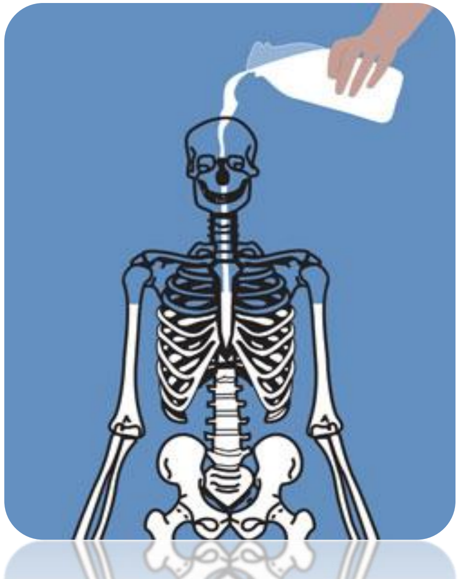
Determination of Calcium in Milk

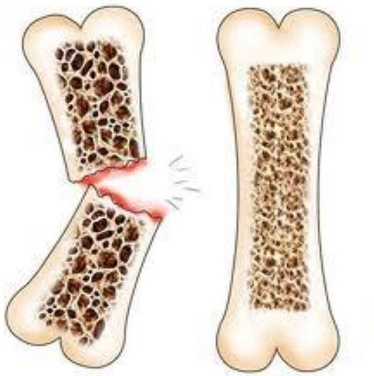


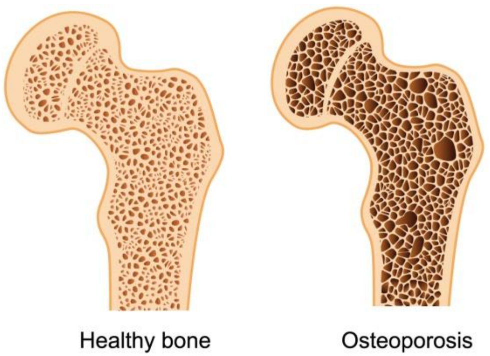
Calcium an important mineral for the body

Calcium is an important component of a healthy diet and a mineral necessary for life.

Calcium 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**.





Recommended Daily Allowance of Calcium

Calcium needs vary with age. The Food and Nutrition Board (FNB) of the Institute of Medicine of the National Academies provides guidelines on the amount of calcium needed each day.

Recommended Daily Allowance in Milligrams (mg)

Life Stage Group	Recommended Daily Calcium Intake
Women and men 9 to 18 years	1,300 mg
Women and men 19 to 50 years	1,000 mg
Women 51 to 70 years	1,200 mg
Men 51 to 70 years	1,000 mg
Women and men > 70 years	1,200 mg
Pregnant or nursing women 14 to 18 years	1,300 mg
Pregnant or nursing women 19 to 50 years	1,000 mg

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.

Principle

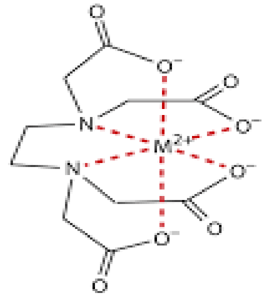
- In this experiment, The determination of calcium in milk is **based on a complexometric titration of calcium** with an aqueous solution of the disodium salt of EDTA at high pH .

- **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.

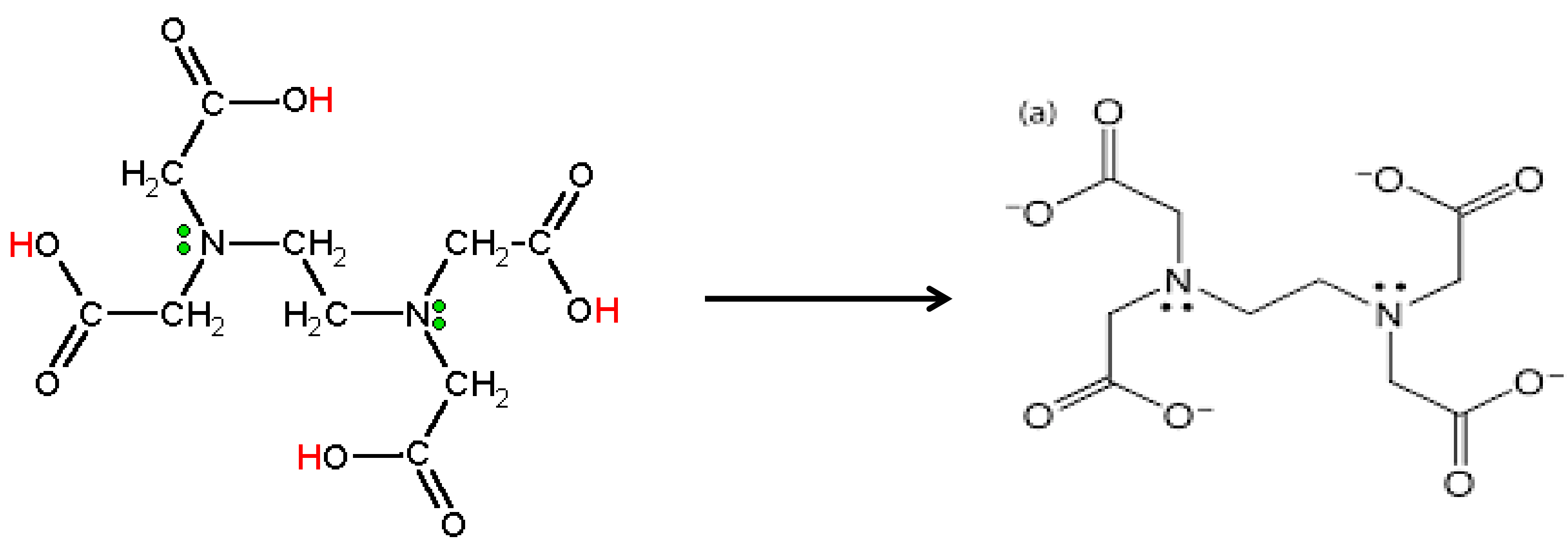
(b)



Principle-con’t

The common form of the agent is **<u>disodium salt Na2H2EDTA</u>**. Itis colorless. It can be weighed and dissolve in water to form a stable solution.

At high pH (> 10) the remaining protons leave EDTA forming **<u>EDTA4- anion</u>**:



At alkaline pH

Indicator-Solochrome dark blue

- The Solochrome dark blue indicator is a suitable indicator in this case as it produces.
- **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.

Indicator + Ca+ ➔ **Ca-Indicator**

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

Ca-indicator

Ca-EDTA
Indicator is free

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 10 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

Calculate the average of EDTA volume required to change the color to blue for the three trails.

Average volume of EDTA (ml)=

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)

Ratio Ca2+ : EDTA = 1 : 1 (moles of EDTA = moles of Ca+)

2. **Calculate weight of Ca2+** :

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

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

or

$$\textbf{Amount of calcium} = \frac{\text{Molarity of EDTA X vol.of EDTA (in liter) X 40.78}}{\text{wieght of sample}} \text{ x } 100$$