

Lecture 08: Powder for inhalation and pharmacotechnical testing of inhalation preparations

A dry powder inhaler is a device that delivers medication to the lungs in the form of a dry powder. Dry powder inhalers are commonly used to treat respiratory conditions such as asthma, bronchitis, emphysema, and COPD, although these devices (such as inhalable insulin) have also been used in the treatment of diabetes mellitus.[1]

Dry powder inhalers are an alternative to aerosol-based inhalers. They may require a procedure to allow the patient to take a measured dose of powder. The medication is usually either contained in a capsule for manual loading or pre-filled inside the inhaler. Once loaded or activated, the operator places the mouthpiece of the inhaler in their mouth and takes a strong, deep breath (ensuring that the medication reaches the lower parts of the lungs), holding their breath for 5 to 10 seconds. A variety of these devices exist. The dose that can be delivered in a single inhalation is usually less than a few tens of milligrams, as larger doses of powder can cause coughing.

Most of these inhalers rely on the force of the patient's inhalation to expel the powder from the device and then break it down into particles small enough to reach the lungs.[2] For this reason, insufficient inspiratory flow rates from the patient can lead to a reduced dose and incomplete breakdown of the powder, resulting in unsatisfactory device performance. Therefore, most dry powder inhalers require a minimum inspiratory effort for proper use, and for this reason, these devices are normally used only in older children and adults.

Using the Inhaler

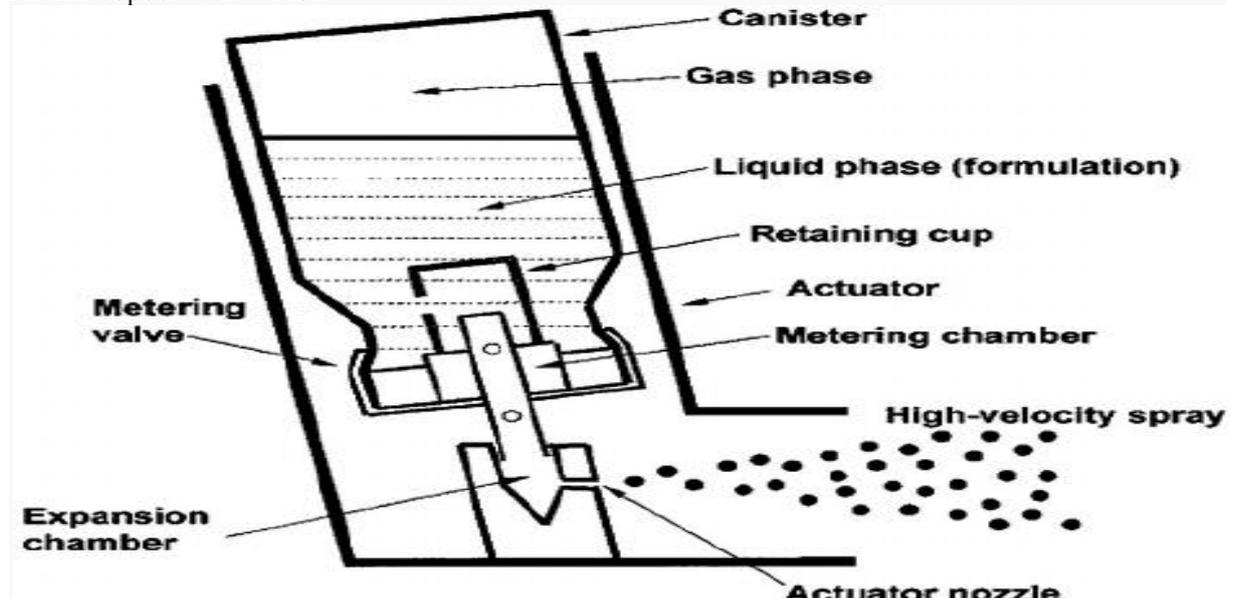
Although dry powder inhalers are commonly used in the treatment of lung disorders, their use requires some dexterity to perform the sequential steps required for their application. Incorrect completion of one or more steps can significantly reduce the delivered dose and its breakdown, and consequently, its effectiveness and safety. Numerous studies have shown that between 50 and 100% of patients do not use their inhaler devices correctly (regardless of type).

Different Types of Inhalers:

This is a device that allows the inhalation of a medicated powder through deep inhalation. There are two types: Multidose forms: the inhaler has an integrated metering system. Single-dose forms: these can be capsules, tablets, or doses of powder in aluminum blisters. The inhaler ensures the release and dispersion of the powder from these forms. Fig. 3. Different forms of powder inhalers

IV.3. Metered-Dose Pressurized Inhalers: Liquid preparations delivered using metered-dose pressurized inhalers are solutions, suspensions, or emulsions packaged in special containers with a metering valve and maintained under pressure with suitable liquefied propellant gases or gas mixtures,

which may also serve as solvents. Suitable co-solvents, solubilizers, and stabilizers may be added. Eur. Pharmacopoeia 7th edition



IV.3.1. Operating Principle: A sealed container containing:

- a liquid phase to be dispersed, which is either a liquid active ingredient or an active ingredient in solution, emulsion, or suspension.
- a gaseous phase: the propellant gas,
- a valve ensuring closure and incorporating the spraying device. The valve includes a dip tube that carries the liquid to a nozzle whose orifice opens to the outside, a flap or valve that, depending on its position, allows or prevents communication between the dip tube and the nozzle, and a spring that ensures the flap is closed when not in use. This spring is not always present in deformation valves. A push button, activated by the user, opens the flap.

A. Compressed Gas Device: In the case of compressed gas, the dispersion of the liquid into fine droplets in atmospheric air is ensured solely by its passage under pressure through the upper orifice of the nozzle: this is therefore a mechanical dispersion. The pressure is due to the compressed gas. It is exerted on the surface of the liquid and transmitted within the liquid to the nozzle orifice.

B. Liquefied Gas Device Dispersion here is not solely mechanical. Gas pressure also plays a role, but it is not the only factor. What exits the nozzle is a mixture of active ingredient and liquefied gas. This

gas is abruptly brought to atmospheric pressure and instantly transitions from a liquid to a vapor state, dispersing the active ingredient with which it was mixed.

IV.3.2. Advantages of the Two Types of Sprayers

A. Compressed Gas Advantages: Pressure varies very little with temperature. The risk of explosion is low when the device is placed in a location with a relatively high temperature. Disadvantages: Dispersion, being purely mechanical, is less efficient. Achieving significant pressure requires a large volume of gas, approximately 50% of the total container volume. If by mistake the user presses the push button while the sprayer is upside down, with the end of the dip tube in the gas phase all the gas will escape in a few seconds.

B. Liquefied Gas Advantages: More efficient dispersion mechanism. Smaller volume occupied by the gas phase (approximately 25%). Constant pressure throughout use due to vaporization of the liquefied gas as the available volume increases. Disadvantages: Pressure inside the container varies with temperature. Risk of explosion if the temperature reaches 500°C. Sensation of cold on tissues.

IV.3.3. Propellant Gases Compressed Gas

- Nitrogen. - Nitrous oxide. - Carbon dioxide Liquefied Gas - These are mainly chlorofluorocarbon (CFC) or hydrofluoroalkanes (HFA) gases such as: • Freons. • Flugens. • Frigen.

IV.3.4. Packaging

• Metal Containers. Made of iron, varnished or tinned sheet iron (tinplate). Aluminum, 0.25 to 0.40 mm thick. They are lightweight, pressure-resistant, and relatively inexpensive. Glass: Thick, ordinary white glass. They are less prone to damage but more fragile and heavier. They are always coated with a shatterproof plastic sheath.

The Valve - Ensures a tight seal on the container and dispensing by spray.

- Metering Valve: Each press releases a predetermined dose of sprayed liquid.

- The push button is generally equipped with an applicator adapted to the application site.

IV.3.5. Filling - Pressure Process: Suitable for compressed and liquefied gases. (Gas dispensing occurs after the valve is installed). - Cold Process: Suitable only for liquefied gases. (Gas dispensing occurs before the valve is installed).

IV.6.3. Tests on the Finished Product:

Flammability check.

Vaporization check.

Valve flow rate measurement.

Spray pattern.

Leak test.

Particle size check

Storage

Dry powder inhalers should be stored in a dry place at a temperature not exceeding 25°C and a relative humidity between 40 and 50% in a sealed container, as exposure of the powder to moisture degrades the device's ability to disperse the medication into a fine powder upon inhalation. Some medications also require protection from light.