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Editorial OMICS International

Universal Pharmaceutical Calculations: An Overview

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Editorial

The purpose of pharmaceutical calculations is to allow the pharmacist to prepare pharmaceutical dosage forms for their patients accurately. There exists a need for every pharmacist to be competent in these calculations for patient's care and safety. Some of the necessary calculations are discussed below.

Aliquot method: This method permits the pharmacist to make measurements for powders or liquids within acceptable errors (usually 5%). The method relies on knowledge of the sensitivity requirement of the balance (for powders) or the deviation value of the measuring device (for liquids). This, in turn, allows calculation of the minimum allowable quantity within a predetermined error rate.

Density Factor (DF): The density factor determination is necessary for accurately preparing suppositories in pharmacy. It is defined as the weight of the drug in grams which occupies the same volume as that of 1 g of the base (usually cocoa butter). The Paddock Laboratory method is often used for such determination of the DF value.

Milliequivalent (mEq): The notion of mill equivalent applies to ions in solution. When ions interact with each other in solution, they do so, 1 equivalent weight to 1 equivalent weight. For example, 1 equivalent weight of calcium always reacts with 1 equivalent weight of chloride in solution. Stated otherwise, 20 g of calcium react with 35.5 g of chloride to form $CaCl_2$. Note that calcium chloride has 2 equivalent weights of each calcium and chloride (it contains 40 g of calcium and 71 g of chloride).

Milligrams percent (mg %): This concentration unit is similar to % w/v, except for the fact that it expresses the number of milligrams of the drug in 100 mL preparation. For a solution which is labelled as 0.12% (% w/v), the concentration may be expressed in mg % (120 mg/100 mL).

Molality (m): When a drug solution is labelled as 1 m, it means that the solution contains 1 mole of the drug per kilogram of solvent. For example, a pharmacist added 3 g of sucrose (342.3 g/mole) to 100 g of water. The resulting solution may be labelled as 0.09 molal.

[(3 g) × (1000 g/kg)/(342.3 g/mole) × (100 g)]

Molarity (M): It is defined as the number of moles of the drug in a one-litre solution. For a hydrochloric acid solution with a concentration of 1 M means there is one mole of HCl in every litre solution. Since the molecular weight of HCl is 36.5 g/mole, thus a 1 M solution contains 36.5 g HCl in one-litre preparation. This translates into 3.65% (%w/v) from the proportionality.

[(100 Ml) × (36.5 g)/(1000 mL)=3.65 g]

Normality (N): The number of gram equivalents of the drug in one-litre solution is the basis of this concentration unit. Normality is related to molarity by the following equation.

[Molarity=(Valence) x Normality]

For example, the valence of sulphuric acid is 2 equivalents/mole. Thus, a 1 M solution of sulphuric acid is 2 N (or 2 Equivalents/L). Since one equivalent weight of sulphuric acid is [(98 g/mole)/(2 Equivalents/mole)=49 g), then a 2 N solution contains (2 × 49 g=98 g of sulphuric acid/L).

Part Per Million (ppm): This concentration unit is reserved for solutions that include ions in a much diluted form. It is defined as the number of parts of the solute present in one million parts of the solution. When water is the solvent (density=1 g/mL), part per million refers to the number of grams of the solute in one million millilitres of solution. Suppose that a solution containing 5 ppm of fluoride ions (19 g/mole) is needed for a patient. The pharmacist may use sodium fluoride (42 g/mole) in preparing this solution. The quantity of NaF needed to make 1 litre of solution is 11 mg (containing 5 mg/L of fluoride ions).

Percent by volume (%v/v): This concentration unit defines the number of millilitres of the drug found in 100 mL of solution. If a pharmaceutical solution is labelled as 4% (%v/v) for its glycerine content, thus it contains 4 mL of glycerine in every 100 mL preparation. If the pharmacist measures 20 mL of this solution using a graduated cylinder, he should expect to have 0.8 mL of glycerine in this volume. This calculation is also done by proportion [(20 mL) × (4 mL)/(100 mL)=0.8 mL].

Percent by weight (%w/w): It is the number of grams of the drug presents in 100 g preparation. For example, a 2% salicylic acid ointment contains 2 g of salicylic acid in each 100 g formulation. For a one-ounce ointment (30 g), there is 0.6 g of salicylic acid. This is done by proportion [(30 g) × (2 g)/(100 g)=0.6 g].

Percent weight by volume (% w/v): For liquid dosage forms, this concentration unit describes the number of grams of the drug available in each 100 mL preparation. If a syrup formulation is labelled as 50% of sucrose (% w/v), then it contains 50 g of sucrose in each 100 mL syrup. When the pharmacist uses this preparation to sweeten an elixir, he can take the 5-mL volume of the resulting syrup and adds it to 95 mL of the elixir formulation. Assuming volumes are additive (100 mL total volume), the amount of sucrose in the final formulation is 2.5 g. This is computed by proportion [(5 mL) (50 g)/(100 mL)=2.5 g]. If one were to express the concentration of sucrose in the final volume of the elixir in % w/v, then this would be stated as 2.5%.

The Hydrophile Lipophile Balance system (HLB): The HLB system is a way for making calculations related to emulsions. In this system, emulsifying agents and oil/oil-like substances are assigned HLB values.

Usually, more hydrophilic compounds have HLB values greater than 10 and more lipophilic materials have HLB values of 10 or lower. The system utilizes a matching technique in selecting the best emulsifying agent for an emulsion by just matching the required HLB value of the oil phase to that of the emulsifying agent. In the case where no exact match is found, then the pharmacist uses two emulsifying agents with their proportions in the final emulsion is determined by alligation calculations.

Tonicity adjustment calculations: There are four different methods for calculations made to adjust the tonicity of solutions. All of these methods depend on the principle of colligative properties of solutions. Tonicity of solutions is improved by the addition of an inert substance, usually sodium chloride or boric acid. The first method is based on knowledge of the freezing point of the solution being adjusted. The second method relies on the value of a parameter known as the sodium chloride equivalent value (E). The value of E allows the pharmacist to convert the quantity of any drug in solution to its osmotic equivalent in sodium chloride. The third and the fourth methods are also based on the E-value. They allow the pharmacist to dilute the drug quantity by a calculated volume of water to make an initial isotonic solution, followed by diluting the resulting solution with another isotonic solution (normal saline) to the desired final volume of the product. The concentration units that describe the tonicity of solutions are osmolarity and osmolality. These are similar to molarity and molality, respectively, except for replacing the number of moles in the solution by the number of osmoles. For sodium chloride, 1 mole equals to 2 osmoles because 1 molecule of NaCl generates 2 ions upon complete dissociation in water. Normal saline solution is often labeled as 308 mOsmol/L because the concentration of NaCl in the solution is 154 mEq/L (using the equation-[mOsmol/L=(mEq/L) × (Number of ions formed)/(Valence)=(154 mEq/L) × 2/ (1 Equivalent/mole)=308)] [1-4].

In summary, pharmaceutical calculations are of utmost importance for the practicing pharmacist to accurately prepare and dispense dosage forms to patients. Applying proper calculations and techniques in a pharmacy operation serves as an essential part in the delivery of pharmaceutical care.

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