Pharmaceutical Analytical Chemistry I

الأستاذ الدكتور جمعه الزهوري (دكتوراه صيدلة-ألمانيا 1991)

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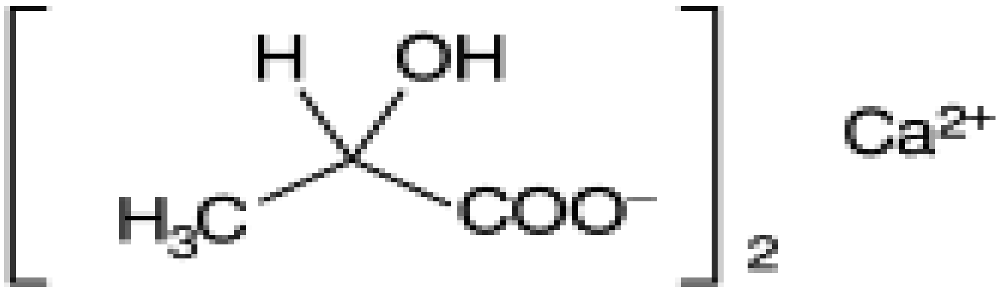
COMPLEXOMETRIC TITRATIONS of Drugs

Calcium Lactate Pentahydrate



Action and use Used in treatment of calcium deficiency

ASSAY

Dissolve 0.200 g in *water R* and dilute to 300 ml with the same solvent. Carry out the complexometric titration of calcium (*2.5.11*).

1 ml of *0.1M sodium edetate* is equivalent to 21.82 mg of C6H10CaO6.

Aluminium Hydroxide Tablets
Action and use : Antacid

Assay **Weigh and powder 20 tablets, avoiding frictional heating. Dissolve a quantity of the powder containing 0.4 g of Dried Aluminium Hydroxide as completely as possible in a mixture of 3 ml of *hydrochloric acid* and 3 ml of *water* by warming on a water bath, cool to below 20° and dilute to 100 ml with *water*. To 20 ml of this solution add 40 ml of 0.05M *disodium edetate VS*, 80 ml of *water* and 0.15 ml of *methyl red solution* and neutralise by the dropwise addition of 1M *sodium hydroxide VS*. Heat on a water bath for 30 minutes, add 3 g of *hexamine* and titrate with 0.05M *lead nitrate VS* using 0.5 ml of *xylenol orange solution* as indicator. Each ml of 0.05M *disodium edetate VS* is equivalent to 2.549 mg of Al_2O_3.**

Complexometric reactions and titration

- Many metal ions form slightly dissociated complexes with various ligands(complexing agents)

معظم المعدن تشكل معقدات مع اللواقط

- The formation of complexes can also serve as the basis of accurate and convenient titrations for metal ions.

المعقد المتشكل يمكن أن يكون أساس للمعايرة

- Complexometric titration are useful for the determination of large number of metals.
- The analytical chemist makes judicious use of complexes to mask undesired reactions.

Complexometric reactions and titration

- Selectivity can be achieved by appropriate use of masking agents (addition of other complexing agents that react with interfering metal ions) and by pH control, since most complexing agents are weak acids or weak bases whose equilibria are influenced by pH

Complex Formation Titrations

A review of complexes and ligands is provided. EDTA, the most common complexer used in complex formation titrations is covered extensively. pH dependent equilibrium calculations are introduced along with titration calculations. Several common indicators used with EDTA titrations are also given.

Complex formation titrations

Many analytical methods rely on the formation of complexes.

Gravimetry	Ni / DMG
Titrimetric methods	Metal - EDTA
Spectrophotometry	Metal - dithiocarbamate

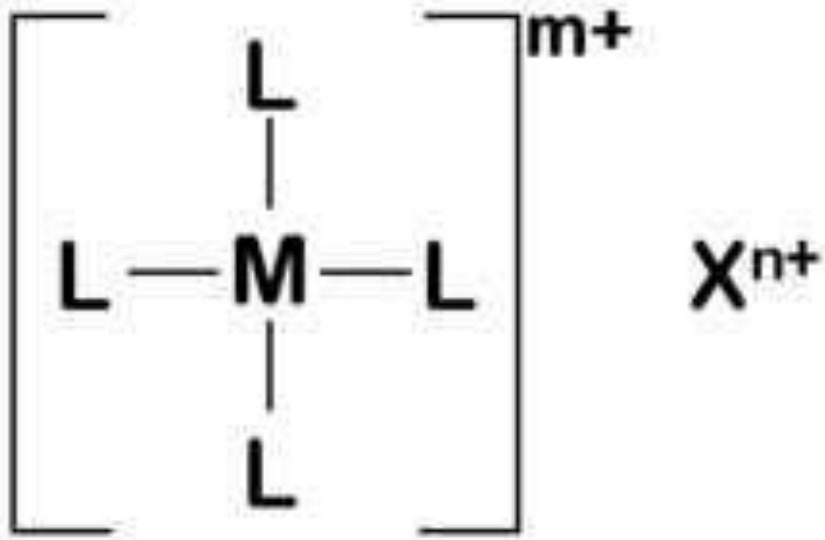
They can be used to form a measurable species, as indicators or to mask the presence of interfering species.

Complexes

- The metal ion is a Lewis acid (electron pair acceptor)
- And the complexer is a Lewis base (electron pair donor)
- The number of molecules of the complexing agent, called the **ligand**
- Most ligands contain O,S ,or N as the complexing atoms.

Complexes

General structure



L - ligand

M - central species

X - counter ion

Complexes

Central species

Must have the ability to accept one or more pairs of electrons in available d orbitals - typically a metal ion.

Ligand

Anion, cation or neutral species with ability to donate electron pair to form a coordinate covalent bond.

Counter ion

Required if complex is charged.

Complexes

Some common ligand groups

halides	thiocarbonyl	hydroxides
carbonyls	mercaptans	oximes
nitroso	acids	amines

Ligands are typically anionic or polar neutral species when working with aqueous systems.

Complexes

Ligands can be classified by dentate number - number of bonds/ligand

Dentate (Latin) means having toothlike projection.

Monodentate

1 bond/ligand - ammonia

Bidentate

2 bonds/ligand - ethylene diamine

Multidentate

variable number based on need - EDTA

Monodentate Ligand

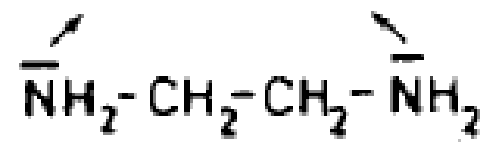
Possess only accessible donor group(e.g. NH_3)

$$Cu^{2+} + 4{:}NH_3 \rightleftharpoons \left[\begin{array}{c} NH_3 \\ \ddot{} \\ H_3N{:}Cu{:}NH_3 \\ \ddot{} \\ NH_3 \end{array}\right]^{2+}$$

Bidentate ligands

Form two binds / central species.

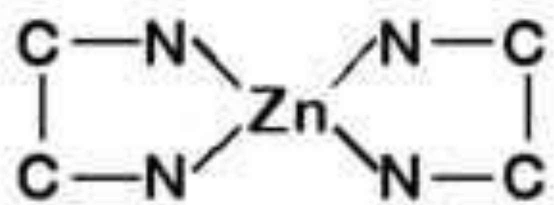
A good example is ethylene diamine.



$NH_2CH_2CH_2NH_2$ - (en)

The amino groups are far enough apart to permit both to interact.

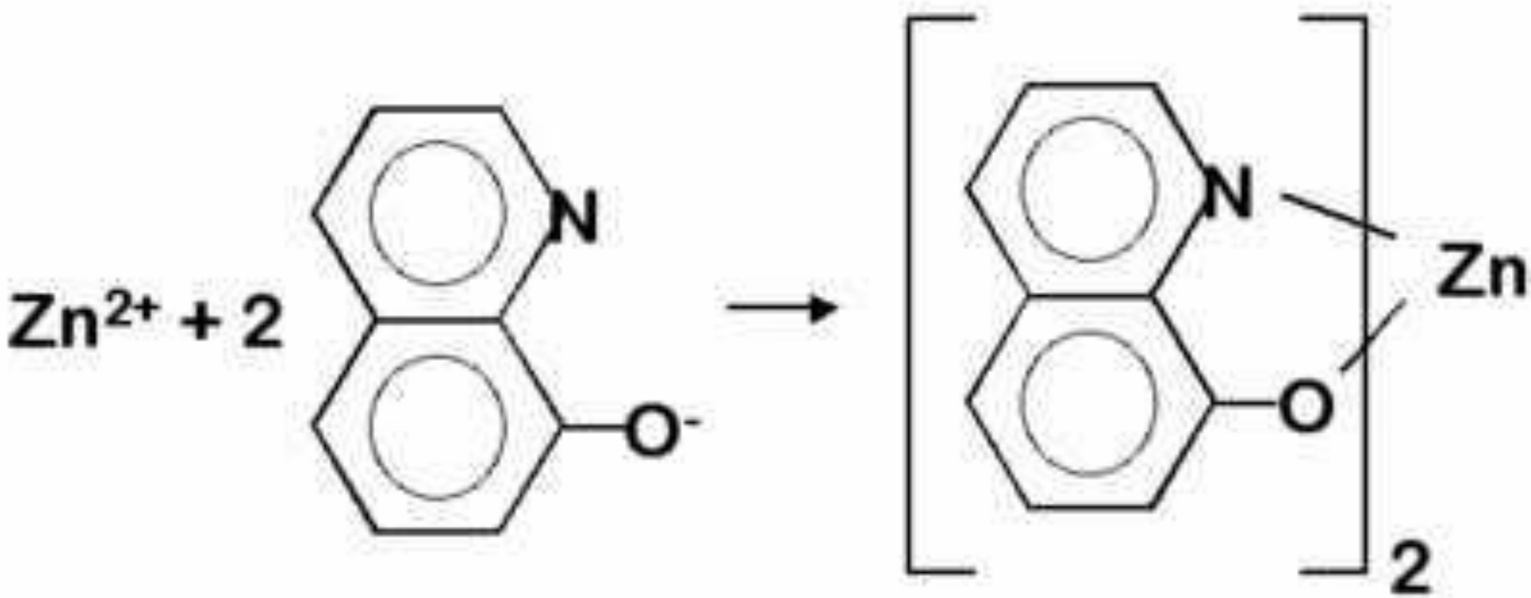
$Zn^{2+} + 2\ en \longrightarrow$



Bidentate ligands

Other common bidentate ligands.

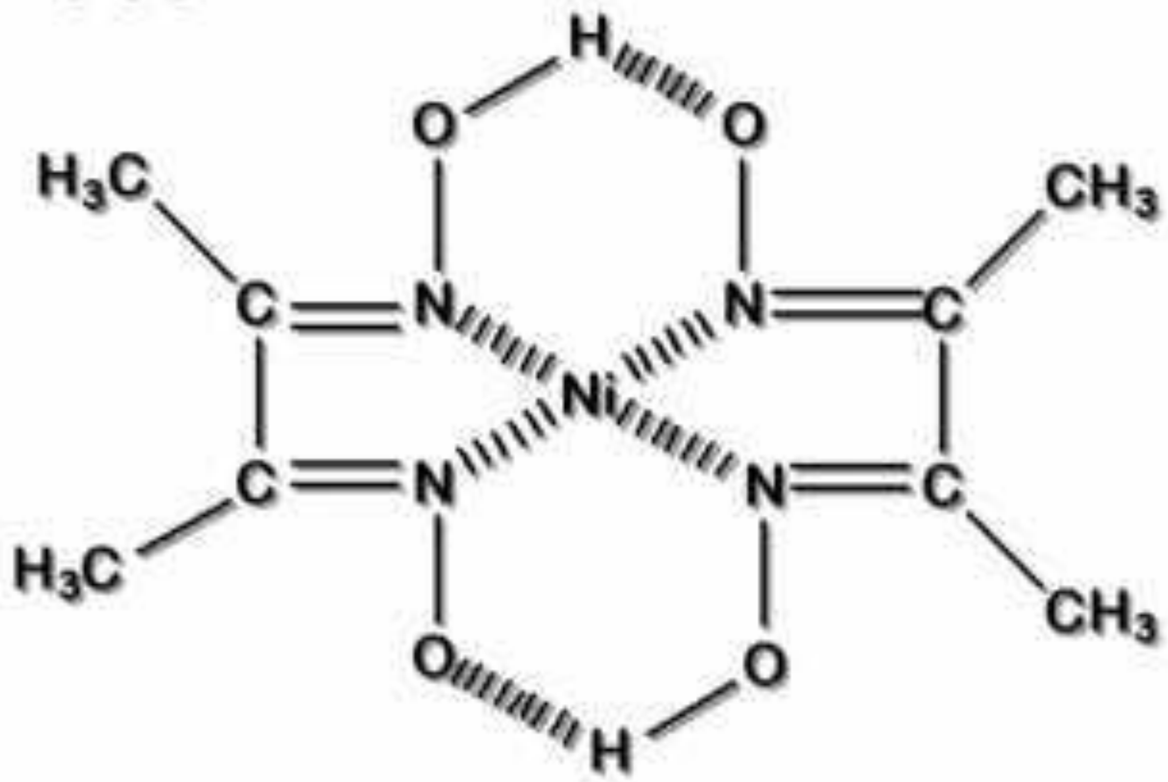
8 - hydroxyquinoline



Bidentate ligands

Other common bidentate ligands.

Dimethylglyoxime - DMG



Bidentate ligands

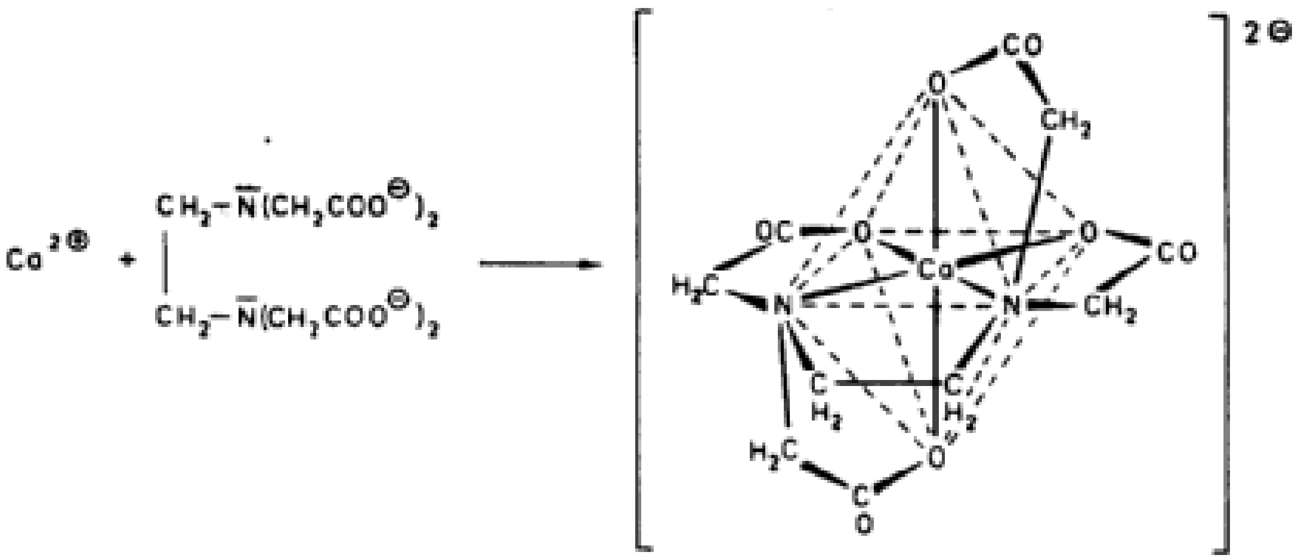
1,10 phenanthroline

Polydentate ligands

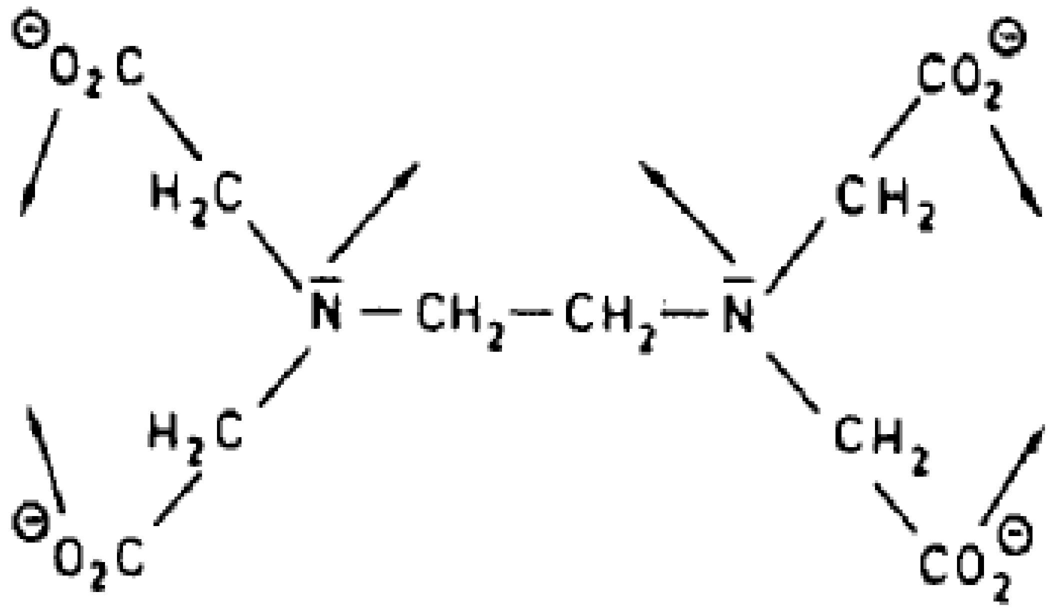
Disodium Edetate

$C_{10}H_{14}N_2Na_2O_8.2H_2O$ 372.2

Action and use Chelating agent.



Polydentate ligands (six)



EDTA

Ethylenediamine tetraacetic acid

One of the most commonly used complexers.

Forms 1:1 complexes with most metals (not group 1A)

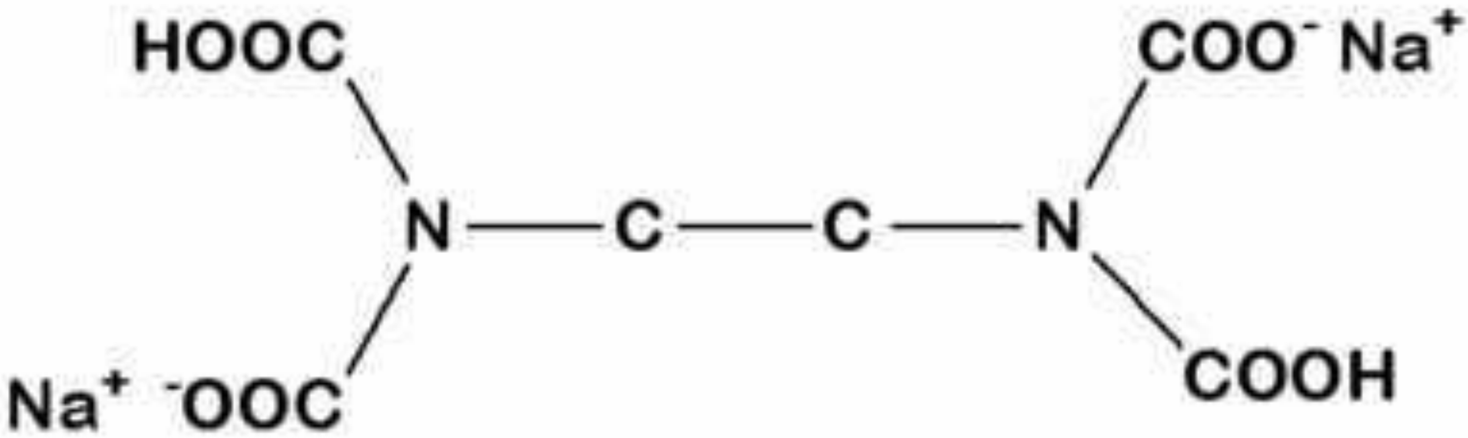
Forms stable, water soluble complexes

High formation constants.

not primary standard material.

EDTA

EDTA is typically used as the disodium salt to increase solubility.



H_2Y^{2-}

The formation constant

EDTA (HY) + M^{+n}

$$M^{+n} + Y^{-4} \longrightarrow MY^{(4-n)}$$

$$K_{MY} = \frac{[MY]^{(4-n)}}{[M^{+n}][Y^{-4}]}$$

Formation Constant

Consider the formation of the EDTA chelate of Ca^{2+}. This can be represented by

$$Ca^{2+} + Y^{4-} \rightleftharpoons CaY^{2-}$$

The formation constant for this is

$$K_f = \frac{[CaY^{2-}]}{[Ca^{2+}][Y^{4-}]}$$

The values of some representative EDTA formation constants are given in the

followig table :

EDTA

Formation constants for some metal - EDTA complexes.

Ion	$\log K_{MY}$	Ion	$\log K_{MY}$	Ion	$\log K_{MY}$
Fe^{3+}	25.1	Pb^{2+}	18.0	La^{3+}	15.4
Th^{4+}	23.2	Cd^{2+}	16.5	Mn^{2+}	14.0
Cr^{3+}	23.0	Zn^{2+}	16.5	Ca^{2+}	10.7
Bi^{3+}	22.8	Co^{2+}	16.3	Mg^{2+}	8.7
Cu^{2+}	18.8	Al^{3+}	16.1	Sr^{2+}	8.6
Ni^{2+}	18.6	Ce^{3+}	16.0	Ba^{2+}	7.8

EDTA

Effect of pH On EDTA Equilibria

The strength and stability of EDTA complexes is pH dependent.

$$M^{2+} + H_2Y^{2-} \longrightarrow MY^{2-} + H^+$$

The reaction shifted to the left as the hydrogen ion concentration is increased, due to competition for the chelating anion by hydrogen ion

Since it is the Y^{4-} for which complexes with the metal, anything that alters its availability will affect our titration

- pH is the major concern.

EDTA Equilibria

EDTA can be represented as having four K_a values corresponding to the stepwise dissociation of the four protons[1]:

$$H_4Y \rightleftharpoons H^+ + H_3Y^- \quad K_{a1} = 1.0 \times 10^{-2} = \frac{[H^+][H_3Y^-]}{[H_4Y]}$$

$$H_3Y^- \rightleftharpoons H^+ + H_2Y^{2-} \quad K_{a2} = 2.2 \times 10^{-3} = \frac{[H^+][H_2Y^{2-}]}{[H_3Y^-]}$$

$$H_2Y^{2-} \rightleftharpoons H^+ + HY^{3-} \quad K_{a3} = 6.9 \times 10^{-7} = \frac{[H^+][HY^{3-}]}{[H_2Y^{2-}]}$$

$$HY^{3-} \rightleftharpoons H^+ + Y^{4-} \quad K_{a4} = 5.5 \times 10^{-11} = \frac{[H^+][Y^{4-}]}{[HY^{3-}]}$$

α = fraction of EDTA ion such as H_3Y^- or H_2Y^{-2} ....

$$\alpha_0 = \frac{[H_4Y]}{[T]} \quad , \quad \alpha_1 = \frac{[H_3Y^-]}{[T]}$$

$$\alpha_2 = \frac{[H_2Y^{2-}]}{[T]} \quad , \quad \alpha_3 = \frac{[HY^{3-}]}{[T]} \quad , \quad \alpha_4 = \frac{[Y^{4-}]}{[T]}$$

$$[T] = [H_4Y] + [H_3Y^-] + [H_2Y^{2-}] + [HY^{3-}] + [Y^{4-}]$$

EDTA equilibria

The effect of the hydrogen ion can then be calculated using α_Y.

$$\alpha_Y = \frac{[Y^{4-}]}{[H_4Y] + [H_3Y^-] + [H_2Y^{2-}] + [HY^{3-}] + [Y^{4-}]}$$

With reciprocal the equation we got :

$$\frac{1}{\alpha_4} = \frac{[H_4Y]}{[Y^{4-}]} + \frac{[H_3Y^-]}{[Y^{4-}]} + \frac{[H_2Y^{2-}]}{[Y^{4-}]} + \frac{[HY^{3-}]}{[Y^{4-}]} + \frac{[Y^{4-}]}{[Y^{4-}]}$$

EDTA equilibria

Determination of α_Y

The EDTA equilibria can be expressed using a series of stepwise formation constants.

$$K_1 = \frac{[H^+][H_3Y^-]}{[H_4Y]}$$

$$K_2 = \frac{[H^+][H_2Y^{2-}]}{[H_3Y^-]}$$

Similar expressions can be written for the other two equilibria

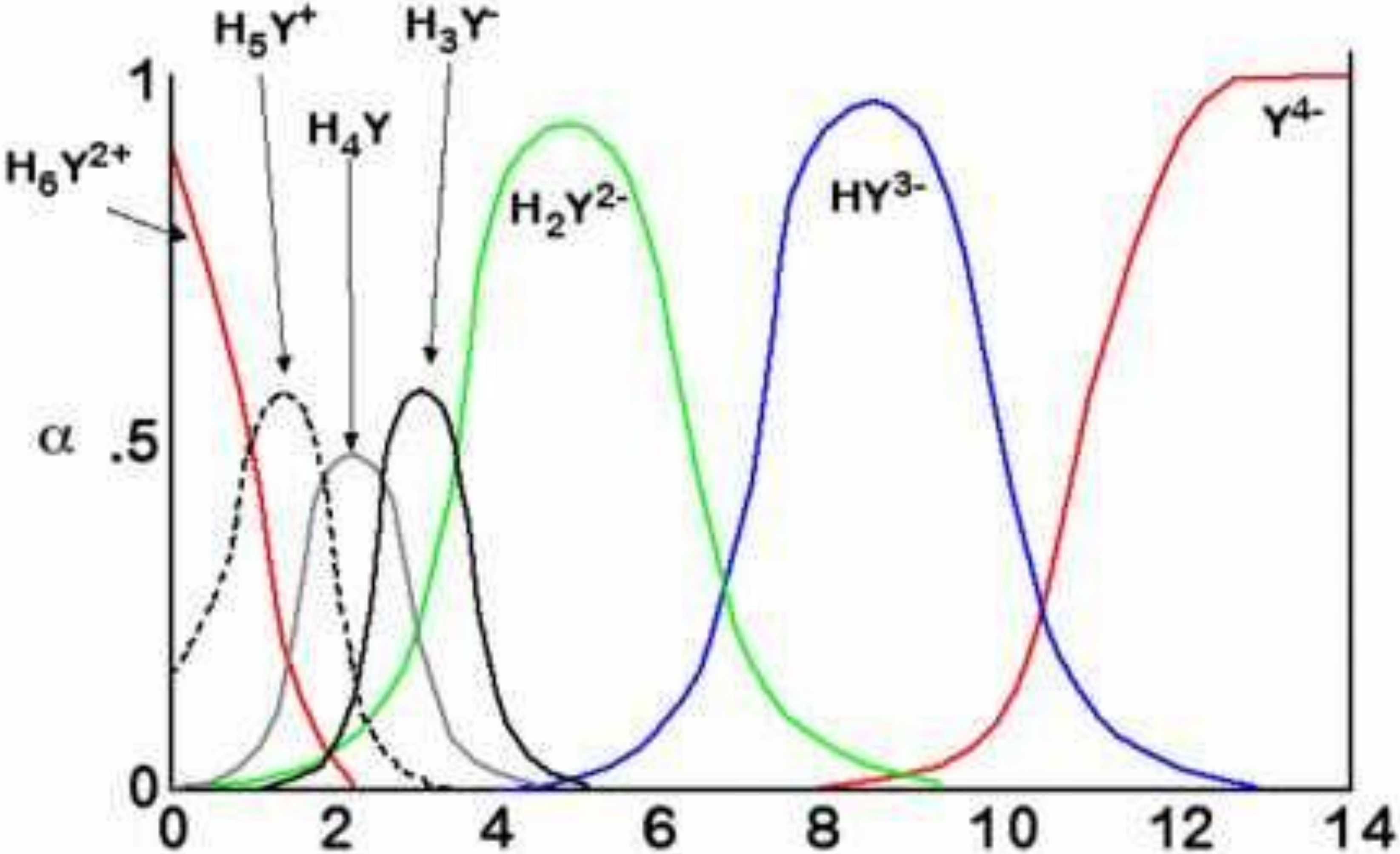
EDTA equilibria

We can proceed through a series of substitutions leading to an equation in terms of $[H^+]$.

$$\frac{1}{\alpha_Y} = \frac{[H^+]^4}{K_1K_2K_3K_4} + \frac{[H^+]^3}{K_2K_3K_4} + \frac{[H^+]^2}{K_3K_4} + \frac{[H^+]}{K_4} + 1$$

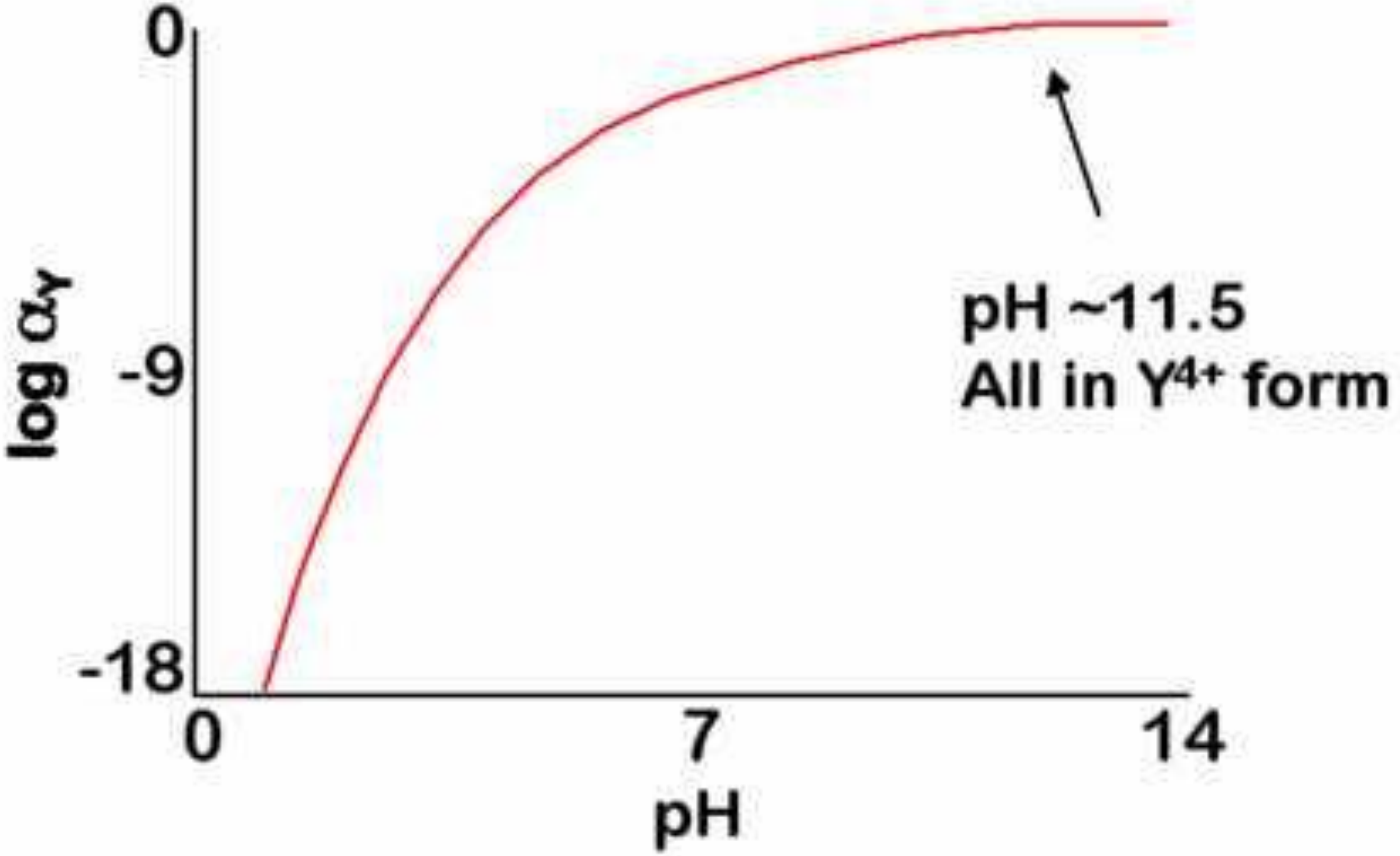
We can then calculate α_Y and plotted as a function of pH. With the same method we can calculate α_1,α_2….

EDTA



pH

EDTA equilibria



According to the relationship between fraction of (fraction of EDTA species) and pH value we got the following statement :

- In acidic media (pH = 3-6) H_2Y^{-2} is predominant.
- In Basic media (pH = 6-10) HY^{-3} is predominant.
- In strong basic media (pH > 10) Y^{-4} is predominant .
- The reaction at pH more than 10 is fast complete.
- The complex which formulated between EDTA and Metal is more stable at pH more than 10.
- we need buffer to fixed the pH in Complexometric titration.

EDTA equilibria

While the actual formation constant for a metal-EDTA complex is:

$$K_{MY} = \frac{[MY^{4-}]}{[M][Y^{4-}]} \quad , \alpha_4 = [Y^{-4}] / T \Longrightarrow Y^{-4} = T \times \alpha_4$$

A conditional constant can be calculated at any known, constant pH as

$$K_{MY}\,\alpha_4 = K_{MY}' = \frac{[MY^{4-}]}{[M][T]}$$

K_{MY}' = Conditional formation constant

Conclusion

Present of great amount of hydrogen will effect on the complex (make weaker) because it will react with Y:

$$M + Y \rightleftharpoons MY$$

$$H^{+} \downarrow\uparrow$$

$$HY\ ,\ H_2Y\ .....\ etc.$$

The Conditional Formation Constant

- The Conditional formation constant value holds for only a specified pH
- We use the conditional formation constant to derivative the titration curve.

EDTA titrations

As with our other types of titrations, we have four regions to deal with.

0% titration

>0% and < 100% titration

The equivalence point

Over-titration region

We'll outline the basic steps for each region using an example.

EDTA titrations

Example

100.0 ml of a 0.0100 M Ni^{2+} solution is buffered at a pH of 10.2.

Determine the pNi at 0, 50, 100 and 200% titration if titrated with a 0.0100M EDTA solution.

$\alpha_4 = 0.47$ and $K_{NiY^{-2}} = 3.98 \times 10^{18}$

We'll be using pNi so that our titration curve can be directly compared to other types of titrations.

EDTA titrations

0% titration Start point

This is pretty straight forward.

We know that we're starting with 0.0100 M Ni^{2+} so:

$$pNi = -\log[Ni^{2+}]$$
$$= -\log[0.0100]$$
$$= 2.00$$

EDTA titrations

50% titration Before the Equivalence point

At > 0% and < 100%, we can assume that the amount if free Ni(II) is:

$$[Ni^{2+}] = \frac{\text{Initial } [Ni^{2+}] \times V_{Ni^{2+}} - [EDTA] \times V_{EDTA\ added}}{V_{Ni^{2+}} + V_{EDTA\ added}}$$

$$= \frac{0.0100M \times 100.0\ ml - 0.0100M \times 50.0ml}{100\ ml + 50\ ml}$$

$$= 3.33x10^{3} \quad pNi = 2.48$$

EDTA titrations

100% titration - the equivalence point.

Now things get interesting!

To determine the $[Ni^{2+}]$, we need to use:

$$K_{MY'} = K_{MY}\ \alpha_4 = \frac{[NiY^{2-}]}{[Ni^{2+}][\top]}$$

$$K_{MY} = 3.98 \times 10^{18}$$

EDTA titrations

We'll need to calculate α_Y at pH 10.2.

$$\frac{1}{\alpha_Y} = \frac{[H^+]^4}{K_1K_2K_3K_4} + \frac{[H^+]^3}{K_2K_3K_4} + \frac{[H^+]^2}{K_3K_4} + \frac{[H^+]}{K_4} + 1$$

$K_1 = 1.02 \times 10^{-2}$ $K_2 = 2.14 \times 10^{-3}$

$K_3 = 6.92 \times 10^{-7}$ $K_4 = 5.50 \times 10^{-11}$

$[H^+] = 6.31 \times 10^{-11}$

EDTA titrations

If you're willing to trust me, then

$$\alpha_4 = 0.47$$

$$K_{MY}\,\alpha_4 = \frac{[NiY^{2-}]}{[Ni^{2+}]\,[T]} = 3.98\times10^{18} \times 0.47$$

$$= 1.87\times10^{18}$$

At the equivalence point, we also know that virtually all of our nickel exists as NiY^{2-}.

EDTA titrations

So, $[NiY^{2-}]$ = 0.0050 M due to dilution.

In addition $[Ni^{2+}]$ = [Y] so:

$$1.87\times10^{18} = \frac{0.0050\ M}{[Ni^{2+}]^2}$$

$[Ni^{2+}] = (0.0050\ M / 1.87\times10^{18})^{1/2}$

$= 5.17\times10^{-11}$ M

pNi = 10.3

EDTA titrations

200% titration

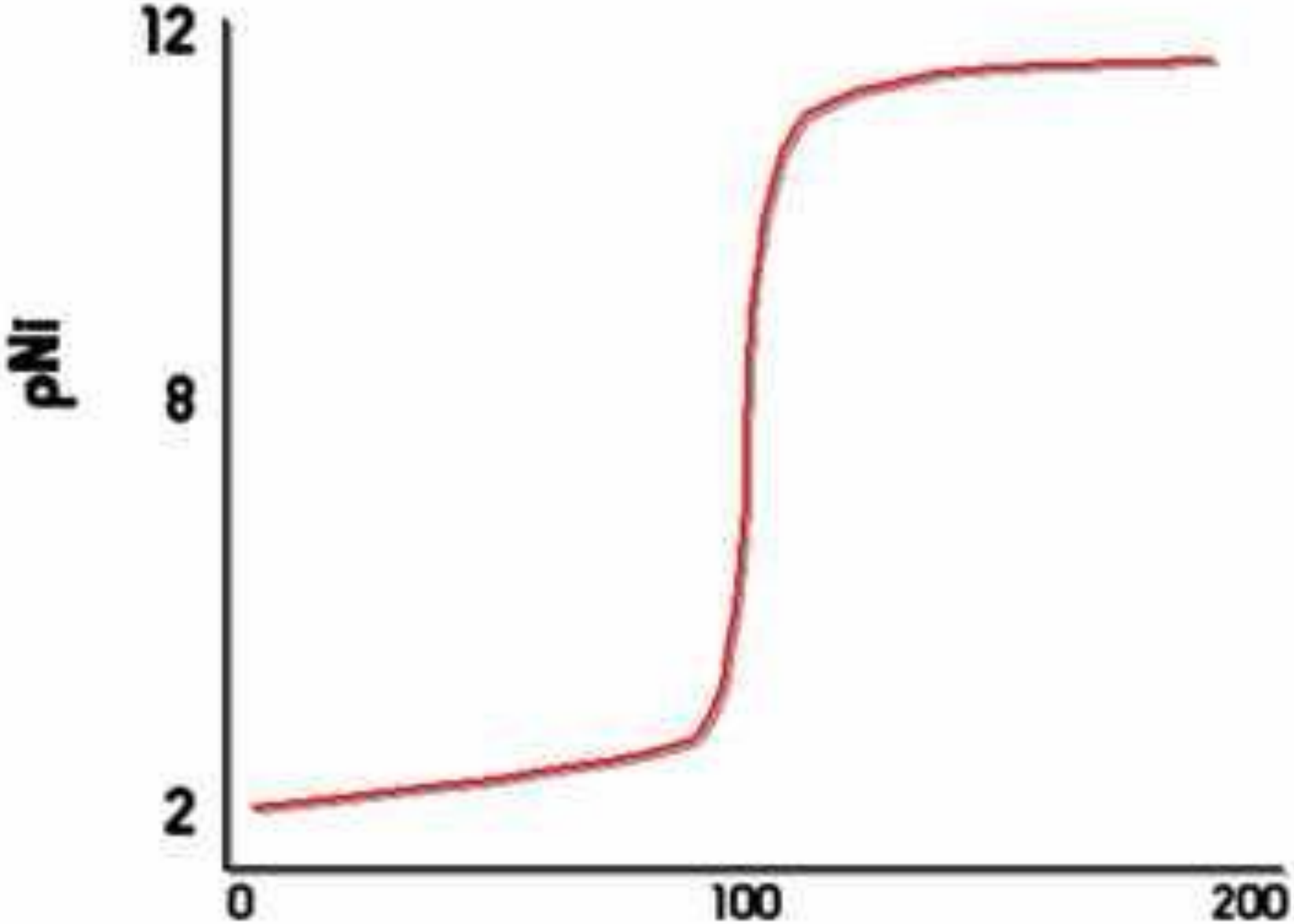
Beyond the equivalence point, we are primarily building up excess EDTA and diluting everything.

At 200% over-titration, $[NiY^{2-}] = [T]$ so:

$$K_{MY}' = \frac{[NiY^{2-}]}{[Ni^{2+}]\,[T]} = 1.87\times10^{18}$$

$[Ni^{2+}] = 5.35\times10^{-19}$ $\quad$ $pNi = 18.27$

EDTA titrations



EDTA titrations

The 200% titration mark is useful for estimating the shape of a titration curve because:

$$pM = \log K_{MY}'$$

Since you also know the 0% value (-log[species]) and the general shape of a titration curve, a reasonable estimate is possible.

EDTA titrations

Example

Estimate what our previous titration curve would look like if our sample was Ca^{2+} rather than Ni^{2+}.

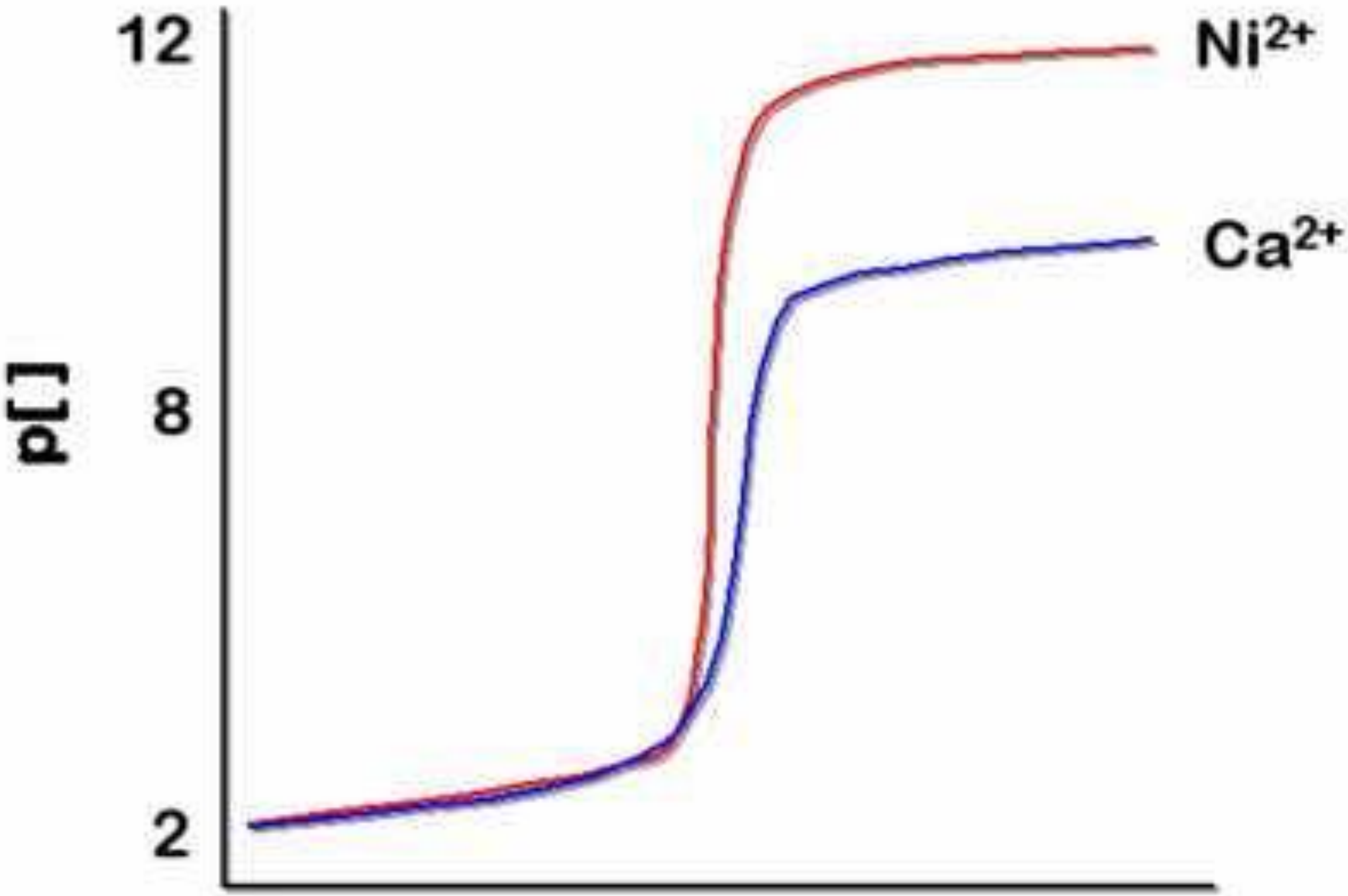
pCa at 0% = 2.00 and α_Y = 0.47 since the same conditions were used.

$$pCa_{200\%} = \log K_{MY}' = \log(K_{MY}\,\alpha_Y)$$

$$= \log(5.01x1010 \times 0.47)$$

$$= -10.4$$

EDTA titrations



Detection of The end point (Indicators)

We can measure the pM Potentiometrically if a suitable electrode is available, for example , an ion-selective electrode , but it is simpler if an indicator can be used.

Indicators used for chelometric titrations are themselves chelating agents.

They are usually dyes of 1,2-dihydroxy azo type. (metal-ion indicators)

INDICATORS

- In general , the metal-indicator complex should be 10 to 100 times less stable than the metal-titrant complex.

Indicators for EDTA titrations

To be a viable indicator, we need a species that:

- Competes for our metal ion.
- Is a weaker complexer than EDTA.
- Exhibits a measurable change between the complexed and uncomplexed form.

$$\underset{\text{(color 1)}}{\text{M-Ind} + \text{Y}'} \longrightarrow \underset{\text{(color 2)}}{\text{MY} + \text{Ind}}$$

Indicators for EDTA titrations

In the presence of an indicator, our reaction proceeds in two steps.

$$M + Y' \longrightarrow MY$$

$$M\text{-}Ind + Y' \longrightarrow MY + Ind$$

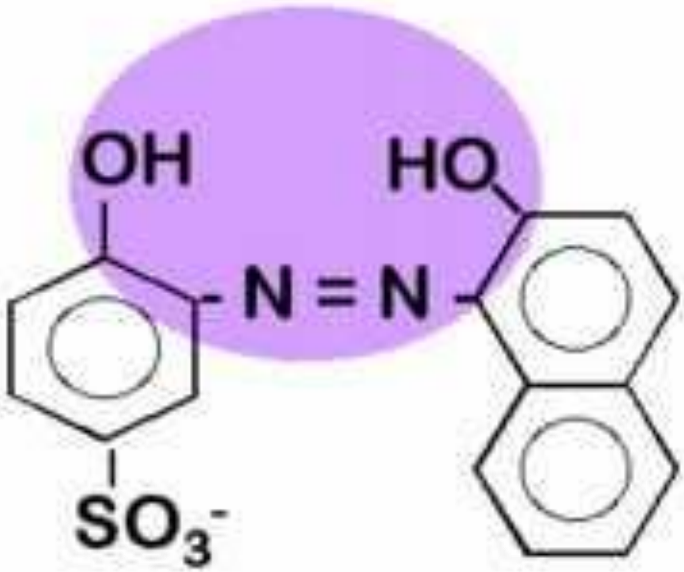
Since it is easier to EDTA to react with the uncomplexed metal, that reaction occurs first.

M-Ind is harder for EDTA to react with so we must insure that only a small amount of indicator is used.

Indicators for EDTA titrations

Calmagite

Will form a colored species with most metal cations.



Calmagite

- Used for Fe^{+++} but we must masking the ions of Ni , Cu, and Al as the following :

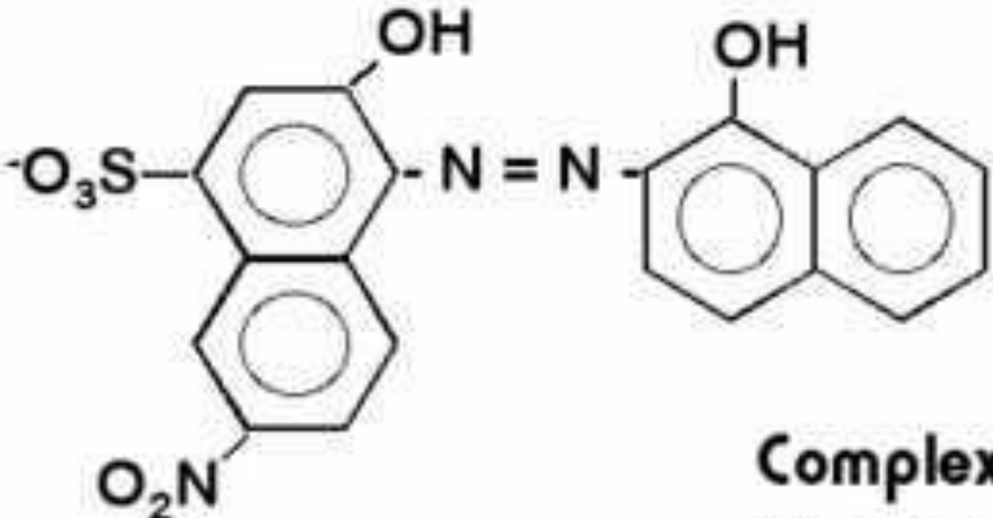
1- Cu and Ni with CN ion.

2- Al with addition of trietanolamine

Indicators for EDTA titrations

Eriochrom Black T

Closely related to Calmagite - same properties but less stable - air oxidation.



It can be use for the titration of Mg^{++} , Ca^{++} and Mn^{++} with EDTA in basic media

Complexes are red
Uncomplexed form is blue

Complexometric Indicators

Indicators	IND H_2	Me-IND
Eriochrome - black T	blue	red
Murexide	blue	red
Calmagite	red	blue
Xylenol Orange	yellow	red
Methylthemol blue	yellow	blue
Calcon	violet	Deep blue

Types of EDTA Titration

1. Direct Titration

$$M\text{- ind} + EDTA^{-2} \rightleftharpoons M\text{-}EDTA + ind^{-2}$$

- Buffer solution is necessary to use to prevent the ppt of Metal
- Mg,Zn,Cd (Eriochrom black-T)
- Ca (Calcon)
- CO,Ni,Cu (Murexid)

Types of EDTA Titration

2- Back Titration

burette

$$M\text{-}EDTA + EDTA + ind^{-2} + Zn^{++} \longrightarrow$$

$$M\text{-}EDTA + Zn\text{-}EDTA + Zn\text{-}ind$$

- The reasons : (No suitable indicator available, difficulty of pH control, can not mask the undesirable ion, slow reaction, unstable complex,…)
- Hg, Pb, Mn and Al

Types of EDTA Titration

3- Displacement Titration → EDTA

$$Mg\text{-}EDTA + M^{++} \longrightarrow M\text{-}EDTA + Mg^{++}$$

- Mn , Ca

Types of EDTA Titration

4- Simultaneous titration

determination of water Hardness (Mg+ Ca)

Mg will be first formed ppt with hydroxyl therefore we titrate the Ca , then we dissolve the ppt of Mg using Perhedrol and HCl and titrate the Mg in present of suitable indicator.

Pharmaceutical USES

- EDTA in Pharmacopeias is used to titrate most all Metals in pharmaceutical dosage form such as Ca,Al,Bi,Mn,Zn ….(ETDA forms stable 1:1 complex with all metals except alkali metals such as Na & K.
- Ca & Mg form complexes which are unstable at low pH therefore titrate in ammonium chloride buffered pH 10

Pharmaceutical USES

Titration in pharmacopeias:

(**Direct)**

- **Calcium chloride**
- **Calcium gluconate**
- **Bismuth sub carbonate**
- **Magnesium carbonate**
- **Calcium acetate**
- **Zinc chloride …….**

(Back): of metal and titrate the excess with Mg^{+2} or Zn^{+2}

- **Aluminum hydroxide**
- **Aluminum Insoluble metal salts ,the sample heated with excess EDTA to form soluble complex sulphate**
- **Calcium hydrogen phosphate ………**

Pharmaceutical USES

- EDTA ,used in Ampoule (anti catalyses)
- Anticoagulant.
- To treatment of heavy metal To determine Ca in blood.
- poisoning such as lead (The chelated lead is excreted via kidneys.

Aluminium Hydroxide Tablets 400 mg

Action and use : Antacid

Assay Weigh and powder 20 tablets, avoiding frictional heating. Dissolve a quantity of the powder containing 0.4 g of Dried Aluminium Hydroxide as completely as possible in a mixture of 3 ml of *hydrochloric acid* and 3 ml of *water* by warming on a water bath, cool to below 20° and dilute to 100 ml with *water*. To 20 ml of this solution add 40 ml of 0.05M *disodium edetate VS*, 80 ml of *water* and 0.15 ml of *methyl red solution* and neutralise by the dropwise addition of 1M *sodium hydroxide VS*. Heat on a water bath for 30 minutes, add 3 g of *hexamine* and titrate with 0.05M *lead nitrate VS* using 0.5 ml of *xylenol orange solution* as indicator. Each ml of 0.05M *disodium edetate VS* is equivalent to 2.549 mg of Al2O3.

Aluminium Hydroxide Tablet

1. If the Tablet average weight is 700 mg, What is the weight of analysis sample?
2. Wright the equation of this titration.
3. If we consumed to the end point 8 ml , what is the % content of the ingredient?

ثانياً- الأشكال الصيدلانية			
Aluminium acetate,Ear drops	0.05M EDTA	Xylenol Orange	0.001349
Aluminium hydroxid ,Oral suspension	0.05M EDTA	Xylenol Orange	0.002549
Aluminium Phosphate,Oral Suspension	0.05M EDTA	Dithizone	0.06098
Aluminium hydroxid Tablets	0.05M EDTA	Xylenol Orange	0.002549
Aromatic Magnesium Carbonate,(Mixture,Oral Suspension	0.05M EDTA	Mordant black II	0.001215
Calcium Gluconate injection	0.05M EDTA	Calcon	0.00400
Calcium Gluconate Tablet	0.05M EDTA	Calcon	0.0242
Calcium Lactate Tablets	0.05M EDTA	Calcon	0.01541

Compound Aluminium Paste	0.05M EDTA	Dithizone	0.004068
Compound Magnesium Trisilicate,Oral Powder	0.05M EDTA	Xylenol Orange	0.02242
Effervescent Calcium Gloconate,Tablete	0.05M EDTA	Calcon	0.02152
Hexachlorophane dusting powder	0.05M EDTA	Xylenol Orange	0.004068
Magnesium Sulphate(Mixture,Oral Suspensiom	0.05M EDTA	Erochromblack-T	0.001232
Sodium Calciumedetate , I.V inj.	0.05M EDTA	Xylenol Orange	0.01871
Zinc Sulphate, Eye drops	0.05M EDTA	Mordant black II	0.002875
Zinc Sulphate Lotion	0.05M EDTA	Mordant black II	0.01438

Bismuth

Introduce the prescribed solution into a 500 ml conical flask. Dilute to 250 ml with water R and then, unless otherwise prescribed, add dropwise, with shaking, concentrated ammonia R until the mixture becomes cloudy. Add 0.5 ml of nitric acid R. Heat to about 70 °C until the cloudiness disappears completely. Add about 50 mg of xylenol orange triturate R and titrate with 0.1 M sodium edetate until the colour changes from pinkish-violet to yellow.

1 ml of 0.1 M sodium edetate is equivalent to 20.90 mg of Bi.

Calcium

Introduce the prescribed solution into a 500 ml conical flask, and dilute to 300 ml with water R. Add 6.0 ml of strong sodium hydroxide solution R and about 15 mg of calconecarboxylic acid triturate R. Titrate with 0.1 M sodium edetate until the colour changes from violet to full blue.

1 ml of 0.1 M sodium edetate is equivalent to 4.008 mg of Ca.

Magnesium

Introduce the prescribed solution into a 500 ml conical flask and dilute to 300 ml with water R. Add 10 ml of ammonium chloride buffer solution pH 10.0 R and about 50 mg of mordant black 11 triturate R. Heat to about 40 °C then titrate at this temperature with 0.1 M sodium edetate until the colour changes from violet to full blue.

1 ml of 0.1 M sodium edetate is equivalent to 2.431 mg of Mg.

المشعر هو نفسه أسود الأيروكروم

Lead

Introduce the prescribed solution into a 500 ml conical flask and dilute to 200 ml with water R. Add about 50 mg of xylenol orange triturate R and hexamethylenetetramine R until the solution becomes violet-pink. Titrate with 0.1 M sodium edetate until the violet-pink colour changes to yellow.

1 ml of 0.1 M sodium edetate is equivalent to 20.72 mg of Pb.

Zinc

Introduce the prescribed solution into a 500 ml conical flask and dilute to 200 ml with water R. Add about 50 mg of xylenol orange triturate R and hexamethylenetetramine R until the solution becomes violet-pink. Add 2 g of hexamethylenetetramine R in excess. Titrate with 0.1 M sodium edetate until the violet-pink colour changes to yellow.

1 ml of 0.1 M sodium edetate is equivalent to 6.54 mg of Zn.

هو نفسه الهكزامين

2- EDTA ,used in Ampoule (anti catalyses)

3- To determine Ca in blood.

4- Anticoagulant.

5- To treatment of heavy metal poisoning such as lead (The chelated lead is excreted via kidneys).


Thank you
Prof. J. Al-Zehouri

Q&A