Quantitative Product Strength

The quantitative composition of certain pharmaceuticals, particularly liquids and semisolid dosage forms, often is expressed in terms of the *percentage strength* of the active and sometimes inactive ingredients. For some dilute solutions, the strength may be expressed in terms of their *ratio strength*. For most injections, many oral liquids, and some semisolid dosage forms, the quantity of active ingredient commonly is expressed as weight of drug per unit volume basis, such as milligrams of drug per milliliter of injection or oral liquid, or as weight of drug per unit weight of preparation, such as milligrams of drug per gram of ointment. The strength of solid dosage forms is given as the drug content (e.g., 5 mg) per dosage unit (e.g., tablets and capsules).

Percent, by definition, means parts per hundred. In pharmacy, percentage concentrations have specific meanings based on the physical character of the particular product or formulation, that is,

> *Percent weight in volume*: Expressed % w/v, this defines grams of a constituent in 100 mL of a preparation (generally a liquid).
> *Percent volume in volume*: Expressed % v/v, this defines milliliters of a constituent in 100 mL of a preparation (generally a liquid).
> *Percent weight in weight*: Expressed % w/w, this defines grams of a constituent in 100 g of a preparation (generally a solid or semisolid, but also for liquid preparations prepared by weight).

Thus, a 5% w/v solution or suspension of a drug contains 5 g of the substance in each 100 mL of the product, a 5% v/v preparation contains 5 mL of the substance in each 100 mL of the product, and a 5% w/w preparation contains 5 g of the substance in each 100 g of the product.

In the manufacture or compounding of pharmaceutical preparations, the pharmacist may calculate (*a*) the strength of an individual component in a product or (*b*) the amount of a component needed to achieve a desired percentage strength.

For example, what is the percentage strength, w/v, of a solution containing 15 g of drug in 500 mL? Since by definition percentage strength is in parts per hundred, just determine how many grams of the drug are present in each 100 mL solution. Solving by proportion: 15 g/500 mL = (×) g/100 mL. The answer is 3 g, and thus, the solution is 3% w/v in strength.

Other examples: 3 mL of a liquid in 1 L of solution = 0.3% v/v, 4 g of drug in 250 mL = 1.6% w/v, and 8 g of drug in 40 g of product = 20% w/w.

How many grams of drug are needed to prepare 400 mL of a 5% w/v preparation? In w/v problems, the specific gravity *of the preparation* is assumed to be the same as that of water (sp. gr. 1.0), so 1 mL is assumed to weigh 1 g. Therefore, in the problem example, the 400 mL is assumed to weigh 400 g, and 5% of 400 g = 20 g, the amount of drug needed.

A v/v problem example: How many mL of a liquid is needed to make 1 pt of a 0.1% v/v solution? 1 pt is equal to 473 mL, and 0.1% of that is 0.473 mL, the answer.

A w/w problem example: How many grams of zinc oxide powder should be used in preparing 120 g of a 20% w/w ointment? The answer is 20% of 120 g = 24 g.

Ratio strength is sometimes used to express the strength of or to calculate the amount of a component needed to make a relatively dilute preparation. Compared to percentage strength designations, for example, a 0.1% w/v preparation (0.1 g/100 mL) is equivalent to 1 g/1,000 mL and may be expressed as a ratio strength of 1:1,000 w/v. Ratio strength expressions use the w/v, v/v, and w/w designations in the same manner as percentage strength expressions. For example:

> *A 1:1,000 w/v preparation of a solid constituent in a liquid preparation* = 1 g of the solid constituent in 1,000 mL of preparation.
> *A 1:1,000 v/v preparation of a liquid constituent in a liquid preparation* = 1 mL of the constituent in 1,000 mL of preparation.
> *A 1:1,000 w/w preparation of a solid constituent in a solid or semisolid preparation* = 1 g of the constituent in 1,000 g of preparation.

A ratio strength calculation: What is the ratio strength of 6,000 mL of solution