



# Comparative Study OF Pharmaceuticals Plastic Packaging & Eco-friendly Packaging

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**Abstract :-**Pharmaceutical packaging plays a pivotal role in preserving these safety and efficacy of medications. There are three types of packaging primary, secondary, tertiary. Here is a study of Pharmaceutical Plastic VS Eco-friendly Packaging. The benefits of plastic packaging is it is durable low cost , Water-resistant, lower energy and heavy chemical and lightweight drawback of plastic packaging they pollute our environment. They pose danger wildlife. Eco-friendly pharmaceutical packaging is easily biodegradable. Moreover these is best than plastic packaging. Among the various materials available in packaging. Here Polyethylene and Glass I have been studied. Polyethylene it is widely used in the pharmaceutical industry for its flexibility, lightweight nature and resistance to moisture and chemical degradation. Moreover it provides excellent barrier properties. Reducing the risk of contamination and extending product shelf life concern regarding its environmental impact, particularly in term of recycling and dispose have arisen. Glass on the other hand is revered for its inert and non- reactive properties making it an ideal choice for sensitive pharmaceutical formulation. It does not interact with drug compounds, ensuring the integrity of the product. Additionally glass is fully recyclable and offers minimal environmental impact. I conducted survey on Plastic and Eco-friendly packaging . From it show that Eco-friendly packaging is the best.

**Index Terms - Pharmaceutical Packaging, Plastic Packaging, Eco-friendly Packaging, Survey of Pharmaceutical Plastic &Eco-friendly Packaging.**

## I. INTRODUCTION

### Packaging :-

Packaging is defined as a technique which allows containment of pharmaceutical product from the time of production in a unit till its use.Packaging of pharmaceuticals essentially provide containment, drug safety, identity, convenience of handling and delivery

### Advantages :-

1. The product uniformity is maintained during packaging
2. The integrity of packaging from is maintain.
3. The side effects are minimized and protected from contamination.
4. Packaging enhance the shelf life of the product this enhancing better stability.
5. Minimize the side effect(Joseph et al., 2013a).

### Disadvantage:-

1. Excessive can lead to increase costs for both manufacturers and consumer.
2. Photosensitive drug can not be protected in transparent glass containers.
3. If you do not pack properly the product will be damaged.
4. Some packaging materials may contain harmful chemicals that can leach into product over time poisoning health risks.

**Types of Packaging:-****1. Primary Package:-**

Primary packaging are those package which are direct contact with the production. The main aim of primary packaging is to protect the formulation from environmental, chemical, mechanical and other hazards.

**2. Secondary packaging :-**

The secondary packaging is packaging that pulls together all the primary packaging from of a single product.

**3. Tertiary Packaging :-**

It is used for warehouse storage and transport shipping. The most common form is a palletized unit load that pack tightly into containers(Garjani, 2016),(Deore et al., 1945)



**Figure 1: Different types of Packaging.**

**Table 1: Materials and examples**

Sr. No	Materials	Types	Examples
1.	Glass	Primary	Ampoules, vials
2.	Plastic	Primary	Ampoules, vials, Infusion bottles, Dropper bottles
3.	Metal	Primary	Ointment tube, paste.
4.	Cardboard	Secondary	But pack in primary pack
5.	Paper	Secondary	Lable, Patients information leaflets
6.	Cardboard plastic	Tertiary	Shippers, Pellets.

**Based on solid , liquid & gaseous packaging:-****I. Liquid Packaging:-****1 . Well Closed Containers:-**

These types of containers provide the protection from foreign particles and loss during transportation sale.

**2. Air Tight Containers:-**

These types of containers protect the containers from environmental hazard. If these containers are intended to be opened on more than one occasions that they remain airtight after reclosure. These known as hermetic sealed container.

**3. Single Dose Containers:-**

This type of containers contain single dose of medicament.

Example- Glass ampoules, Vials, etc.

**4. Multi Dose Containers:-**

As the name indicate these type of containers hold more than single dose and their contents are withdraw at various intervals.

Example- Vials.

**5. Light Resistance Containers:-**

These containers protect the content from light (UV light) . These are made up of materials which do not allow UV light pass from them to contents.

Examples- Amber coloured glass containers.

**II. Solid Packaging:-****1. Strip Package:-**

In these content are sealed in a packet. These package is made up of two layer of film. A strip containing many pockets & each pocket contain single dose of medicament.

**2. Blister Package:-**

It is made up of base layer (PV layer) with cavities which contain pharmaceutical product. This types of package provide greater protection than strip package. The lid is made up aluminium of paper foil.

**3. Alu-Alu Packaging:-**

Alu-Alu packaging means aluminium foil at both the upper & lower side of pack . Alu-Alu packaging is similar to that blister packaging the forming film is formed of aluminium foil instead of plastic material.

**4. Bottle Packaging:-**

Bottles are commonly used for liquid pharmaceutical as well as for tablet & capsules. capsules

**Material used-**

Polyethylene, Polypropylene Screw Cap, Polystyrene

**5. Pouches :-**

Plastic pouches made from strong LDPE film. With a re-sealable strip at the top easy to open and close. It have waterproof, tide proof, air proof and non-poisonous property.

### III. Gaseous Dosage Packaging:-

#### 1. Aerosols :-

Suspension of fine solid or liquid particles with gas used to apply drug to respiratory tract having atomizer with in device.

#### 2. Sprays:-

Gaseous preparation of drug containing alcohol applied to mucous membrane of nose or throat with atomizer or nebulizer.

#### Packaging Function :-

##### 1. Protective Function :-

Packaging protects the container from and dynamic force during transportation and storage. Vibration is mainly responsible for cracking emulsion which can be inhibited by using good package. It also protect the content from biology hazard. It protect the containers from moisture temp, environmental gases, humidity etc. Light sensitive material can be protected from light by using primary packaging of amber coloured bottles.

**2. Identification Function :-** A packaging provide information regarding products such as date of manufacturing. Expiry date, use, batch no, warning if any etc. It provide an easy identified products example – colour fluted bottles are used for external preparation.

##### 3. Storage & Transport Function :-

Packaging play an important role in storage and transportation of product. Packaging shapes should be such that it can be handled easily. It must be so designed that it can be handled easily. It must be so designed that they can be stored in efficient manner i.e safely one above the other. The dimension of packaging should be according to pellets(Singh et al., 2011).

#### Machinery Used For Packaging:-

Strip packaging machine, Blister packaging machine, Ampoule, liquid, Syringe filling machine.

#### Plastic Packaging

What is the meaning of plastic packaging:-

Plastic packaging means plastic wrapping or casing or containers prepared in advance to seal good to protect from deterioration or contamination with other good or extraneous matter, with temperature proof seal and labeled to describe the product before sale or distribution or offer.



Figure 2: Plastic Packaging Container.

#### 1. Advantages :- (Singh et al., 2011)

1. Less weight than glass.
2. Variety of size and shapes.
3. It is flexible.
4. Essentially chemically inert, strong, rigid safety use, high quality various design.
5. Extremely resistant to breakage.
6. Resistance to chemical, water & impact.

#### 2. Disadvantages:-

1. Plastic is a non-renewable resources.
2. The plastic are embrittlement at low temperature.
3. The plastic are low heat resistant & poor ductility.
4. They are non-biodegradable.
5. The poisonous gaseous product produced by decomposition plastic can cause cancer.

Table 2: Functional Parameters of Pharmaceuticals Plastic Packaging :-

Sr. No	Parameters	Description
1.	Chemical Compatibility	Packaging materials must be chemically compatible with the pharmaceutical product they contain to prevent interactions that could affect the drug stability or efficacy.
2.	Barrier Properties	Plastic packaging should have appreciated barrier properties to protect the pharmaceutical from external factors such as moisture, oxygen and light. This helps prevent degradation and ensure product stability.
3.	Light Protection	Light-sensitive drugs need packaging that provides protection against UV and visible light to maintain their potency.
4.	Dosage Accuracy	Packaging must enable accurate dispensing of the pharmaceutical product, especially for liquid formulation.
5.	Materials Compatibility	The choice of plastic material should be suitable for the pharmaceutical composition, pH, and temperature requirements to avoid leaching or absorption of the drug.
6.	Product Identification	Packaging should allow for clear labeling and identification of the product, including batch number, expiration dates, and dosage.

#### Pharmaceutical packaging product obtained from various plastic materials:-

- Cap & Closure
- PET bottle
- Dropper
- Measuring Cup, Spoon, Cylinder
- Stopper
- Eye drop bottle
- Nasal drop large volume Parental Containers (Flexible & Non flexible)
- Spray pump.

#### Materials used for Plastic Packaging:

- Polyethylene
- Polypropylene
- Polyvinyl Chloride (PVC)
- Polyamide (Nylon)
- Polystyrene
- Polycarbonate

#### Polyethylene Packaging

Polyethylene (PE) is the most widely used type of plastic in pharmaceutical plastic packaging. PE is classified by its density and three grades of PE used in pharmaceutical packaging; low density polyethylene (LDPE), linear low-density polyethylene (LLDPE) and high density polyethylene (HDPE).

#### Low-density polyethylene (LDPE)

A density range of 0.91 to 0.93 g/cm<sup>3</sup> is what distinguishes low density polyethylene (LDPE). High pressure and high temperature are generated (100-3000 atm, 8-300 °C). LDPE is a flexible and soft substance. with excellent puncture resistance and a high elongation before breaking. Due to its low density, it does, however, easily break down over time. LDPE has a translucent look and is heat sealable, odorless and chemically inert. Despite having a relatively high gas permeability, it possesses a reasonable moisture barrier performance. In addition, LDPE exhibits decent machinability, good acid and basic resistance, and good oil resistance. It also exhibits strong heat sealing. Poor UV Resistance and the need for severe temperatures in some applications are this plastic's drawbacks. Additionally, it has a low tensile strength and is brittle (Bonthagarala et al., 2022).

#### Linear low-density polyethylene (LLDPE)

Linear low-density polyethylene (LLDPE) has a similar range density as LDPE but has shorter non-uniform distribution of side chain with no branching of long chain LLDPE is produced by copolymerizing ethylene with butane, hexane, octane, or 4-methyl pentene at low pressure. LLDPE has better mechanical properties a higher melting point and lower transparency compared to LDPE. However studies on LLDPE have received much attention due to the remaining drawbacks in mechanical & thermal properties such as low stiffness, strength and poor heat resistance. LLDPE is also used to make plastic bottles. These pharmaceutical products are widely used in daily life. (Joseph et al., 2013b)

#### High-density polyethylene (HDPE)

The density range for high density polyethylene (HDPE) is 0.94 to 0.96 g/cm<sup>3</sup>. Low pressure is used to make it. There is little branching in HDPE, resulting in higher tensile strength, crystallinity, and melting temperature than LDPE, as well as a stronger intermolecular force. HDPE is a highly crystalline substance that almost never branches. Since it has the lowest permeability and best resistance, it has the best chemical characteristics. It features a decent oxygen barrier and a good moisture barrier.

HDPE has been utilized in a variety of pharmaceutical applications, including sterile equipment and componentry. It is compatible with a number of sterilization techniques, such as the low-temperature oxidative sterilization procedure, ethylene oxide, steam under controlled conditions, and electron beam. Example: The most used material for containers in pharmaceutical packaging is HDPE (Joseph et al., 2013b).





**Figure 3: Polyethylene Plastic Containers**

➤ **Advantages of polyethylene :-**

1. **Chemical Resistance:-** Polyethylene is resistant to many chemical, making it suitable for packaging a wide range of pharmaceutical products without the risk of chemical interaction.
2. **Moisture Barrier:-** It provides an effective moisture barrier, preventing moisture ingress that can degrade the quality and efficacy of pharmaceuticals.
3. **Lightweight:-** Polyethylene packaging is lightweight, reducing shipping costs and making it easier for patients to handle and carry their medications.
4. **Durability:-** It is durable and can withstand physical stress during transportation without compromising the integrity of the pharmaceuticals.
5. **Cost-Effective:-** Polyethylene packaging is cost-effective, which is important in the pharmaceutical industry where cost control is crucial.
6. **Tamper-evident:-** Polyethylene can be designed with tamper-evidence features to enhance product safety and security.
7. **Recyclable:-** Many polyethylene products are recyclable, aligning with sustainability efforts in the pharmaceutical industry.
8. **Transparency:-** Clear polyethylene packaging allows patients to easily see the contents, which is important for compliance with medication regimens.

➤ **Disadvantages of Polyethylene:-**

1. **Permeability:-** Polyethylene can have a degree of permeability to gases and moisture, which may affect the stability of pharmaceutical products. This can lead to reduced shelf life or degradation of sensitive medications.
2. **Environmental Concerns:-** Polyethylene is a type of plastic derived from fossil fuels, and its production and disposal can contribute to environmental issues. It is not biodegradable and can contribute to plastic pollution if not properly managed.
3. **Limited Barrier Properties:-** While polyethylene provides a basic barrier against external contaminants, it may not be suitable for highly sensitive pharmaceuticals that require stringent protection against oxygen, light, or moisture.
4. **Incompatibility with Certain Drugs:-** Some medications may interact with polyethylene packaging materials, potentially leading to drug degradation or changes in drug properties.
5. **Recycling Challenges :-** The recycling of polyethylene packaging can be complex due to variations in material types and colors. Proper recycling facilities and practices are required to manage this plastic effectively.
6. **Physically Damage Susceptibility:-** Polyethylene packaging may be susceptible to physical damage, such as tearing or punching, which can compromise the integrity of the pharmaceutical products.

**How to Dispose of Plastic Packaging**

- **Check local Regulations-** Different regions have specific guidelines for waste disposal. Research local regulations to understand the appropriate disposal method for pharmaceutical plastic packaging.
- **Empty Content –** Ensure that the packaging is completely empty before disposal. Follow the instructions on the medication label for proper use and disposal.
- **Non-Recyclable Plastic-** Some pharmaceutical plastic packaging might not be recyclable due to the type of plastic or other factors. In such cases, dispose of them in regular trash.
- **Follow Hazardous Waste Rule –** If the pharmaceutical packaging contained hazardous or controlled substances, follow local hazardous waste disposal rules to ensure safe disposal (Pareek & Khunteta, 2014), (Raina & Jindal, 2017).

**Eco-friendly Packaging :-**

Eco-friendly packaging is any packaging materials that is friendly to environment and dose not harm it any way. For a packaging material to be eco-friendly it should either be easily biodegradable & compostable or something that can be reused and easily recycled when discarded. It is usually made of naturally derived materials and is non toxic to the environment and living beings.



**Figure 4: Eco-friendly Packaging**

➤ **Advantages:-**

**1. Biodegradable :-**

If the packaging is made from natural materials this means it will be biodegradable plastic is not easily biodegradable. But eco-friendly packaging easily biodegradable. Some eco-friendly packaging, such as sustainable paper products, will even be compostable.

**2. Easily Reused or Recycled :-**

Part of what make packaging eco-friendly is it's ability to be reused or recycled. Encouraging the reuse of packaging means that its lifespan is extended, which reduce need for new material. If the packaging is good enough quality, it should be able to reused for thing like further packaging, storage and even arts and crafts.

**3.No Harmful Toxins :-**

Non-sustainable petrochemicals resources such as crude oil. Which is used to make most plastic is incredibly harmful to the environment in terms of both extraction, refinement, distribution use disposal. Eco-friendly packaging has none of these issue over it's lifespan(Das et al., 2018).

➤ **Disadvantage of Eco-friendly Packaging :-**

1. Cost :- Eco-friendly packaging materials can be more expensive than traditional options, which can increase production cost for business.
2. Durability :- Eco-friendly materials like paper or cardboard may be less durable than plastic or other materials, potentially leading to product damage during transportation or storage.
3. Recycling Infrastructure :- In some area, recycling facilities for eco- friendly materials may be lacking, making it difficult for consumers to dispose of them properly.
4. Limited Shelf life :- Some eco-friendly materials may have a shorter shelf life, affecting product freshness and shelf stability.
5. Production Energy :- The manufacturing process for certain eco-friendly materials may require more energy or resources than convention packaging materials.

**Table 3: Functional Parameters of Eco-friendly Pharmaceutical Packaging (Adane & Muleta, 2011):-**

Sr. No	Parameter	Description
1.	Barrier Protection	Provide protection against moisture, light oxygen and temperature variations.
2.	Biological Protection	Provide protection against biological contamination.
	Physical Protection	Ensure protection against any physical damages.
3.	Information Contamination	Conveys information on the correct usage of dosage form, there contents their provenance, side effects and waring.
4.	Identification	It is meant for identification of the product.
5.	Security	Pharmaceuticals packaging possesses certain feature to prevent it from counterfeiting. It also prevent small children from accessing the contents of formulation.
6.	Convenience	Packaging must be convenient enough to increase consumer access to product & improve distribution, handling selling & using such product.

**Need for the development of Eco-friendly pharmaceutical packaging materials -**

Any pharmaceutical packaging materials must protect the formulation from ambient environmental factors in order to prolong shelf life and preserve its contents. Environmental responsibility is taken into account when creating pharmaceutical packaging. Sustainability as well as certain relevant environmental and recycling laws.

In several nations, packaging waste disposal and recycling have received more focus. Traditional environmentally friendly pharmaceutical packaging only accounts for a relatively small portion of waste, but its disposal can also have negative effects on the environment. To achieve this, provisions should be established for the introduction of newer eco-friendly packaging(Deore et al., 1945) (Council et al., 2005).

**Qualities of Eco-friendly Pharmaceutical Packaging Materials** (Council et al., 2005),(Deore et al., 1945)

**Reuse** - Eco-friendly packaging materials have the ability to reduce packaging weight. The wasteful disposal of degradation products is decreased as a result. Additionally, some statutory requirements forbid the overpackaging of some formulas. Use several dosage containers rather than single-use ones, for instance, and one large bottle of formulation rather than several tiny ones. The following are the top three factors for minimizing pharmaceutical packaging material. Reduction of quantity of packaging waste ,Supporting eco friendly marketing campaigns, Increasing shipping efficiency [10]

**Recycle** – Eco-friendly packaging has the ability to recycle old packaging into brand-new packaging. Examples of recyclable, environmentally friendly packaging materials include glass, metal, thermoplastic, paper, and paperboard. Additionally, materials recovered through recycling of glass and metal are much safer for compositions against germs. [11]

**Renew** – It is the properties of eco-friendly packaging material obtained from renewable natural resource that can be reprocessed into new packaging e. g thermoplastic.

**Materials used for Eco-friendly Packaging :-**

Glass	Starch
Paper & Paperboard	Xylan
Aluminium	Cellulose
Steel	Chitin / Chitosan

**Mostly used Glass Packaging****Glass Packaging**

Glass account for 20 % of the weight of all packaging. Its raw materials are present in abundant quality in nature hence it is considered greener. It can be reused and recycled easily to make new containers which further reduce its untoward environmental impact. Glass is widely used as an eco-friendly pharmaceutical packaging material. Various grades of glasses are classified official in pharmacopoeias based on their utility and chemical characteristics. The certain pharmaceutical including medicinal products for oral and local administration, for example bottles for tablets, injection syringes for unit or multi-dose administration.

**Types of glass :-****Type I Glass : Borosilicate Glass**

The ingredients of this form of glass include oxide, alkali, and/or alkaline earth oxide. Glass containers used in the production of pharmaceuticals must not be reused, with the exception of type I glass containers. It is very resistant to hydrolysis and thermal shock. It is more inert chemically than soda-lime glass. It is primarily used to prepare laboratory glass equipment, injection containers, and injection water(Kumar & Gupta, 2012),(Amalia Yunia Rahmawati, 2020).

**Figure 5: Borosilicate Glass****Type II Glass : De alkalized soda lime glass**

It has higher level of sodium and calcium oxide. It is less resistance to leaching property as compare to type I glass but more resistance than type III. It is used to store infection fluids, plasma and alkali sensitive product(Garjani, 2016).

**Figure 6: De alkalized soda lime glass**

**Type III : Regular soda lime glass**

This type of glass contains metal oxide, sodium oxide, aluminium, earth oxide mainly calcium oxide. The main disadvantage is that it can leach alkali in preparation. So it is used to store liquid formulation which are not alkali sensitive. It is also used to store all types of solid dosage forms (Adane & Muleta, 2011).



**Figure 7: Regular soda lime glass**

**USP type NP Glass : Non Parental**

As the name implies, non-parenteral formulations are stored in this type of glass where heat shock is not a concern. These formulations are employed to store topical, oral, and capsule medications. Because autoclaving will damage the glass, it is not used for products that are autoclaved. Quicken the process of glass deterioration. Dry heat sterilization is not an issue with type III bacteria. [15]



**Figure 8: NP Glass : Non Parental**

➤ **Advantages of Glass Packaging (Das et al., 2018):-**

1. **Chemical Inertness** : Glass is chemically inert, ensuring that pharmaceutical products stored within glass containers are not affected or contaminated by the container itself.
2. **Impermeability** : Glass is impermeable to gases and moisture, preventing the ingress of air, light, or moisture that could degrade the pharmaceutical product.
3. **Preservation of Product Integrity** : Glass containers maintain the purity and stability of pharmaceuticals by protecting them from external factors, such as UV light and oxygen, which can degrade the product.
4. **Recyclability** : Glass is highly recyclable, making it an environmentally friendly option and reducing the carbon footprint associated with pharmaceutical packaging.
5. **Safety** : Glass is non-toxic and does not release harmful substances into the pharmaceutical product, ensuring that it remains safe for consumption.

**Disadvantages of Glass Packaging :-**

1. Glass is fragile. So its containers are easily broken when dropped and knocked.
2. Glass containers are heavy
3. Glass containers may release alkali to aqueous preparation.

**How Dispose Eco-friendly Packaging**

**Separate Component** – Separate any recyclable components, such as cardboard boxes, paper inserts.

**Clean Materials**- Rinse or clean the packaging. To remove any residue or contamination. This helps ensure that the material can be recycled properly.

**Check Recycling Symbols** – Look for recycling symbols on the packaging to identify the type of materials it is made from. Different materials may need to be recycled separately.

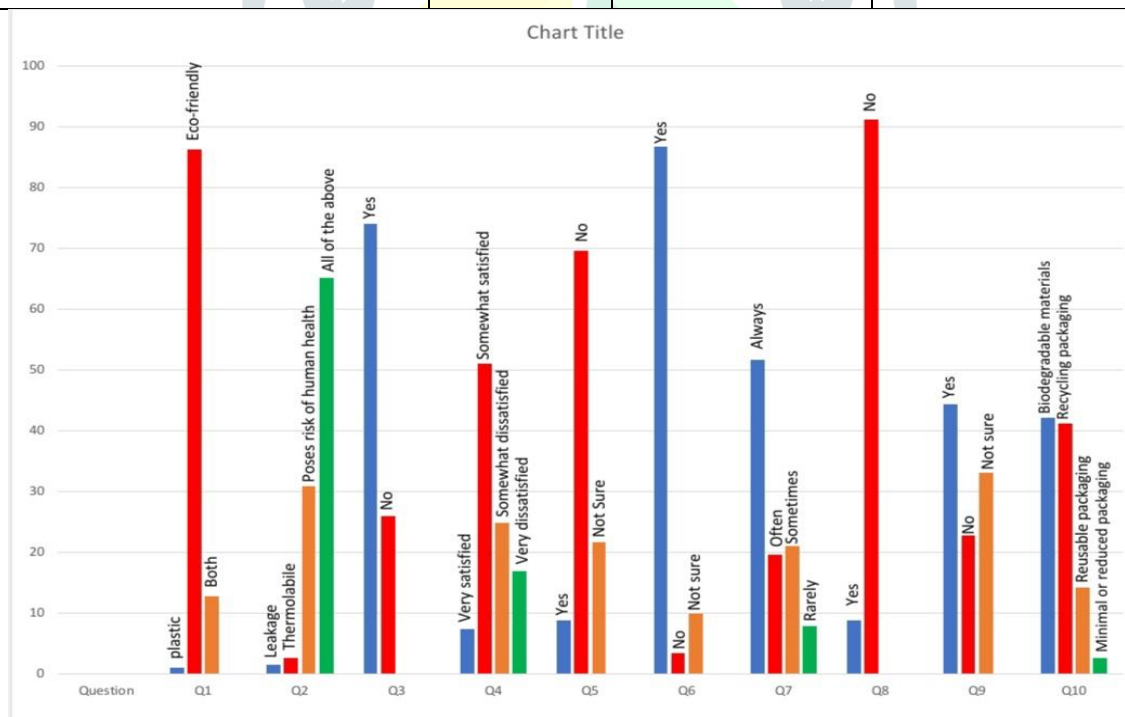
**Recycle properly** – Place the recyclable materials in the appropriate recycling bins according to your local guidelines.



**Non- Recyclable Components** – If some components are not recyclable, try to find alternative uses for them before considering dispose. e. g Cardboard boxes can be used for storage and glass containers can be repurposed for other purpose(Amalia Yunia Rahmawati, 2020).

**Table 4: Survey of Plastic and Eco-friendly Packaging**

Sr. No	Question				
1.	What is your priority towards packaging	Plastic 1%	Eco-friendly 86%	Both 12%	
2.	What you ever purchased pharmaceutical products the come in plastic packaging.	Leakage 1.5%	Thermolabile 2.5%	Pose risk of human health 30.9%	All of the above 65.2%
3.	Have you ever purchased pharmaceutical products that come in plastic packaging.	Yes 74%	No 26%		
4.	How satisfied are you with the durable of plastic pharmaceuticals packaging?	Very satisfied 7.4%	Somewhat satisfied 51%	Somewhat dissatisfied 24.8%	Very dissatisfied 16.8%
5.	Do you believe plastic pharmaceuticals packaging is environmental friendly?	Yes 8.8%	No 3.4%	Not sure 21.6%	
6.	Do you believe eco-friendly pharmaceutical packaging is effective is reducing environmental impact?	Yes 86.9%	No 3.4%	Not sure 9.8%	
7.	Are you actively involve in reducing or disposing of pharmaceuticals packaging in an eco-friendly way?	Always 51.7%	Often 19.5%	Sometimes 21%	Rarely 7.8%
8.	Do you use any medicine whose packaging is damaged?	Yes 8.8%	No 91.2%		
9.	Do you believe that plastic pharmaceuticals packaging provide adequate protection against moisture and contamination?	Yes 44.3%	No 22.7%	Not sure 33%	
10.	Which eco-friendly packaging features do you find most appealing?	Biodegradable material 42.2%	Recycling packaging 41.2%	Reusable packaging 14.2%	Minimal reduced packaging 2.5%



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### Conclusion :-

In Conclusion Plastic Packaging provides an effective barrier against moisture air & contaminants, helping to preserve the quality and safety of pharmaceutical products. Transparent plastic packaging allows consumers to see the products, verify its authenticity, and check for expiration dates or dosage introduction. Plastic Packaging is often more cost-effective than some alternative materials like glass, which can reduce production & transportation expenses. But drawback of plastic packaging is that plastic packaging contributes to plastic pollution and takes a long time to decompose, harming the ecosystem and wildlife. Some pharmaceutical plastic packaging is not easily recyclable, leading to increased waste. There are concerns about potential leaching of harmful chemicals from plastic into medications, affecting patients' safety. Therefore, eco-friendly packaging materials are often designed to be recyclable or biodegradable, helping to minimize pharmaceutical-related waste and its impact on landfills. These packaging materials can be designed to maintain the integrity and safety of pharmaceutical products. Protecting them from environmental contamination. Over time, sustainable packaging can lead to cost savings through reduced material usage, waste disposal, and potential energy saving in manufacturing.

Addressing these drawbacks requires a shift towards more Sustainable & Eco-friendly Packaging solutions in the pharmaceutical industry to minimize the environmental impact & ensure the safety and well-being of consumers.

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