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Quality Assurance and Quality Control Packaging of Materials-A Review

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Abstract
Material packaging is a crucial component of the pharmaceutical industry. The drug product's quality, stability, and identity are impacted by its packaging. Packaging should reduce component loss, offer an acceptable level of protection, and avoid physically or chemically interacting with what is inside in a way that could change their quality beyond the parameters specified in each unique monograph or pose a toxicity risk. In order to promote adherence to a prescribed course of treatment, pharmaceutical packaging offers protection, presentation, identity, information and convenience. Rubber, plastic, glass, metal, and cork are possible materials for the closing. Rubber, plastic, glass, metal, and cork are possible materials for the closing. To assess the quality, integrity, and compatibility of packing materials, a number of tests are available. Quality testing specifications and requirements vary depending on the kind of pharmaceutical products being used. Numerous techniques are used to test containers; notable tests for glass include the Cracked Glassware. Transparency testing is used to evaluate closure materials. Test for Penetrability Fragmentation Self-sealing proficiency exam, extractive exam, etc. Package material testing is required in accordance with regulations set forth by USFDA, WHO GMP, ICH, and other regulatory bodies.

Keywords
Documentation, Training Programs, Supplier Audits, Inspection Protocols, Visual Inspection, Shelf-Life Testing.

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1. INTRODUCTION:
Make sure that medications are stored appropriately to keep their therapeutic efficacy from the moment of packing till consumption is an important component of the procedure for packaging. The art and science of preparing goods for use, storage, and transportation is referred to as packaging. In order to promote adherence to a prescribed course of treatment, pharmaceutical packaging offers protection, presentation, identity, information, and convenience. package's composition.[1]

Primary packaging is material that involves and holds the product first (**Figure1**).
Bottles, vials, ampoules, and all sorts of packing which comes in direct contact with the product are samples of the smallest unit of distribution or use. Secondary packaging was once employed to maintain the critical packaging, which included cartons & boxes **(Figure 2)**. Transport shipping and bulk handling are both used for tertiary packaging **(Figure 3)**. [5,6]

Figure 1. Different types of Primary Packaging

Figure 2. Different types Secondary Packaging

Figure 3. Tertiary Packaging

Figure 4. Types of Packaging

1.1 Types of Glass:

Glass Type 1: Borosilicate; Type 2: Soda lime glass; Type 3: Typical fizzy lime glass; Type 4: Soda lime glass.

1.2 Quality Control of Containers:

A pharmacopoeial article's box is meant to store the drug or medical items that it may come into touch with or come in. Personal contact with. Even for short periods of time, containers must be selective after assessing the nature of the contents and possible effects of make and storage [2,3].

1.3 Glass Containers: Glass jars come in both colored and colorless varieties. A borosilicate glass classified as neutral contains notable concentrations of caustic and/or alkaline earth oxides, aluminum oxide, and boric oxide. Its resistance to hydrolysis is only weak.[7]

2. EVALUATION PARAMETERS:

2.1 Powdered Glass Test:

Alkaline components (calcium, potassium, sodium, aluminum, etc. oxides) are leached out the glass containers into the purified water at high temperatures. The rate of leaching of caustic can be improved in the powdered glass, which is crucial. The idea behind the glass paste test is to calculate how much alkali has been leached. Acid-based titration with methyl red indicator is the fundamental analysis.[8]

2.2 Water Attack Test:

Only vessels that were recently exposed to sulfur dioxide fumes in an environment with regulated humidity levels should be utilized for this test. The surface alkali is neutralized by such a treatment. The

glass is now more resistant to chemicals. Finding out if the alkali that has leached from a container's surface is within the permitted limits is the basic idea behind the water attack test. The full has container (ampoule) must be used because its inside is being tested. The total quantity of acid required to neutralize the alkali that been released from the top is estimated, and the alkali leaching process is sped up by utilizing a high temperature for a certain period. The termination point is identified with methyl red indicator. Acid-base titration is the fundamental.[16]**(Table 1).**

Table 1. Limits of Alkalinity for Glass Containers

Tests	Containers	Limits ml of 0.02 N H_2So_4
Powdered Glass Test	Type 1	1.0
	Type 3	8.5
	Type NP	15.0
Water Attack Test	Type 2 (100ml of less)	0.7
	Type 2 (over 100ml)	0.2

2.3 Plastic Containers: Polymer (low or higher volume), polypropylene, polyvinyl chloride, polystyrene, and to a lesser extent polyethylene terephthalate (PET) are the polymers used to make plastic containers for pharmaceutical items. Several polymers are combined with appropriate additives, if needed, to form the containers. They ought to be made of materials devoid of any compounds that could be extracted in such quantities from other contents to change the product's stability or efficacy or to pose a hazardous risk. Antioxidants, lubricants, plasticizers, and impact modifiers are examples of additives; antistatic and mold-release agents are not.[4]

2.4. Permeation:

Aa shelf life may be adversely damaged if gases, vapors, or liquids seep through plastic containers. The permeability of oxygen and water vapor via the plastic wall into the medication may cause issues if the dosage form is at risk of hydrolysis and oxidation.

2.5. Leaching:

Aa shelf life may be negatively impaired if gases, vapors, or liquids escape through plastic used for packing. The permeability of oxygen and water vapor via the plastic wall into a medication may cause issues if the dosage form is susceptible to hydrolysis and oxidation. Temperature and humidity have a major impact in plastic's ability to allow the passage of water and oxygen. At a rise in temperature relates to a rise in gas flow ability.[13]

2.6. Reactivity to Chemicals:

Some plastic formulation additives have the potential to combine chemically without one or more therapeutic product components. The look of the plastic or pharmaceutical product can be changed by even minute amounts
of chemically incompatible material.

3. TESTS ON PLASTIC CONTAINER:

3.1 Leak Test:

Pour water into 10 containers. After fitting the closures, for a full day at room temperature. None of the containers show any indications of leaking.

3.2 Collapsibility Test:

To extract the contents, it must be squeezed. When used, a container that collapses inwards releases no less than 90% of the apparent contents at the necessary flow rate at room temperature.

3.3 Clarity of Aqueous Extract:

Choose pieces from appropriate containers that are unlabeled, unmarked, and not laminated. These portions should be chosen at random and should produce the necessary total sample area, with no strip being larger than 20 cm overall. Shake the strips in at least two different batches of bottled water for a minimum of thirty seconds each, then drain the water completely to remove any remaining material.

3.3. Water Vapour Permeability Test:

Five nominally sized containers should be filled with water. The bottles should then be heat sealed with an appropriate seal, such as a metallic foil-polyethylene laminate. Accurately weigh each container, then let it stand (without covering) for fourteen days at a temperature of 20 to 25 0C and an approximate humidity of 60+5%. Weigh the containers again. [12]

3.4 Ophthalmic Preparations in Plastic Contains:

1 Tests for leaks and collapse watery extract's clarity; Non-flammable leftovers Adhere to the testing procedures outlined under Non-parenteral Preparations.
2 Intracutaneous test; Systemic injection test Observe the tests outlined under Parenteral Preparation using Plastic Containers.
3 Test for ocular inflammation. This test is intended to assess how a rabbit's eye reacts when extracts from the subject matter are injected.

3.5 Metal Containers:

Aluminum and its many alloys, and Tin are commonly electroplated increase corrosion easier for producing aerosol cans. On the other hand, pure aluminum is used to make foil. Aluminum foil is frequently utilized as a barrier to water in multilayer laminates, which may also contain plastic and paper. The foil from aluminum can be shaped into laminates, blister structures, semi-rigid containers, and rigid containers. Compared to alternative packaging materials, metals provide a variety of benefits. Metal is almost completely impervious to gas and water, just like glass. Metal containers are also incredibly durable and shatterproof. Metal allows very easy manufacture and very easy use for applications needing malleability, such as collapsible tubes. Additionally, metals can be crafted into more intricate delivery systems like aerosol administration devices, dry powder inhalers, metered-dose inhalers, and even needles that are ready to use. The pricing and quality control of metals are their main drawbacks. Metals are more expensive to buy and create usable containers out of by nature. Additionally, during manufacturing, metals are vulnerable to the formation of "pinhole" defects, which can seriously impair their barrier qualities, particularly in extremely thin portions.[9]

3.6 Paper, Paperboard and Cardboard:

Paper products, paperboard, and cardboard are most frequently used in over-the- counter (OTC) exterior packaging and blister lidding stock. Paper products, paperboard, and cardboard are usually used as part of the secondary medicinal container since they provide almost no moisture or gas barrier. Paper can be coated or laminated with a number of materials to give it more protection. More often than not, paper is the only part of multicomponent systems that provides the best possible environmental protection for the medication environment when it comes to important packaging functions. Paper is a very confusing barrier for a toddler, Paper additionally makes printing on.

Figure 5. Different types of materials: paper; cartons/cardboards

4. PACKAGING DESIGN AND SPECIFICATIONS:

A packaging component's quality control process begins at the design phase. Every element of pack creation that could result in quality issues needs to be recognized and reduced.

Packaging Design:

4.1 Component Dimension and Shape:

The policy needs to be to standardize component size and shape. The only substance that differs between plastic bottles and rubber plugs during production is what allows for shape and size standardization. The components will vary in size.[18]

4.2 Validation Trials in Packaging:

The packaging operation must be validated once the components for a specific product have been recognized. This is to guarantee that, at the necessary packaging pace, a constant pack quality is achieved.

4.3 Material of Construction:

It is important to give considerable thought to the construction material, especially if the product will be communicated with the container. It is imperative to guarantee that the item in question does not degrade or become contaminated upon interaction with the container, nor does it compromise the strength of the packing.

4.4 Component /Product Validation:

The pharmaceutical company must conduct compatibility investigations between the medication and container once the composition has been decided upon in order to guarantee that product deterioration does not occur over the market life of the product. Products must be able to be protected from the environment by the container.[11]

5. WHO GUIDELINES FOR PACKAGING MATERIAL QUALITY CONTROL:

Pharmacopoeial and other specific needs must be met by each container and closures intended for use Appropriate sample sizes, requirements, testing techniques, cleaning protocols, and sterilization protocols must align with the compatibility of the packaging materials. Plastic granules must also meet all pharmacopeial standards, which include passing biological and physio-chemical testing.

In accordance with the specified process, all of the containers and closures must be washed with water before being sterilized for injection. The stoppers, containers, and closures must be made with an

airtight seal in mind when they are attached to the bottles. Closures and containers used for a specific product do not negatively impact the product. Upon using the glass bottles, the printed Glass bottles:

a) The glass bottle's shape and design must be logical and consistent.
b) Only glass bottles composed of USP, the Type-1 and Hs Type-ll are permitted.
c) Non-parenteral sterile products may be stored in glass USP Type-ll containers.[15]

6. CONCLUSION:

Any pharmaceutical sector nearly always requires packaging materials to be tested. The drug product's quality, stability, and efficacy are impacted by the packaging material. A package's material costs should be as minimal as feasible without sacrificing the product's quality. Before it was brought to the local marketplaces or made available to product consumers, it had to pass the test specifications. The test type used should comply with regulatory agencies' standards.

CONFLICTOF INTEREST

The authors declare to have no conflict of interest.

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REFERENCES

[1] RoopKhar, S.P. Vyas, Farhan Ahmad, Gaurav Jain, Lachman/Lieberman the Theory and Practice of Industrial Pharmacy 4th edition CBS publishers.
[2] Shailaja and Mahesh Kataria., Quality Control Testing of Packaging Materials. Pharmatutor, Pharmacy Infopedia 2013.
[3] The Indian Pharmacopoeia Commission Ghaziabad, Indian Pharmacopoeia 2007 volume 1, pg.no.363-371
[4] United States Pharmacopoeia 2007, volume 1 pg.no. 661.
[5] Lachman Leon, Liberman H.A. and Kaing J. L The Theory and Practice of Industrial Pharmacy.3rd edition. New Delhi: CBS Publishers & Distributors Pvt. Ltd. Pg.no. 711-732 2013.
[6] Pharmaceuticals Packaging Technology, Taylor and Francis by Dean D.A, Evans E.R fifth edition page no.188-189.
[7] "Packaging": Cooper and Gunn's Tutorial Pharmacy, Sixth edition, CBS publishers page no. 139-140.
[8] Pharmaceutics- 1 by R.M. Mehta, Page No: 74-85.
[9] The Theory and Practice of Industrial Pharmacy by Leon Lachman, page no :711-724.
[10] Indian Pharmacopoeia, Government of Indian ministry of health and family welfare, The Indian Pharmacopoeia commission, Ghaziabad, Volume 1, 6.1, 6.2, 6.3, 361-370, 2007.
[11] Proceedings of IUFOST Symposium on Aseptic Processing and Packaging of Foods. Tylösand, Sweden: Lund University and the Swedish Food Institute Proceedings of IUFOST Symposium on Aseptic Processing and Packaging of Foods. September 9–12 1985.
[12] Emch, F. *Mitt. GebieteLebensm. Hyg.*, 76: 44 1985.
[13] Edwards, J. "Proceedings of NFPA Conference 'Capitalizing on Aseptic'. pp. 45 Washington, DC: Food Processors Institute October 11–12 1983.
[14] Rose, D. *"Good Manufacturing Guidelines for the Processing and Aseptic Packaging of Low-Acid Foods"* , Technical Manual No. 11 Chipping Campden : Campden Food Preservation Research Association 1986 .
[15] Organization of Pharmaceutical Producers of India, "Quality Assurance Guide" Chapter 11.5 Page no. 1-4, Fourth Edition 2001,
[16] Jerkins W.A, Osborn K.J, "Packaging Drugs and Pharmaceuticals", edition 1993, Technomic Publishing Co. Inc., Page no. 1372-1389
[17] "European Pharamocopeia"5.0, Vol-1, page no.303-317
[18] Dean D.A, Evans E.R, and Hall I.H, "Pharmaceutical Packaging Technology".