

# Role of Buffers in Pharmacy

*Buffer solution is solution which resists a change in its pH when small amount of acid or base is added into it*



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# Role of buffer solutions in pharmacy

- ▶ Solubility
- ▶ Colour
- ▶ Stability of Compounds
- ▶ Patient comfort
- ▶ Optimizing biological activity
- ▶ Analytical laboratory

# Solubility

- ▶ A controlled pH medium is helpful in controlling the solubility of compounds.
- ▶ For example, in acidic medium, solubility of different compounds (inorganic salts of  $\text{Fe}^{+3}$ , phosphates and borates) is increased; but these inorganic salts precipitate in alkaline media.
- ▶ Likewise, there are many organic compounds which are insoluble in acidic medium but are soluble in alkaline pH, e.g., alkaloids and amines are soluble in acidic solutions and insoluble in solutions of basic pH.
- ▶ Thus, pH plays an important role in solubility behaviour of compounds. The required pH is adjusted by buffers.

# Colour

- ▶ The pH of a solution is known to affect the colour of many natural dyes, present in fluid extract or of synthetic drugs. This property of colour changing at different pH values is used in identification of various compounds. e.g. red colour of cherry and rasbery syrup has been maintained at acidic pH which becomes pale yellow to nearly colourless at alkaline pH.
- ▶ The colour of synthetic compounds like phenolphthalein, phenolsulphonaphthalein has also pH dependent.

# Stability of compounds

- ▶ Because of hydrolysis, many compounds are unstable in aqueous solutions. These solutions can be stabilized by regulating the pH.
- ▶ Ascorbic acid and penicillin are unstable in an alkaline pH
- ▶ Sodium thiosulphate and sodium polysulphide preparations have to be stored at alkaline conditions to prevent separation of sulphur.
- ▶ Nitriles become brown in acid media because of formation of coloured nitrogen oxides.
- ▶ The normal salts or acid salts of carbonates and sulphites at acidic medium liberate carbon dioxide and sulphur dioxide respectively. So they could not be maintained at acid pH.

# Patient comfort

- ▶ Injectables and preparations for external and internal use become irritating if their pH is different from the normal for the particular tissue involved. An extremely acid or alkaline pH must be avoided because of tissue damage.
- ▶ In case of parental preparations, pH should be considered carefully and the ideal pH is 7.4, which is pH of blood. The most commonly used buffers in parenteral products are acetate, phosphate, citrate and glutamate.
- ▶ In ophthalmic preparations, buffers are generally used to maintain pH with the physiological range of lacrimal fluid (eye fluid). The lacrimal fluid has a pH range 7-8, but it has good buffering capacity and can tolerate preparations having pH values between 3.5-10.5 with little discomfort. Outside this range (3.5-10.5), increases lacrimation may occur with other complications. The buffering agents used in ophthalmic preparations include borate, carbonate and phosphates.
- ▶ In topical products (used in skin) such as ointments and creams are also buffered to ensure stability to the formulation. The most commonly used buffers in ointments and creams are citric acid/ its salts and phosphoric acid/ its salts.

# Optimizing biological activity

- ▶ Optimum pH conditions for activity of medicinal compounds have to be maintained.  
e.g -1. Sodium dihydrogen phosphate is used to buffer methenamine solution.  
2. Lower pH of sodium hypochlorite usually improves the germicidal efficiency of the preparation.
- ▶ Enzymes contain most activity only on certain pH values. For example, at pH 1.5, there is a maximum activity of pepsin.

# Analytical laboratory

- ▶ In analytical laboratory, the buffers of known pH for use as standards are used frequently.
- ▶ Calliberation of pH meter and preparation of indicator colour standards need accurately known buffer solutions.