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BIOLOGICAL AND PHARMACEUTICAL BUFFER SYSTEMS

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Abstract:
Generally, buffers are used in the pharmaceutical products for two purposes, viz., to adjust the PH of Product for maximum stability and to maintain the PH within the optimum physiological PH range. Pharmaceutical solutions generally have a low buffer capacity in order to prevent overwhelming the bodies' own buffer systems and significantly changing the PH of the body fluids. Buffers have concentrations in the range of 0.05 to 0.5M and buffer capacities in the range of 0.01 to 0.1, which are usually sufficient for pharmaceutical solutions. Most pharmaceutical buffers are composed of ingradients that are found in the body (eg. acetate, phosphate, citrate and borate). The ingradients are selected from the available ones considering their sterility, stability, cost, toxicity, etc.

Key Words: *Buffers, Optimization, Citric acid, Lacrimal fluids.*

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BUFFERS IN PHARMACEUTICAL SYSTEMS

Solid Dosage Forms:

Buffers have been widely in solid dosage forms such as tablets, capsules and powders for controlling the PH of the environment around the solid particles. This has practical application for the drugs that have dissolution rate limited absorption from unbuffered solutions [1-6]. One of the special applications of buffers is to reduce the gastric irritation caused by the acidic drugs. For example, sodium bicarbonate, magnesium carbonate and sodium citrate antacids are used for the purpose of reducing toxicity [7-10].

Semisolid Dosage Forms:

Semisolid preparations such as creams and ointments undergo PH changes upon storage for long storage for a long time, resulting in its reduced stability.Hence; buffers such as citric acid and sodium citrate or phosphoric acid/sodium phosphate are included in these preparations so as to maintain their stability

Parenteral Products:

Use of buffers is common in the parenteral products. Since the PH of blood is 7.4,these products are required to be adjusted to this PH. Change in PH to higher side (more than 10) may cause tissue necrosis while on lower side (below 3) it may cause pain at the site of action. Commonly used buffers include citrate, glutamate, phthalate and acetate. The PH optimization is generally carried out to have better solubility, stability and reduced irritancy of the product.

Ophthalmic Products:

The purpose of buffering some ophthalmic solution is to prevent an increase in PH can affect both the solubility and the stability of the drug. The decision whether or not buffering agents should be added in preparing on ophthalmic solution must be based on several considerations. Normal tears have PH of about 7.4 and posses some buffer capacity[11-14].

BUFFERS IN BIOLOGICAL SYSTEMS

Buffers for biological systems should satisfy the following requirements

- A PKa value between 6.0to 8.0
- High water solubility and minimal organic solvent solubility
- Exclusion by cellular membranes
- Minimal interaction between buffer and critical reaction compounds
- Should not absorbs light in the visible and Uv spectrum
- Stable and resistant to enzymatic degradation
- Minimal changes on dissociation from changes In Concentration and temperature
- Easy to manufacture and purify
- Cost effective
- Ionic strength
- Permeability

Buffers are important to biological systems because they enable the organism to maintain homeostasis with the little physiological cost

Blood: Blood consist of primary and secondary buffer systems contributing the PH 7.4. When PH of the blood goes below7.0 or above 7.8, life is in danger .The PH of the blood in diabetic coma is reported to drop as low as 6.8.

Primary buffers present in plasma are – Carbonic acid-bicarbonate system and acid alkali salts of phosphoric acid systems

Secondary buffers that are present in erythrocytes are – hemoglobin/ oxyhemoglobin system and acid salts of phosphoric acid system

Lacrimal Fluids: Lacrimal fluids (tears) have been found to have a great degree of buffer capacity, allowing dilution of1:15 with neutral distilled water. The PH of tears is about 7.4 , with range of 7.0 to 8.0. Normally, pure conjunctival fluid is more acidic than the tear fluids commonly employed in pharmacy. The PH increase rapidly when the sample is removed for analysis because of loss of carbon dioxide from the tear fluid

Three Buffer Systems in Body Fluid

Protein Buffer Systems:

Proteins are the most important and widely operating buffers in the body fluid. The protein buffer system is an integral component of the body's pH controlling mechanism. Protein buffers are either intracellular or extracellular [15-19]. Their functionality is mainly intracellular focused and include haemoglobin (Hb). Hb is the protein that functions to transport oxygen within the body. Plasma proteins function as buffers but their amount is small in comparison with the intracellular protein buffers. Protein buffers include basic group, and acidic protein buffer groups, that act as hydrogen ion depletors or donors to maintain the pH level at 7.4. The most well-known protein buffers include 0.1 M NaH2PO4, pH 6.2 (Activation buffer), PBS, pH 7.4 (Alternate Coupling Buffer) and the PBS, 1 percent BSA, pH 7.4 (Assay Buffer).

Phosphate Buffer System [20-22].

The phosphate buffer system is comprised of two ions: hydrogen phosphate ions and dihydrogen phosphate ions. The pH level of the blood drops below 7.4 when the H+ ions in the bloodstream increase. Hydrogen phosphate ions accept all additional H+ ions to reestablish the equilibrium between the hydroxide and hydrogen ions in the blood. When the pH level of the blood increases above 7.4, the dihydrogenate phosphate ions release additional hydrogen ions to reinstate the pH level of the blood to its optimal 7.4.

Bicarbonate Buffer System [23-25]

The bicarbonate buffer system functions to maintain the pH level in the blood of mammals. It also plays a major role in the formation of acid in the stomach, and to neutralize the pH of chyme that enters the small intestine from the stomach. The bicarbonate buffer system manages acid/base imbalances and effectively manages the release of excess carbon dioxide as a bi-product of cellular respiration.

BUFFER CAPACITY [26-29]

Buffering capacity is defined as the number of moles of strong base or acid needed to change the pH of a liter of buffer solution by one unit. A general buffer capacity estimate is 40 percent of the total sum of the molarities of the conjugate base and acid.

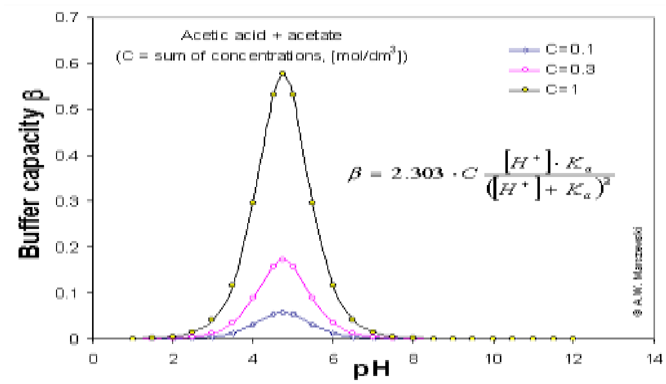

Table1: **Standard Buffers with their pH Range and Quantities of Ingredients**

Buffer	pH	Method
Hydrochloric acid Buffer	1.2 - 2.2	50 ml of 0.2M kcl and a sufficient amount of 0.2 N Hcl. Final volumes is made by adding water to make 200ml solution.
Acid phthalate buffer	2.2 - 4.0	50 ml potassium hydrogen phthalate and sufficient volume of 0.2N Hcl. Final volume is made by adding water to make 200 ml solution
Neutralized phosphate buffer	4.2 - 5.8	50 ml potassium hydrogen phthalate and sufficient volume of 0.2N NaOH. Final volume is made by adding water to make 200 ml solution
Phosphate buffer	5.8 - 8.0	50 ml potassium dihydrogen phosphate and sufficient volume of 0.2N Hcl. Final volume is made by adding water to make 200 ml solution
Alkaline borate buffer	8.0 - 10.0	50 ml boric acid-potassium chloride and sufficient volume of 0.2N NaOH. Final volume is made by adding water to make 200 ml solution

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