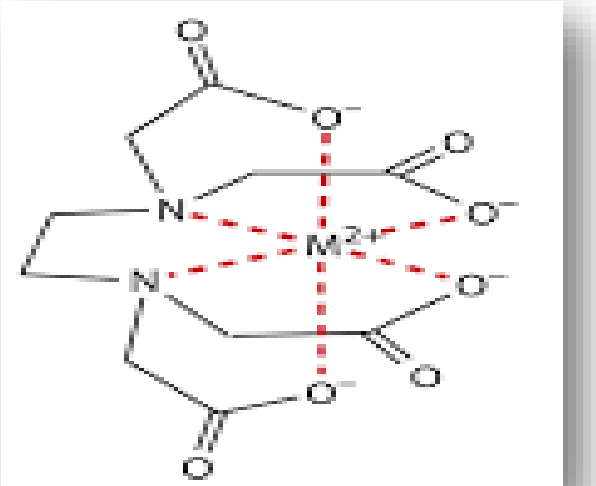
Practical Part

Objective:

- Determination of Calcium in milk sample.

Principle:

- In this experiment, The determination of calcium in milk is based on a **complexometric titration** of calcium with an aqueous solution of the disodium salt of EDTA at high pH value (12). “why?”

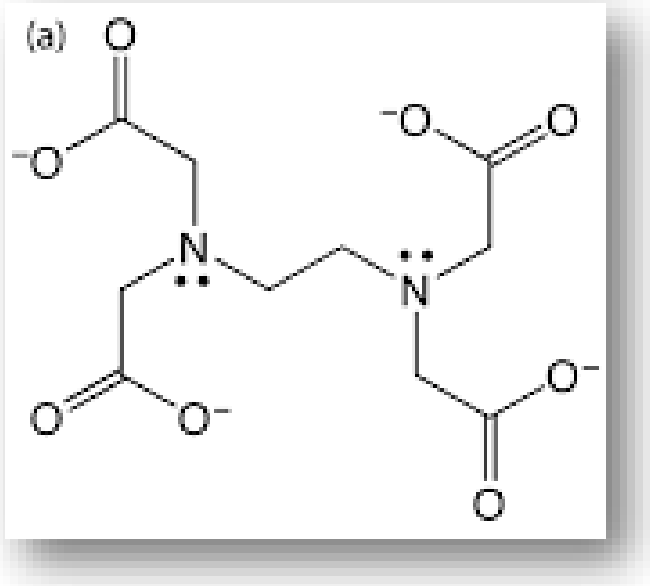


- **Complexometric titration is** a type of titration based on complex formation between the analyte and titrant.

- Such compounds are capable of forming chelate complexes with many cations in which the cation is bound in a ring structure.
- The ring results from the formation of a salt-like bond between the cation and the carboxyl groups together with a coordinate bond through the lone pair of electrons of the nitrogen atom.

Principle cont’:

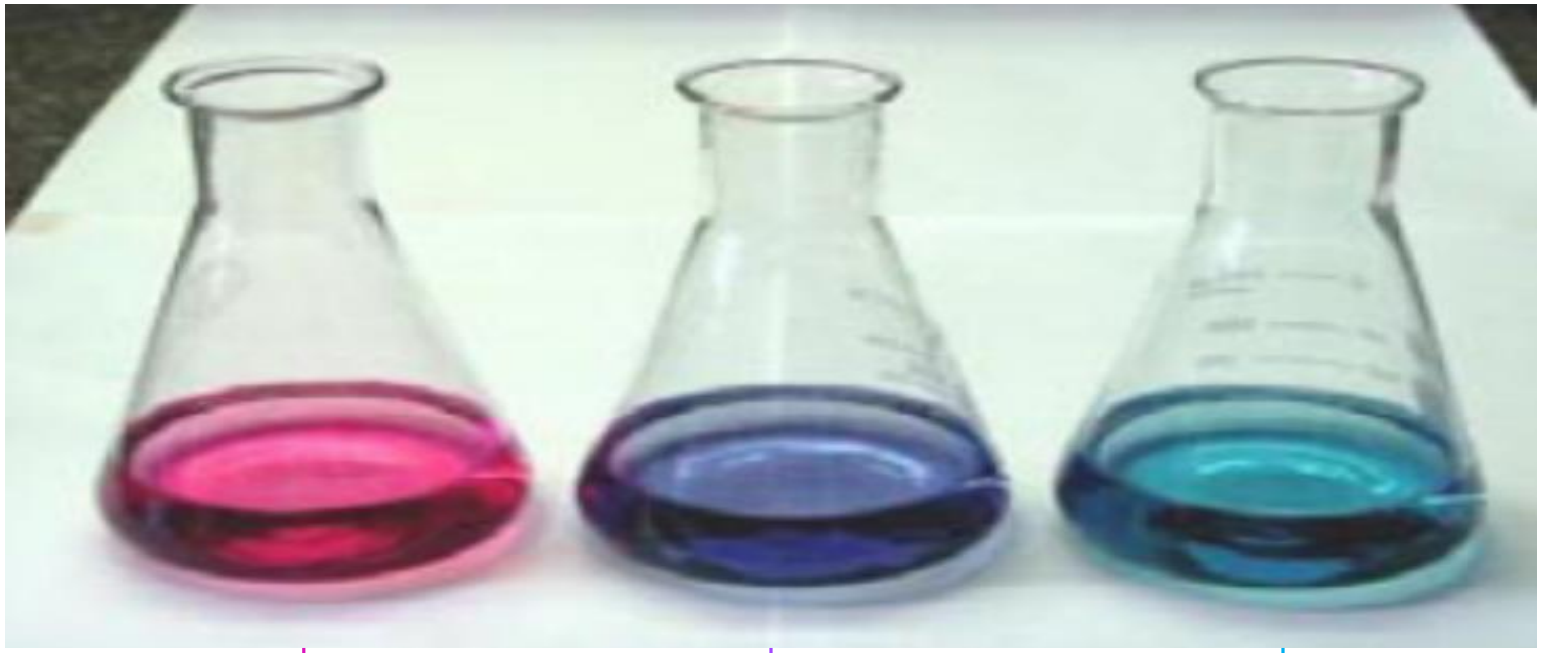
- The common form of the agent is disodium salt Na2H2EDTA.
- Itis colorless and can be weighed and dissolve in water to form a stable solution.
- At high pH (> 10) the remaining protons leave EDTA forming $EDTA^{4-}$ anion:



Indicator-Solochrome dark blue:

- The Solochrome dark blue indicator is a suitable indicator in this case.
- The dye itself has a blue color.
- This blue dye also forms a complex with the calcium ions changing colour from blue to pink/red in the process, but the dye–metal ion complex is **less stable** than the EDTA–metal ion complex.
- As a result, when the calcium ion–dye complex is titrated with EDTA the Ca2+ions react to form a stronger complex with the EDTA changing the dye color to blue.

- Ca-Indicator + $EDTA^{4-}$ ➔ Ca-$EDTA^{2-}$ + Indicator



Excess Ca2+ ions present to complex with indicator

Ca2+ ions almost all complexed by EDTA

All Ca2+ ions complexed by EDTA, indicator completely uncomplexed

Principle cont’:

- **How to determin calcium in the presence of Mg?**

- This method for determining Ca2+concentration in the presence of Mg2+relies on the fact that the pH of the solution **is sufficiently high** ((The pH will be approximately 12.5 due to the addition of concentrated NaOH solution)) to ensure that all magnesium ions precipitate as magnesium hydroxide before the indicator is added.
- In this condition, magnesium ions are precipitated as hydroxide and **do not interfere** with the determination of calcium.

Method:

- Combine 10mL of sample, 40mL distilled water, and 4mL of 8M sodium hydroxide solution into an Erlenmeyer flask and allow solution to stand for about 5 minutes with occasional swirling.
- A small of magnesium hydroxide may precipitate during this time. Do not add the indicator until you have given this precipitate a chance to form.
- Then add 6 drops of the Solochrome dark blue solution.
- After that start to titrate with EDTA solution.
- Repeat titration for three trials.

Results :

	EDTA volume (ml)
1	
2	
3	
Average	

Calculation:

1. Calculate the moles of EDTA required to complex the Ca2+ ions in the sample:

➔ Number of moles (for EDTA) = Molarity of EDTA x volume of EDTA in L

Note : Ratio Ca2+:EDTA = 1 : 1 (i.e moles of EDTA = moles of Ca2+)

2. Calculate weight of Ca2+ :

➔ Weight of Ca2+ = Number of moles x molecular weight (40.78)

- **% of Ca2+ = (weight of Ca2+ / weight of sample) x 100**

OR

- **Amount of calcium=** $\frac{(Molarity\ of\ EDTA \times vol.\ of\ EDTA\ (in\ liter) \times 40.78)}{(wieght\ of\ sample)} \times 100$