

# PACKAGING FUNDAMENTALS GUIDE

*CHOOSING THE RIGHT PACKAGING  
FOR YOUR PRODUCT HAS NEVER BEEN EASIER!*

**HANDBOOK ON**



UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION



A project funded by  
the European Union



In collaboration with  
the Government of Sri Lanka



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December 2020. Colombo, Sri Lanka

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*Note: The views expressed in this publication are those of the author and do not necessarily reflect the views of the United Nations Industrial Development Organization.*



UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION

Department of Digitalization, Technology and Innovation, UNIDO  
EU - SRI LANKA TRADE-RELATED ASSISTANCE

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The Directorate of Programme Development and Technical Cooperation (PTC) of UNIDO is responsible for providing technical cooperation services on technological and economic issues and is organized into three directorates: the Directorate of Digitalization, Technology and Agri-Business (DTA), the Directorate of Environment and Energy, and the Directorate of Programmes, Partnerships and Field Coordination. The Department of Digitalization, Technology and Innovation (DTI), within the DTA, is responsible for assisting developing countries to participate effectively in the rule-based global trading system among other services. The Investment and Technology Promotion Division, also within DTA, closely interlinks UNIDO's Investment and Technology Promotion Offices (ITPOs) with investment promotion agencies (IPAs) and international corporate partners to form an extended Investment and Technology Promotion Network of UNIDO.

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Centre (ITC), aims to increase the competitiveness of Sri Lankan small-and-medium-sized enterprises (SMEs) in regional and EU markets to support inclusive, trade-led growth. It focuses on export strategy, trade policy and facilitation, national quality infrastructure (NQI) and value chains in the spice, food and information technology (IT) / business process outsourcing (BPO) sectors.

Within the framework of the project, UNIDO supports SMEs in strengthening the spice and food value chains, including, among other interventions, on enhancing product packaging. UNIDO supported the development of a national Packaging Testing Centre (PTC) in cooperation with the Government of Sri Lanka. PTC will serve local SMEs by carrying out packaging materials testing according to international requirements as well as providing packaging consultancies. By facilitating the appropriate selection of packaging materials for products, these services smooth the way for international exports, especially to premium markets like the EU.

Mr. Sam Arslan, International Packaging Expert, UNIDO prepared this publication under the supervision of Mr. Juan Pablo Diaz-Castillo, Industrial Development Officer, UNIDO and Dr. Jairo Villamil-Diaz, International Technical Specialist, UNIDO. The author would like to thank his strong collaborators, Dr. Villamil-Diaz and Ms. Sumathy Rajasingham, National Quality Expert, UNIDO for their support in their technical review of this publication. Interested readers are invited to contact UNIDO ([dti@unido.org](mailto:dti@unido.org)) with any feedback or

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# BASIC PACKAGING TERMINOLOGY

<b>Adhesive</b>	A substance capable of holding materials together through surface attachment.	<b>Case</b>	Non-specific term for transport packaging, often used to refer to a box.
<b>Bag</b>	Flexible packaging of single or multiple layers or plies, generally enclosed on all sides except one, forming an opening that may or may not be sealed after filling.	<b>Child-Resistant Package</b>	A package which is difficult for young children to open (or gain access to the contents), but which is possible for adults to use properly.
<b>Barrel</b>	Packaging with a circular cross-section, with greater length than breadth, convex sides and two flat ends of equal diameter.	<b>Closure</b>	The means of closing packaging to retain its contents.
<b>Barrier Material</b>	Material that retards or prevents the transmission or permeation of gases or the passage of solids, liquids, gases or radiated energy.	<b>Collapsible Tube</b>	Flexible packaging with a nozzle and cap at one end and closed at the other, serving as both container and dispenser.
<b>Base Pack (unit pack)</b>	The smallest pack with identical or different products that are to be supplied at the same time.	<b>Commercial Package</b>	Packaging that conforms to the requirements of the respective level of trading with regard to quantity of content and the type, quality or design of the package.
<b>Bottle</b>	Rigid packaging typically made of glass or plastic, with a comparatively narrow neck or mouth, a closure and usually no handle.	<b>Consolidated Pack</b>	More than one package grouped together to facilitate handling operations.
<b>Box</b>	Rigid packaging with rectangular or polygonal sides, usually completely enclosing the contents.	<b>Consumer Packaging</b>	Packaging and its contents that constitute a sales unit for the final user or consumer at the point of retail.
<b>Bulk Packaging</b>	Packaging intended to contain loose articles, large masses of solids or granular materials, or liquids for transport or storage.	<b>Container/Shipping Container</b>	An article of transport equipment strong enough to be suitable for repeated use, and specially designed to facilitate the carriage of goods by one or more means of transport without breakage of load.
<b>Bundle</b>	Bundle: A number of articles bound with materials under tension, which also may be wrapped.	<b>Containerization</b>	Shipping method in which goods are loaded together in one container.
<b>Can</b>	Small primary packaging, usually cylindrical and usually made of metal.	<b>Crate</b>	Transport packaging with incomplete surfaces.
<b>Carton</b>	Folding, collapsible packaging generally made from boxboard.	<b>Cushioning Material</b>	A material used to isolate or reduce the effect of externally-applied shock and/or vibration forces.
		<b>Distribution Packaging</b>	Packaging designed to contain one or more articles or packages or bulk material for the purposes of transport, handling and/or distribution.
		<b>Drum</b>	Cylindrical packaging whose bottom end is permanently fixed to the body and whose top end (head) is either removable or non-removable.

<b>Dwell Time</b>	Time spent in the same position, area, stage of a process, etc.
<b>Fastener</b>	A device that serves to secure one part to another.
<b>Flexible Packaging</b>	Packaging whose shape is likely to change after the contents are added or removed.
<b>Heat Sealing</b>	A method of bonding mating surfaces under controlled application of heat, pressure and dwell time.
<b>Industrial Packaging</b>	Packaging for raw materials, components and partially manufactured or finished goods, for distribution from manufacturer to manufacturer and/or other intermediaries, such as processors or assemblers.
<b>Jar</b>	Small rigid packaging made of glass, plastic or ceramic, with a wide mouth.
<b>Label</b>	A piece of paper or another material, displaying information and affixed to the packaging or article.
<b>Overpack</b>	An enclosure generally used by a single consignor to contain one or more packages, consolidated into a single unit to facilitate easy handling and stowage during transport.
<b>Packaging (operation)</b>	The operations involved in the preparation of goods for the containment, protection, handling, delivery, storage, transport and presentation of goods, from raw materials to processed goods, and from the producer to the user or consumer.
<b>Packaging (product)</b>	Any product to be used for the containment, protection, handling, delivery, storage, transport and presentation of goods, from raw materials to processed goods and from the producer to the user or consumer, including processors, assemblers or other intermediaries.
<b>Pail</b>	Packaging with a circular cross-section, tapered and equipped with a lid and usually a handle.
<b>Pallet</b>	A rigid horizontal platform of minimum height, compatible with handling by pallet trucks and/or fork-lift trucks and other appropriate handling equipment, used as a base for assembling, stacking, storing, handling or transporting goods and loads.

<b>Preservation</b>	The application of protective measures, such as cleaning, drying and the use of preservatives and barrier materials to prevent deterioration.
<b>Pressure Sealing</b>	Cold sealing, sealing under controlled application of pressure and dwell time.
<b>Primary Packaging</b>	Packaging designed to come into direct contact with the product.
<b>Rigid Packaging</b>	Packaging whose shape remains essentially unchanged after the contents are added or removed.
<b>Sealing</b>	A method of bonding mating surfaces.
<b>Secondary Packaging</b>	Packaging designed to contain one or more pieces of primary packaging, together with any protective materials where required.
<b>Shrink Wrap/ Shrink Film</b>	A plastics material that shrinks in size when heated to conform to the item(s) packaged.
<b>Staple/ Stitch</b>	A U-shaped round or flat wire fastener, which may or may not be clinched, for closing packaging or holding packaging components together.
<b>Strapping</b>	A strip of material, generally with a flat or circular cross-section, used to secure packaging or articles within a container, to hold together a bundle or bale, to reinforce packaging, or to secure packaging or articles to a pallet.
<b>Stretch Wrap</b>	A material that elongates when applied under tension and which, through elastic recovery, conforms to the item(s) packaged.
<b>Tag</b>	A label attached to the packaging or article by means of a tie or other suitable means.
<b>Tape</b>	A strip of flexible material with one or more adhesive faces.
<b>Unit Load</b>	A single item or assembly of items designed to enable these to be handled as a single entity.

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# LIST OF ABBREVIATIONS

<b>EU</b>	European Union
<b>FAO</b>	Food and Agriculture Organization
<b>GMP</b>	Good Manufacturing Practices
<b>ISO</b>	International Organization for Standardization
<b>ITI</b>	Industrial Technology Institute
<b>LCA</b>	Life Cycle Assessment
<b>LCI</b>	Life Cycle Inventory
<b>PTC</b>	Packaging Testing Centre
<b>RFID</b>	Radio Frequency Identification
<b>SAARC</b>	South Asian Association for Regional Cooperation
<b>SME</b>	Small and Medium-sized Enterprise
<b>SPS</b>	Sanitary and Phytosanitary
<b>UNIDO</b>	United Nations Industrial Development Organization
<b>WTI</b>	World Trade Institute
<b>WTO</b>	World Trade Organization

This publication presents on the essence of packaging technology. It links the packaging world to the food chain and the manufacturing of goods, specifically foods and spices made in Sri Lanka. Packaging technology covers the manufacturing of 3D packaging from raw materials passing through different stages of the packaging life cycle until the final packaging waste stage. Packaging is defined as “ensuring safe delivery of a product to its final consumer in very good condition and at a minimum affordable cost”. Globally, packaging is of great importance to both manufacturer and consumer. It prevents the spoiling, tampering, breakage or theft of products, protects products from outside contamination, and helps by extending the product shelf life, as well as identifying the product contained inside and encouraging the consumer to buy.

This publication also presents a brief outline of the fundamental packaging concepts that exist in the world and provides a summary of the main functions of packaging, making it easier for manufacturers and sellers to choose the right packaging for the right content and product. This guide lists the most important applications of packaging according to material and food content. It summarizes the fact that liquid and oily food products, as well as spices, should be packed in flexible, laminated, plastic packaging or rigid packaging with food grade specifications. Dry foods can be packed in low-cost flexible packaging, such as polyethylene and polypropylene plastic packaging or paper and

cardboard materials. With regard to liquid and pasty mixture products, it is preferable to pack them in coated cans or glass jars for improved permeability and a longer shelf life.

With respect to product traceability, packaging and its graphics will help identify and track the product by printing specific and unique barcodes for the products to be tracked throughout the food chain.

Local Sri Lankan regulations concerning labelling and packaging materials describe most of the requirements for local trade but require complementary points that would make the product eligible to be exported to the EU and other international destinations.

It should be mentioned that this publication also describes the major role of packaging sustainability, covering important topics such as eco, green or environmentally-friendly packaging, which can be based on biodegradable, recyclable, reusable, non-toxic materials that are made from recycled products and manufactured through environmentally low-impact processes.

Finally, this guide includes the main steps taken by UNIDO in cooperation with the Government of Sri Lanka to establish a new Packaging Testing Centre in Colombo that will serve all SMEs in the country, guide them through their technical packaging issues and simplify the process of testing packaging materials.

This guide covers the essentials of packaging and the use of packaging materials in food and spice products, especially those packaged locally in Sri Lanka. It is useful to all manufacturers, converters and product sellers of the food chain in Sri Lanka and the wider region. The main objective of this publication is to help them to enrich their knowledge of the basics of packaging technology. It will guide them through the correct channels and the relevant local authorities in Sri Lanka to get the required technical support and overcome their packaging development challenges.

“Packaging is the science, art and technology of enclosing or protecting products for distribution, storage, sale, and use. Packaging also refers to the process of designing, evaluating, and producing packages. It can be described as a coordinated system of preparing goods for transport, warehousing, logistics, sale and end use. Packaging contains, protects, preserves, transports, informs, and sells. In many countries, it is fully integrated into government, business, institutional, industrial, and personal use.”

This publication specifically concerns food and spice products to be packaged locally in Sri Lanka. The main purpose of this guide is for manufacturers, converters and sellers to make a connection between the nature of the chosen food or spice product and the appropriate packaging material and design to be used.

The guide outlines the pathway and mindset to be considered in order to make the right choice of packaging material according to its content. Many requirements must

be satisfied for packaging materials, which have a wide range of specifications. All parties involved are responsible for taking the necessary measures before choosing packaging, depending on the nature of the product. The entire packaging life cycle can be affected by a single decision.

### Methodology: Carbon Footprint Mindset

The carbon footprint mindset is a theory that lies behind the development of every process concerning packaging manufacturing and the elaboration of food products. The aim of this concept is usually to reduce emissions of carbon dioxide (CO<sub>2</sub>) in the atmosphere, which are generated during the manufacturing process of the packaging or product. In the sections below, a general overview is provided of the specific ecological points where manufacturers, converters and sellers are involved, and where responsibilities are determined for better packaging or product choice.

When choosing the most adequate packaging for your product, it is essential to take the 2 main factors listed below into account, which are directly related to the carbon footprint generator:

- **Ecological Impact:** Packaging is responsible for significant portions of the waste stream. Some waste can be recycled, but many packaging materials are not always eligible for recycling. Most packaging materials produced end up in a landfill, being composted (if biodegradable) or being incinerated (if appropriate).

- **Production Footprint:** Products with excessive packaging use additional resources in the production chain.

Consequently, production will require extra energy and in doing so pollute the environment to a much greater extent. Therefore, by reducing the packaging materials required the negative impact on the environment will be reduced.

This publication emphasizes the above carbon footprint factors, which will directly affect the choice of the most suitable packaging for a given product. All parties (from the private or governmental sectors) involved in packaging materials will be able to consider all the necessary factors before deciding on the right packaging and related tests to be performed.

### Food Preservation Through Packaging

Food preservation is directly linked to any packaging development. In fact, food preservation prevents the growth of microorganisms (such as yeasts). Food preservation may also include processes that inhibit visual deterioration, such as the enzymatic browning reaction in apples after they are chopped during food preparation.

Many processes designed to preserve food involve more than one food preservation method, such as preserving fruit by turning it into jam, by adding sugar and sealing it within an airtight jar to prevent recontamination. Some traditional methods of preserving food have been shown to have a lower energy input and carbon footprint when compared to modern methods.

A highly critical aspect of food preservation is choosing the right packaging for the food content. This publication will help to make this choice easier for manufacturers of food products.



## CHAPTER 1



### FUNDAMENTALS OF PACKAGING TECHNOLOGY:

# FUNCTIONS & GENERALITIES

**The history of packaging** goes back to the dawn of humanity, when human beings used leaves, animal skin, wood and nutshells as packaging to transport or protect their food. Indeed, packaging evolved with the evolution of humanity, especially after the industrial revolution in the 18th century when it went through a sudden increase in quality and quantity.

The basic functions of any packaging material are:

#### 1.1 “CONTAIN” PACKAGING FUNCTION

The first step in designing packaging is to consider the nature of the product and the kind of packaging needed to contain it. These considerations should include:

PACKAGING FUNDAMENTALS

- The product's physical form:

mobile fluid, viscous fluid, semi-solid, granular material, paste, gas/fluid mixture, multi-component mix, solid state product, etc.

- The nature of the product:

corrosive, flammable, fragile, abrasive, volatile, aseptic, odorous, sticky, toxic, perishable, hygroscopic, under pressure, etc.

The characteristics and qualities of various packaging materials strongly influence and affect the containment abilities of packaging.

**1.2 “PROTECT & PRESERVE”  
PACKAGING FUNCTION**

The “protect” packaging function refers to the prevention of physical damage while “preserve” refers to stopping or inhibiting chemical and biological changes to the content or product. Protecting the content involves isolating it from shock, vibration or compression, while “preserving” often refers to the extension of the food’s shelf life beyond the product’s natural life, or even refers to the maintenance of food sterility.

Both functions: “Protect” and “preserve” need to be always quantified through chemical and specific tests done in assigned laboratories.



Protecting the content involves isolating it from shock, vibration or compression.



**1.3 “TRANSPORT” PACKAGING FUNCTION**

The Transport function entails the effective movement of goods from the point of production to the point of final consumption. This involves various transport modes, handling techniques and storage conditions. In addition to the general physical rigours of distribution, there are a number of carrier rules that will influence the design of packaging. Examples of the information required to design successful distribution packaging appears in **Table 1.1** below:

TRUCK	RAIL	AIRCRAFT
Cargo ship	Storage duration	Storage conditions
Handling methods	Unitizing methods	Specific shipping unit
Weight consideration	Stock picking	Dimension limits
Carrier rules	Environmentally controlled storage	

**Table 1.1** Typical Transport, Handling and Storage Information

1.4. "INFORM/SELL" PACKAGING FUNCTION

The communication role of packaging is perhaps the most complex packaging function to understand, measure and implement, due to the multiple levels at which this communication must work. Laws and customs regulations dictate certain messages without giving much leeway with regards to how they are presented. The most important messages to include on packaging labels are listed in Fig 1.1 below:

**Fig 1.1**  
Mandatory Packaging Label Information

**Product Name**  
Usually beside the brand name. Tells you what the food is.

**Date Marking**  
This is the 'Use By', 'Sell By' and 'Best Use Before' date. It gives the date by which the food should be eaten.

**Net Weight**  
This gives the actual weight of the food excluding the packaging in liquid, the net weight is the weight of the drained food.



**Usage Instructions**  
These are instructions for storing or using the product.

**Nutrition Information**  
This panel shows the nutrients found in one serving or in 100 g / 100 ml of the food.

**Ingredient list**  
This shows all the ingredients are listed in descending order by weight.

**Manufacturer's Details**  
Every label includes the name and address of the manufacturer, importer or distributor.

**Fig 1.2**  
Mandatory Nutrition Facts Information

Most nutrition requirements are based on a standardized serving size, not necessarily the label serving size.

Calories or total sugars are limited in certain products to control for added sugars, because added sugars are not disclosed on the label.<sup>1</sup>

The **trans fat** amount and the ingredient list are considered. No products containing partially hydrogenated oils are eligible for certification.

Cholesterol limits vary for meat and non-meat products.

Sodium limits vary by food category and are based on label serving size.<sup>2</sup>

The ingredient list is reviewed when evaluating certain products, because added sugars are not disclosed on the label.<sup>3</sup>

Nutrition Facts	
8 servings per container	
<b>Serving size</b>	<b>1 cup (68g)</b>
<b>Amount per serving</b>	
<b>Calories</b>	<b>370</b>
<b>% Daily Value*</b>	
<b>Total Fat 5g</b>	<b>7%</b>
Saturated Fat 1g	5%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 150mg	6%
<b>Total Carbohydrate 48g</b>	<b>15%</b>
Dietary Fiber 5g	14%
Total Sugars 13g	
Includes 10g Added Sugars	20%
<b>Protein 12g</b>	
Vitamin A 10mcg	20%
Vitamin C 1mg	100%
Vitamin D 1mcg	50%
Vitamin E 2mcg	100%
Riboflavin 5mcg	75%
Magnesium 400mcg	100%
Chromium 75mcg	80%
Potassium 5g	100%

\* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Requirements for % Daily Value of specific nutrients vary by food category.

Limits for saturated fat vary by certification category. Total fat is also limited because it is required by FDA health claim regulations.<sup>4</sup>

Grain-based products are required to have at least 10% Daily Value of fiber.<sup>5</sup>

At least 10% Daily Value of one of six beneficial nutrients (vitamin A, vitamin C, iron, calcium, protein, dietary fiber) is required.<sup>6</sup>

The packaging itself communicates its content to the consumer in many ways, such as:

- Selected materials
- Shape and size
- Colour and effects
- Typography
- Symbols
- Icons
- Illustrations

**Fig 1.3**  
Sri Lankan tea box showing a traditional elephant illustration



**Fig 1.4**  
A Lebanese pack for traditional olive oil featuring an illustration of an olive oil tree



**Fig 1.5** An Indian pack for chilli powder and coriander spice powder

All of these means of communication must be balanced and supportive of the consumer persona, with appeal and instant recognition. All supporting material, such as promotions and advertisement, must be consistent with the image projected by the package. Graphic design is a crucial subject that should be given high importance in selling the product and channelling the information on the packaging for better marketing. **Figs 1.3, 1.4 and 1.5** below present some packaging designs that are distributed worldwide.

The packaging design should transmit the product culture and background.

Packaging design is of great importance when it comes to selling your products as people gauge the quality of a product by looking closely at the packaging design. If the packaging design makes a good first impression, they are likely to buy the product. Therefore, product labels do not only provide some details and legal information; more than that, they help people make a purchase decision.

Marketers now believe that good packaging design has a ripple effect on people. Once a person has found an item of packaging beautiful, he or she is likely to take a photo of it to share with friends on social media. This triggers a sharing chain and thousands of people are able to see the packaging. In this way, packaging becomes a tool for products to reach an increasing number of people.

Businesses depend greatly on packaging design to make a lasting impression on customers in terms of the quality of their product.

Customers are first attracted by a product's packaging design, even though customer loyalty to a brand is largely determined by its usefulness and quality. This brings us to the importance of packaging design and design trends.

Packaging design trends are constantly changing, and we should be aware of what colours, shapes, symbols, lines, and so on are currently in use. Trends give an indication of what is currently being used in the industry and which design elements will be useful to follow.

The seven most inspirational packaging design trends for last year are listed below:



**Fig 1.6** Simple, Clear and Bold Designs

Simple, Clear and Bold Design

Recently, packaging designers have been placing an emphasis on creating simple and clean designs that people can understand instantly. Uncluttered designs such as these are useful in successfully sending out a brand message to the target audience. (See **Fig 1.6**)

Designers understand that using minimal elements in a package's design will elevate the product. Shoppers do not have much time in a fast-paced world. As a result, you have only a few seconds to have an impact on them with the help of an attractive packaging design that they see first when choosing a product. A clean-cut design is sure to convey a clear brand message.



**Fig 1.7** Custom Lettering

Custom Lettering

Designers are most likely to opt for custom lettering to give a feeling of warmth and raw energy. Custom lettering includes elements like irregular lines and natural textures. (See **Fig 1.7**)

This type of unique lettering helps to make a product stand out and breaks the traditional trend of using digital designs. Since hand lettering creates a feeling of wholesomeness and of being a handmade product, a feeling of nostalgia is created. We believe that the hand lettering trend is here to stay for a long time when creating attractive label designs.

# 3



**Fig 1.8**  
Splashing  
Colours  
Around

## Splashing Colours Around

Another fast-developing trend for packaging design is a wild use of colours. We know that colours evoke emotions and are responsible for purchasing decisions to some extent. Lately, packaging designers have been using colours in exciting ways, incorporating bright colours with vibrant shades to make packaging attractive to customers. (See **Fig 1.8**)

Designers are also using colours to show the differences between product variants. In this way, customers can immediately identify a particular variant of a product without going through the whole range.



# 4



**Fig 1.9**  
Repetition

## Repetition

Repetition has its own place in creating amazing graphic designs, and you can notice such patterns everywhere in many designs from the past and present. In product packaging design, the repetition of beautiful patterns has become a fad. The repetition of a visual motif has the purpose of creating a strong brand message. As such, in order to build a strong brand identity, designers create bold or playful patterns depending on the personality of the brand. (See **Fig 1.9**)

5

▲  
**Fig 1.10**  
Build  
Narrative



**Build Narrative**

Packaging design should not be a dry use of colours or elements. Instead, it must convey some kind of story or message about the brand so that customers can instantly connect with it. For this purpose, graphic designers have started to incorporate illustrations to build a narrative. (See **Fig 1.10**)

6

▼  
**Fig 1.11**  
Pastel Colours



**Pastel Colours**

Calming colours have already made a comeback and they are likely to continue to be used in packaging design in the future. Calming packaging designs are the new trend, which means that pastel colours will undergo a resurgence. These soft colours give the impression of being neutral and are the exact opposite of explosive and bright colours. (See **Fig 1.11**)

7

**Unique Shapes**

Designers are also experimenting with the shape of packaging. As products should immediately catch the eye of potential customers, they create unique packaging shapes that look different in shops. Packaging designs such as these may look extreme, but they are a new trend to draw people's attention. These types of designs speak loudly and clearly for the product; all one would need to do is place one's company logo on it. Customers will quickly come to know about the brand and what it is selling. (See **Fig 1.12**).



◀  
**Fig 1.12**  
Unique Shapes

To summarize, these are the key packaging design trends that were most prevalent in 2019. Many of these trends have continued from previous years and they are still holding their place, although entirely new trends may emerge. Packaging design is undergoing rapid changes with designers experimenting with colours, typefaces, shapes and other elements. In 2019, certain colours and shapes dominate design preferences, and metallic colours and actual shapes inspired by nature are major design features.



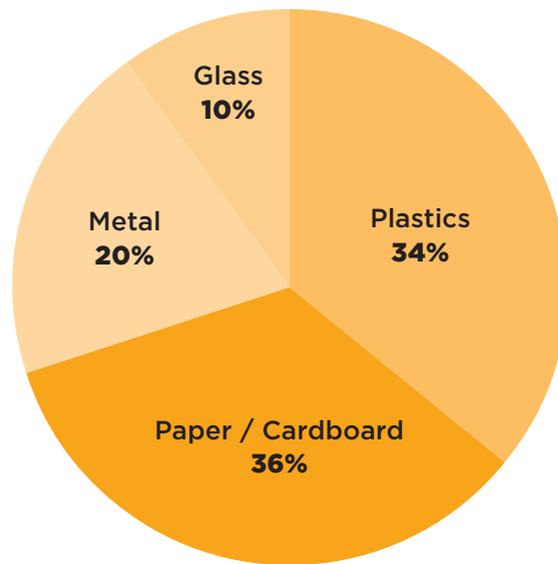
## CHAPTER 2



# THE BEST FOOD PACKAGING CHOICE

**FOR YOUR PRODUCT**

**In order to be able** to choose the most appropriate packaging material for your food or spice product, you should initially evaluate different packaging materials that exist in the market, together with their possible chemical and physical properties. Choosing the most adequate packaging for your products requires high expertise in packaging materials, and scientific knowledge of the interaction between product (texture) and potential packaging material are of the utmost importance. In **Fig 2.1** below, it is apparent that the percentage differs between packaging materials that are used and consumed globally in the food chain.



**Fig 2.1** Packaging Material Distribution in the Food Chain

A number of packaging materials are included to provide desirable functions within the packaging system for numerous types of food products. In most commercial food products, paper, paperboard and plastics are primary packaging materials (with primary meaning being in direct contact with the content). Metal and glass are also widely used for various liquid and semi-solid food products.

The appropriate selection of packaging material is the most important factor to guarantee safety and quality of food. Typically, the process relies on

the characteristics of major packaging materials (paper and paperboard, plastics, glass and metal) and their compatibility with food products. Typical properties for food packaging systems involve gas and humidity barriers and mechanical, thermal, rheological, morphological, optical and physical properties. The gas and humidity barrier property are often considered the most important factor to guarantee the shelf-life of food products.

## 2.1 PACKAGING MATERIALS USED IN THE FOOD SECTOR

### 2.1.1 PAPER & CARDBOARD

Paper is widely used because it is low-cost, holds its shape and is easily decorated. Commercially available paper is predominantly made from cellulose fibre from pulped wood but can also be made from other sources such as cotton, straw, sisal and hemp, all of which are recyclable. Paper and board are usually measured by weight or calliper. Material weighing less than 250 grams per square meter (GSM) is referred to as paper, and material of around 250 GSM is referred to as paperboard. **Fig 2.2** below shows an example of a cardboard box for shipping and transportation.

The fibres of machine-made paper run parallel to the length of the machine that produced it, and the fibre or grain direction affects paper performance:



▲ In most commercial food products, paper, paperboard and plastics are primary packaging materials



**Fig 2.2** Packaging Material: Paper and Cardboard

- ✓ Paper tears easiest along the fibres
- ✓ Folding is easiest along the fibres
- ✓ Fold endurance is greatest across the fibres
- ✓ Stiffness is greatest when flexed across the fibres

Paper can also be laminated to increase strength or provide barrier properties, and the materials used can have a gloss or matte finish or be embossed. Other materials, such as foil or plastics, can be laminated onto paperboard. Packaging produced

using paper and board includes cartons, labels, leaflets, tubes, corrugated cases, rigid boxes and pulp packs.

Plain paper is not used to protect foods for long periods of time because it has poor barrier properties and is not heat sealable. When used as primary packaging, paper is almost always treated, coated, laminated, or impregnated with materials such as waxes, resins, or lacquers to improve functional and protective properties. The many different types of paper used in food packaging are as follows:

#### **Kraft paper**

**Kraft paper:** Kraft paper is produced by a sulphate treatment process. Kraft paper is available in several forms - natural brown, unbleached, heavy-duty, and bleached white. Natural Kraft paper is the strongest of all papers and is commonly used for bags and wrapping. It is also used to package flour, sugar, and dried fruits and vegetables.

#### **Sulphite paper**

**Sulphite paper:** Sulphite paper is lighter and weaker than Kraft paper. Sulphite paper is glazed to improve its appearance and increase its wet strength and oil resistance. It can be coated for higher print quality and is also used in laminates with plastic or foil. It is used to make small bags or wrappers for packaging biscuits and confectionary.

PACKAGING FUNDAMENTALS



**Greaseproof paper**

Greaseproof paper is made through a process known as beating, in which the cellulose fibres undergo a longer than normal hydration period that causes them to break up and become gelatinous. These fine fibres are then packed densely together to provide a surface that is resistant to oils but not wet agents. Greaseproof paper is used to wrap snack foods, biscuits, chocolate bars and other oily foods, a use that is being replaced by plastic films.

**Glassine**

Glassine is a greaseproof paper taken to an extreme (further hydration) to produce a very dense sheet with a highly smooth and glossy finish. It is used as a liner for biscuits, cooking fats, fast foods and baked goods.

**Parchment paper**

Parchment paper is made from acid-treated pulp (passed through a sulphuric acid bath). The acid modifies the cellulose to make it smoother and impervious to water and oil, which adds some wet strength. It does not provide a good barrier to air and moisture, is not heat sealable, and is used to package fats such as butter and lard.



PAPER CAN ALSO BE LAMINATED TO INCREASE STRENGTH OR PROVIDE BARRIER PROPERTIES, AND THE MATERIALS USED CAN HAVE A GLOSS OR MATTE FINISH OR BE EMBOSSED.

With regards to paperboard and cardboard, they are thicker than paper with a higher weight per unit area and are often made in multiple layers. They are commonly used to make containers for shipping, such as boxes, cartons, and trays, and are rarely used for direct food contact. The various types of paperboard are as follows:



**White board:**

A white board is made from several thin layers of bleached chemical pulp; it is typically used as the inner layer of a carton. White board may be coated with wax or laminated with polyethylene for heat sealability, and it is the only form of paperboard recommended for direct food contact.

**Solid board:**

Solid board possesses strength and durability as it has multiple layers of bleached sulphate board. When laminated with polyethylene it is used to create liquid cartons (known as milk board). It is also used to package fruit juices and soft drinks.



### Chipboard

Chipboard is made from recycled paper and often contains blemishes and impurities from the original paper, which makes it unsuitable for printing, folding and direct contact with food. It is often lined with white board to improve both appearance and strength. The least expensive form of paperboard, chipboard is used to make the outer layers of cartons for foods such as tea and cereals.



### Fibreboard

Fibreboard can be solid or corrugated. The solid type has an inner white board layer and outer Kraft layer and provides good protection against impact and compression. When laminated with plastics or aluminium, solid fibreboard can improve barrier properties and is used to package dry products such as coffee and milk powder. The corrugated type, also known as corrugated board, is made with two layers of Kraft paper with a central corrugating (or fluting) material. Fibreboard's resistance to impact abrasion and damage from crushing means it is widely used for shipping bulk food and the case packing of retail food products.

### 2.1.2 GLASS

Commercially-available glass is made from silica, sodium carbonate and calcium carbonate. Other compounds can be added to give colour, sparkle or heat shock resistance. **Fig 2.3** below shows an example of a glass jar containing liquid food.

Glass has an extremely long history in food packaging; the first glass objects for holding food are believed to have appeared around 3000 BC. The production of glass containers involves heating a mixture of silica (the glass former), sodium carbonate (the melting agent), and limestone/calcium carbonate and alumina (stabilizers) to high temperatures until the materials melt into a thick liquid mass that is then poured into moulds. Recycled broken glass is also used in glass manufacturing and may account for as much as 60% of all raw materials.

Glass containers used in food packaging are often surface-coated to provide lubrication in the production line and eliminate scratching or surface abrasion and line jams. Glass coatings also increase and preserve the strength of the bottle to reduce breakage. Improved breakage resistance allows manufacturers to use thinner glass, which reduces weight and is better for disposal and transportation.

Because it is odourless and chemically inert with virtually all food products, glass has several advantages for food-packaging applications: It is impermeable to gases and vapours, and therefore maintains product



**Fig 2.3**  
Packaging  
Material:  
Glass

freshness for a long period of time without impairing taste or flavour. The ability to withstand high processing temperatures make glass useful for the heat sterilization of both low-acid and high-acid foods. Glass is rigid, provides good insulation, and can be produced in a variety of different shapes. The transparency of glass allows consumers to see the product, yet variations in glass colour can protect light-sensitive contents. Finally, glass packaging benefits the environment because it is reusable and recyclable.

Like any material, glass has some disadvantages. Despite efforts to use thinner glass, its heavy weight adds to transportation costs. Another concern is its brittleness and susceptibility to breakage from internal pressure, impact, or thermal shock.

Glass is a popular and useful food packaging material because it is:

- ☑ Inert
- ☑ Can be easily sterilized
- ☑ Acts as a barrier to moisture and gas
- ☑ Pressure resistant, to a degree
- ☑ Can be moulded into a variety of shapes
- ☑ Transparent, making the product visible
- ☑ Highly recyclable

It is important to mention that glass packaging materials can be coloured during their initial manufacturing. Coloured glass can be used for a variety of cosmetic and pharmaceutical products to protect the content from UV light, and consequently avoid any reaction or alteration of the content. The only inconvenience in such cases is the product appearance when the content is not visible to consumers. The most obvious drawback is fragility and the danger of broken glass. Glass can be directly decorated, but it is most commonly labelled.

### 2.1.3 METAL

Metal is the most versatile of all packaging forms. It offers a combination of excellent physical protection and barrier properties, formability and decorative potential, recyclability, and consumer acceptance. The metals used predominantly in packaging are tin-plate or aluminium, which are used to make food and drink cans, aerosol cans, tubes, drums, and slip or hinged lid drums. All packs are recyclable.

Tin-plate is tin-plated steel, and the most common material used in food cans. Steel can also be used unplated or with coatings. Aluminium is used for drinks cans, closures, trays, tubs and tubes. As foil, it can be used in multi-laminate constructions or as a blister pack or container seal. **Fig 2.4** below shows examples of coated and uncoated metal cans used to preserve food.

**Fig 2.4**  
Packaging  
Material:  
Metal

When used, metal provides the following packaging characteristics:

- ✓ Strength and rigidity
- ✓ Barrier to gas and moisture
- ✓ Pressure resistance
- ✓ Temperature and pressure resistance / tolerance
- ✓ Corrosion resistance through coatings
- ✓ Easy sterilization
- ✓ Direct decoration or labelling

**Aluminium foil:** Aluminium foil is made by rolling pure aluminium metal into very thin sheets, followed by annealing to achieve dead-folding properties that allow it to be folded tightly. Moreover, aluminium foil is available in a wide range of thicknesses with thinner foils used to wrap food and thicker foils used for trays. Like all aluminium packaging, foil provides an excellent barrier to moisture, air, odours, light, and microorganisms. It is inert to acidic foods and does not require lacquer or other protection. Although aluminium is easily recyclable, foils cannot be made from recycled aluminium without the formation of pinholes on thin sheets.

**Laminates and metalized films:** Laminated aluminium packaging involves the binding of aluminium foil to paper or plastic film in order to improve barrier properties. Thin gauges facilitate application. Although lamination to plastic enables heat sealability, the seal does not completely block moisture and air.



Because laminated aluminium is relatively expensive, it is typically used to package high value foods such as dried soups, herbs, and spices. A less expensive alternative to laminated packaging is metalized film. Metalized films are plastics containing a thin layer of aluminium metal. These films have improved barrier properties to moisture, oils, air, and odours, and the highly reflective surface of the aluminium is attractive to consumers. Metalized films are more flexible than laminated films and are mainly used to package snacks. Although the individual components of laminates and metalized films are technically recyclable, the difficulty in sorting and separating the material precludes economically feasible recycling.

BECAUSE LAMINATED ALUMINIUM IS RELATIVELY EXPENSIVE, IT IS TYPICALLY USED TO PACKAGE HIGH VALUE FOODS SUCH AS DRIED SOUPS, HERBS, AND SPICES

### 2.1.4 PLASTIC

Plastic is the most common packaging material and, at the same time, one of the most difficult to dispose of. The characteristics common to all plastics are that they are light, strong and cheap to manufacture. It is for these reasons that they are used so much as an alternative to cardboard and glass packaging materials. **Fig 2.5** below shows a variety of plastic packaging materials with different shapes and applications.

**Fig 2.5**  
Packaging  
Material:  
Plastics



Plastics can be used on their own or in combination with other materials. Their properties vary considerably but usually include:

- ✓ Lightweight
- ✓ Easily mouldable into almost limitless shapes
- ✓ Ability to form rigid containers or flexible films
- ✓ Potential impact resistance
- ✓ Direct decoration or labelling
- ✓ Heat sealability

The disadvantages of plastics are typically polymer specific, and the correct choice of polymer can mitigate weaknesses to a practical degree. Factors that should be considered are:

- ✓ No plastic provides an absolute barrier to gas and moisture
- ✓ Plastics melt at temperatures ranging from 650°C to 2,300°C
- ✓ Chemical resistance varies
- ✓ Additives in plastics can contaminate some products.

**Common plastic polymers used in packaging include:**

### Cellulose

Plain cellulose is a glossy transparent film that is odourless, tasteless and biodegrades within approximately 100 days. It is tough and puncture-resistant, although it tears easily. It has dead-folding properties that make it

suitable for twist-wrapping (e.g. sugar confectionery). However, it is not heat sealable, and the dimensions and permeability of the film vary with changes in humidity. It is used for foods that do not require a complete moisture or gas barrier, such as fresh bread and some types of sugar confectionery. Cellulose acetate is a clear, glossy transparent, sparkling film that is permeable to water vapour, odours and gases, and is mainly used as a window material for paperboard cartons. (Fig 2.6)

**Fig 2.6**  
Plastics:  
Cellulose





**Fig 2.7** Plastics: LDPE

## PACKAGING FUNDAMENTALS

### Polyethylene (PE)

**Low Density (LDPE):** LDPE is used for flexible tubes, films and some bottles. It has a low melting point, and as a film is a relatively poor oxygen and moisture barrier (**Fig 2.7**).



**Fig 2.9** Plastics: PP



**Fig 2.10** Plastics: PET



**Fig 2.8** Plastics: HDPE

**High Density (HDPE):** HDPE is widely used for bottles and tubes. It has a higher melting point than LDPE but is not suitable for use in ovens. HDPE does not provide a sufficient barrier to gas to be used for carbonated drinks (**Fig 2.8**).

**Linear Low Density (LLDPE):** LLDPE is predominantly used as a film, or as a sealing layer on multi-laminate materials for bottle seals, sachets, pouches and bags. It is available in expanded form for wads.

### Polypropylene (PP)

Polypropylene is widely used for closures due to its ability to form a hinge that resists cracking and splitting (**Fig 2.9**). It is also used for dispensers, actuators, bottles, jars, cartons, trays and as a film, either on its own or in laminations such as crisp packets or pouches. Polypropylene is also available in expanded form for tubs and trays.

PP typically has a higher melting point than PE so despite not being suitable for use in ovens it is more appropriate for hot fill products. It is resistant to a relatively wide range of chemicals.

### Polyethylene Terephthalate (PET)

PET is widely used for stretch-blown bottles containing drinks, toiletries and food, and has excellent clarity (**Fig 2.10**). It can be also used for jars, tubes and trays. Offering by far the best gas and moisture barrier of any packaging plastic used for containers, PET is ideal for carbonated beverages and its resistance to heat makes it suitable for ovenable trays for ready meals.



**Fig 2.11**  
Plastics: PVC Wrap

**Polyvinyl chloride (PVC)**

PVC is not widely used, despite only a third of its content being derived from oil. It is still widely used in vacuum forming for inserts, clam packs and blister packs due to its good production line performance. PVC films have excellent stretch and cling properties for hand wrapping fresh produce. PVC is not environment friendly packaging as it is costly to recycle **(Fig 2.11)**.



**Fig 2.12**  
Plastics: PS

**Polystyrene (PS)**

PS is mainly found in its expanded form as protective mouldings for fragile products. It is also available as moulded toiletries and cosmetics containers (compacts), as well as some bottles, jars and cups **Fig 2.12**, and has good chemical resistance and excellent clarity, although it can be coloured. However, this packaging leaves a large carbon foot-print and it is very difficult to recover and recycle.

THE CHARACTERISTICS COMMON TO ALL PLASTICS ARE THAT THEY ARE LIGHT, STRONG AND CHEAP TO MANUFACTURE.

**2.1.5 LAMINATES AND COEXTRUSIONS**

Laminates and co-extrusions are designed to benefit from the properties of two or more materials. Technically, laminates are two materials bonded together and co-extrusions are multiple polymers extruded together from a molten state to form a single material.

**Fig 2.13**  
Plastics:  
Laminates

**Fig 2.13** below shows a variety of laminates and co-extruded materials used for food and spices



The following laminates are widely used, from sachets through to form-fill-seal cartons such as Tetra Paks (Fig 2.14):



Fig 2.14 Plastics: Laminates forming Tetra Pak Packaging



**Paper (or board) / Polythene (PE)**

Typically, paper or board provides rigidity and an easily-decorated surface, while polythene offers heat sealability and liquid containment. However, PE is not a barrier in the true sense of the term because water vapour can pass through it.



▲ Co-extrusion is the simultaneous extrusion of two or more layers of different polymers to make a film.

**Paper or PET / Aluminium foil / Polythene**

Likewise, polythene provides heat sealability while aluminium foil provides barrier properties, with the paper or PET on the outer surface allowing for decoration. PET in particular gives a high gloss finish.

**PET / PE-EVOH (ethyl vinyl alcohol)-PE**

As above but for a clear, high-barrier laminate, EVOH is used instead of the aluminium foil.

Co-extrusion is the simultaneous extrusion of two or more layers of different polymers to make a film. Co-extruded films have three main advantages over other types of film. They have very high barrier properties, similar to laminates but produced at a lower cost; they are thinner than laminates and are therefore easier to use on filling equipment; and the layers do not separate. There are three main groups of polymers that are co-extruded:

- ✓ Low-density and high-density polyethylene, and polypropylene
- ✓ Polystyrene and acrylonitrile-butadiene-styrene
- ✓ Polyvinyl chloride

A three-layer co-extrusion typically has an outside layer with high gloss and printability, a middle bulk layer which provides stiffness and strength, and an inner layer which is suitable for heat sealing. **Table 2.1** below shows the different combinations of co-extruded material with their potential food application.

SELECTED APPLICATIONS OF CO-EXTRUDED PLASTIC FILMS	TYPICAL FOOD APPLICATIONS
High impact polystyrene- PET	Margarine, butter tubs
Polystyrene- polystyrene PvDC- polystyrene	Juice and milk bottles
Polystyrene- polystyrene PvDC-polyethylene	Tubs for butter, cheese, margarine, bottles for coffee, mayonnaise, sauces.

**Table 2.1** Examples of Co-extruded Films and their Food Applications

**Plastics Codes and Identification Signs**

**Fig 2.15**  
Plastic Codes

**Fig 2.15** below lists the different plastic codes according to their chemical formula and applications. It also describes the main use and application for each type of plastic.

 PETE	 HDPE	 V	 LDPE	 PP	 PS	 OTHER
Polyethylene Terephthalate	High-Density Polyethylene	Polyvinyl Chloride	Low-Density Polyethylene	Polypropylene	Polystyrene	Other
Common products: soda & water bottles; cups, jars, trays, clamshells.	Common products: milk jugs, detergent & shampoo bottles, flower pots, grocery bags	Common products: cleaning supply jugs, pool liners, twine, sheeting, automotive product bottles, sheeting	Common products: bread bags, paper towels & tissue overwrap, squeeze bottles, trash bags, six-pack rings	Common products: yogurt tubs, cuos, juice bottles, straws, hangers, sand & shipping bags	Common products: to-go containers & flatware, hot cups, razors, CD cases, shipping cushion, cartins, trays	Common types & products: polycarbonate, nylon, ABSm acrylic, PLA; bottles, safety glasses, CDs, headlight lenses
Recycled products: clothing, carpet, clamshells, soda & water bottles	Recycled products: detergent bottles, flower pots, crates, pipe, decking	Recycled products: pipe, wall siding, binders, carpet, backing, flooring	Recycled products: trash bags, plastic lumber, furniture, shipping envelopes, compost bins	Recycled products: paint cans, speed bumps, auto parts, food containers, handers, plant pots, razor handles	Recycled products: picture frames, crown molding, rulers, flower pots, hangers, toys, tape dispensers.	Recycled products: electronic housings, auto parts
						

## 2.2 PACKAGING MATERIALS ADVANTAGES & DISADVANTAGES

**Table 2.2** below summarizes the main advantages and disadvantages of packaging materials and could help in choosing the correct and adequate packaging material for your product, depending on your budget and quality requirements.

PACKAGING MATERIAL	ADVANTAGES	DISADVANTAGES
Paper	<ul style="list-style-type: none"> <li>• Recyclable, environmentally friendly</li> <li>• Light</li> <li>• Easy to print on</li> <li>• Easy to fold</li> <li>• Cheap</li> </ul>	<ul style="list-style-type: none"> <li>• Easily flammable</li> <li>• Weak sealing</li> <li>• Not permeable to humidity or gas</li> <li>• Sensitive to moisture</li> <li>• Mechanically weak</li> </ul>
Plastics	<ul style="list-style-type: none"> <li>• Conditionally recyclable</li> <li>• Light</li> <li>• Easy to shape - flexible</li> <li>• Printable</li> <li>• Cheaper than glass</li> </ul>	<ul style="list-style-type: none"> <li>• Environmentally non-biodegradable/toxic</li> <li>• Includes chemical additives</li> <li>• Absorbs flavours</li> </ul>
Glass	<ul style="list-style-type: none"> <li>• 100% recyclable</li> <li>• Transparent</li> <li>• 100% barrier to flavours, moisture and gases - outstanding permeability</li> </ul>	<ul style="list-style-type: none"> <li>• Can break and contaminate the content</li> <li>• Heavy for transportation</li> <li>• Expensive material due to its costly manufacturing process</li> </ul>
Metal	<ul style="list-style-type: none"> <li>• Completely impermeable to flavours, moisture and gases - outstanding barrier</li> <li>• Long food shelf life</li> <li>• Recyclable</li> <li>• Food content safety (strong food preservation)</li> </ul>	<ul style="list-style-type: none"> <li>• Content not visible</li> <li>• Possible corrosion effects</li> <li>• Storage issues and spaces</li> <li>• Needs extra internal coating for food preservation</li> <li>• Costly</li> </ul>

PACKAGING MATERIAL	ADVANTAGES	DISADVANTAGES
Laminates and co-extrusions	<ul style="list-style-type: none"> <li>• Improve the strength of the material by making it more resistant to tearing</li> <li>• Protect it from outside deteriorating agents (light, moisture, gas), great barrier properties, extended shelf-life</li> <li>• Great sealability properties to avoid leakages</li> <li>• Higher packaging material stiffness</li> <li>• Suitable for sterilization at high temperatures</li> <li>• Great printing properties, especially when using the offset printing technique</li> </ul>	<ul style="list-style-type: none"> <li>• Not easily recyclable</li> <li>• If aluminium foil is used, the product can't be seen</li> <li>• Choices of lamination depend on the properties of the content, as well as environmental factors</li> </ul>

**Table 2.2** Packaging Materials Advantages and Disadvantages

## 2.3 FOOD PACKAGING MATERIALS

Food packaging materials must possess a number of basic characteristics, and should be capable of maintaining not only food quality but also food safety. Additionally, they also have the ability to block unfavourable elements such as chemical contaminants, moisture, oxygen, light and external force. Food packaging materials act as a barrier against the permeation of water vapour, O<sub>2</sub>, CO<sub>2</sub>, and other volatile compounds (flavours and taints).

The main characteristics and properties required for food packaging materials are listed in **Fig 2.16** below:

Fig 2.16 Characteristics of Food Packaging Materials



**2.4 FOOD PACKAGING MATERIALS VS. FOOD APPLICATION**

Table 2.3 below summarizes the possible options available for choosing an appropriate packaging material that best fits your food application. You can use the table below as an overall reference:

FOOD PACKAGING MATERIAL	TYPICAL FOOD APPLICATIONS
Paper	Flour, dried fruit, sugar, dried vegetables, biscuits, groceries
White paperboard	Ice cream, chocolate blocks, frozen food, trays of eggs, fruit, meat, fish, snack foods, confectionery, nuts, salt, cocoa powder and spices
Glass jars/bottles	Spices, jam, sauces, juices, all kinds of carbonated and non-carbonated liquids, pasty food products, dairy products
Metal cans (coated)	Beer and alcoholic beverages, high acidity juices like orange, strawberry juice, fish, meat, soups, soft drinks
Metal cans (uncoated)	For non-food contact such as cosmetic creams, perfumes
Metal cans (pressurized)	Juices, soft drinks, sparkling water
Plastics - Cellulose	Sugar sweets and confectionery, fresh bread
Plastics - Low density polyethylene (LDPE)	Grocery bags, food wrap, bread bags, rubbish bags, biscuits, chocolate bars
Plastics - High density polyethylene (HDPE)	Fruit juices, squashes, juice concentrates, vinegar, cooking oil, milk, wine, syrup
Plastics - Polypropylene (PP)	Snack foods, dried foods, margarine tubs, yoghurt,
Plastics -Polyethylene terephthalate (PET)	Crystal water, carbonated drinks, dressings, edible oil, peanut butter,
Plastics - Polyvinyl chloride (PVC)	Meat, cheese, cooking oil,
Plastics - Polystyrene (PS)	Fruits, eggs, yogurt, drinking cups
Laminates - Polyvinylidene chloride coated polypropylene (2 layers)	Crisps, snack foods, confectionery, ice cream, biscuits, chocolate
Laminates - Polyvinylidene chloride coated polypropylene-polyethylene	Bakery products, cheeses, confectionery, dried fruit, frozen vegetables
Laminates - Cellulose-polyethylene-cellulose	Pies, crusty bread, bacon, coffee, cooked meats, cheeses
Laminates - Cellulose acetate-paper-foil-polyethylene	Dried soups, spices
Laminates - Metalized polyester-polyethylene	Coffee, dried milk, soups, herbs, and spices
Laminates - Polyethylene-aluminium-paper	Dried soup, dried vegetables, chocolate, spices
Coextrusions- Polypropylene with ethylene vinyl alcohol	Mustard, mayonnaise, jams, tomato ketchup

Table 2.3 Best Food Packaging Material according to Food Application



## CHAPTER 3



### PACKAGING SUSTAINABILITY:

# ENVIRONMENT FRIENDLY PACKAGING

**By definition, Sustainable Packaging** is the development and use of packaging that results in improved sustainability. This involves increased use of life cycle inventory (LCI) and life cycle assessment (LCA) to help guide the use of packaging with a reduced environmental impact and ecological footprint. It considers the entire supply chain: from basic function and marketing to end of life (LCA) and rebirth. Additionally, an eco-cost to value ratio can be useful. Sustainable packaging must meet the functional and economic needs of the present without compromising the ability of future generations to meet their own needs. Sustainability is not necessarily an end state, but is a continuing process of improvement.

The creation of packaging uses natural resources, which has independent environmental impacts. Water and electricity are required to create the product. By-products of manufacturing can cause unfortunate side effects. The creation of plastics, for example, emits toxic carbon monoxide and other undesirable organic compounds. In fact, many manufacturers admit that producing packaging costs more than producing the item to be packaged.

In 2001, it was estimated that approximately 9.3 million tonnes of packaging waste were generated in the United Kingdom alone. Such waste almost always ends up in landfills, and much of the waste found there is packaging waste. Much of this packaging, including polystyrene and other plastics, does not break down quickly. In fact, some of the packaging that makes its way to landfills does not break down at all, creating long-term environmental problems.

**Sustainable Packaging** is a relatively new addition to the environmental considerations for packaging. It requires more analysis and documentation to look at the packaging design, choice of materials, processing, and life cycle. Companies that implement eco-friendly actions reduce their carbon footprint, use more recycled materials and reuse more packaging components.

### 3.1 PACKAGING LIFE CYCLE

Fig 3.1 below shows the life cycle of packaging from source to end of life.



Fig 3.1 Packaging Life Cycle

Eco-friendly packaging is designed and manufactured by packaging engineers after taking into account the carbon footprint of each stage of the life cycle and measuring the possible impact on the environment of the packaging and its waste. Consequently, three end-of-life alternatives are available, depending on the packaging material and its design:

**Landfill or Compost (if Biodegradable):** Landfill is the act of collecting packaging waste and burying it under the ground, thus isolating it until it is completely chemically, physically or even biologically degraded (composting). All around the world, governments spend billions on managing waste, of which discarded packaging accounts for a significant proportion.

**Recycling or Reusing:** Recycling is the process of converting waste materials into new materials and objects. It is an alternative to “conventional” waste disposal that can save material and help to reduce greenhouse gas emissions.

**Incineration or Thermal Recovery:** Incineration is a waste treatment process that involves the combustion of the organic substances contained in waste materials and packaging. Incineration and other high-temperature waste treatment systems are described as “thermal treatment”. The incineration of waste materials converts them into ash, flue gas and heat, which can be used in any production or manufacturing operation.



▲ Landfill is collecting waste and burying it under the ground, thus isolating it until it is completely degraded.

### 3.2 RECYCLING FACTS

- ☑ The energy saved from recycling one metal can is enough to power a TV for three hours.
- ☑ Every steel can is 100% recyclable over and over again to make products like bicycles and cans.
- ☑ For every tonne of glass recycled, 315 kg of CO<sub>2</sub> emissions are saved.
- ☑ The energy saved from recycling one glass bottle can power a 100-watt light bulb for almost one hour.
- ☑ Recycling aluminium cans save 95% of the energy used to make new cans.

These examples and many others demonstrate the importance of recycling packaging material. The challenge remains in the packaging design process.

### 3.3 PACKAGING DESIGN GUIDELINES: GREENER PACKAGING

There are 10 main concepts for designing sustainable packaging that should be followed when aiming for eco-friendly packaging:

1. **Take a life cycle approach** to package design (refer to **Fig 3.1**)
2. **Evaluate each component** of your packaging
3. **Consider new alternatives** for distribution packaging
4. **Look for opportunities** to make your packaging reusable
5. **Consider changes** to your product

- 6. **Design for recyclability** whenever possible
- 7. **Employ packaging strategies** that encourage product consumption
- 8. **Know where your** packaging materials come from
- 9. **Evaluate your distribution system** for space-saving opportunities
- 10. **Consider materials** made from renewable sources

Applying these guidelines throughout the development process will help to make packaging designs more eco-friendly and minimize their negative impact on the environment at the final stages.

### 3.4 PACKAGING SUSTAINABILITY: CASE STUDIES OF SUSTAINABLE SOLUTIONS

#### Case Study 1: Snack Nuts Packaging Design - Plastic Can vs. Flexible Pouch

The stand-up pouch uses 80% less plastic packaging material per unit weight of product.

PACKAGING FORMAT	PRODUCT NET WEIGHT	PACKAGING NET WEIGHT	PACKAGING PER 100 G OF PRODUCT	IMAGE
Plastic Can with Plastic Lid	17 Ounces	64.2 g	13.3 g	
Stand Up Plastic Pouch with Zipper	16 Ounces	11.5 g	2.5 g	

**Table 3.1** Case Study 1: Sustainability Improvements

#### Case Study 2: Shipping Sacks

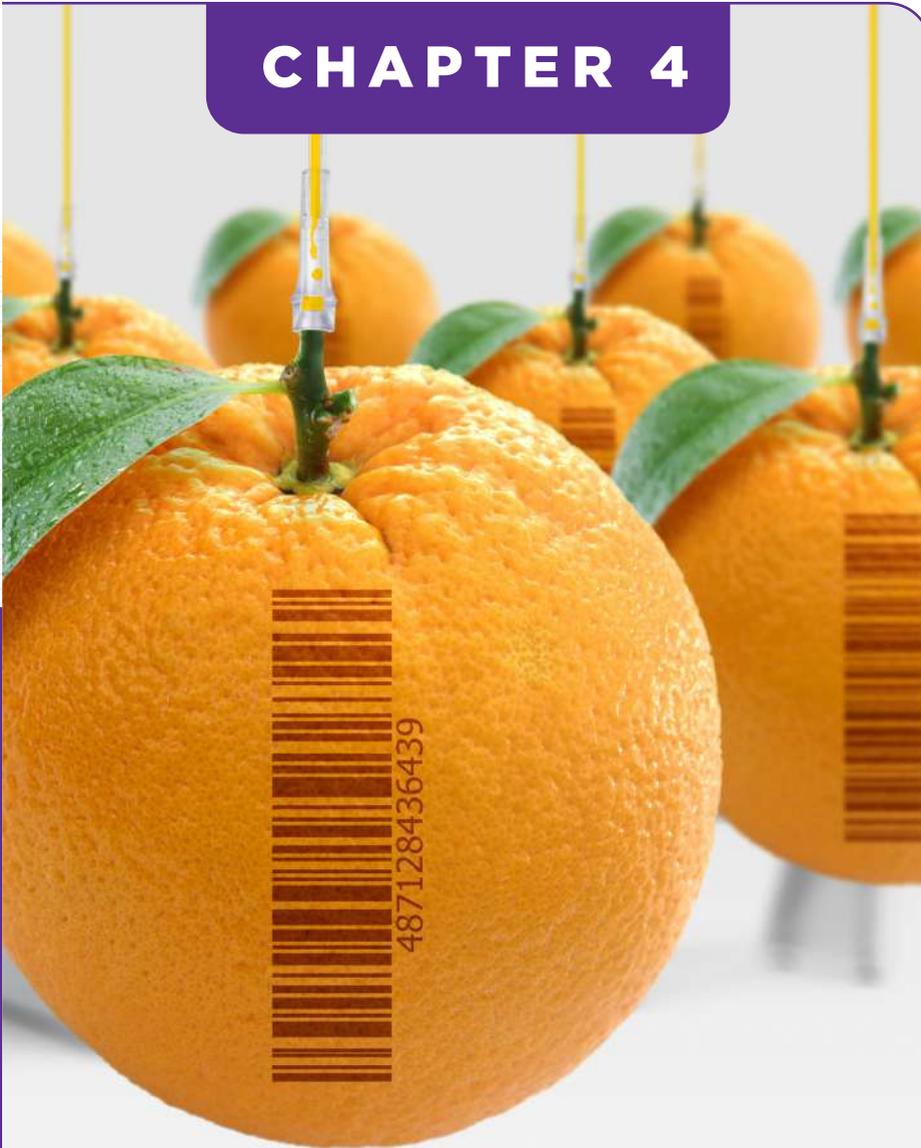
By using higher-performance resins, a major resin manufacturer in Europe has been able to decrease the weight of material used to pack and transport a pallet of PE resins by 40%. Consequently, approximately a weight of 5 MT (Metric Tons) less polymer was used to pack resins per year.

YEAR	MATERIAL THICKNESS
1993	7.8 mm
1994	7.0 mm
1995	6.3 mm
1998	5.5 mm
2001	4.7 mm

**Table 3.2** Case Study 2: Sustainability Improvements



## CHAPTER 4



# PRODUCT TRACEABILITY FOOD SAFETY MANAGEMENT

**All products** can be traced throughout their life cycle via their packaging. Tracing products is important in order to detect product failures, and consequently implement an urgent recall from the market. Informing supply chain entities of product information is crucial, especially when it comes to the following information:

- Batch and lot number
- Manufacturing and expiry date

The above information will help in tracking the product to be recalled and detecting which manufactured batch or lot is affected by the recall. Consequently, retrieving the products from the market after having

dispatched and distributed the product worldwide will be easier and faster.

#### 4.1 TRACEABILITY BENEFITS

Tracing an item through various stages of production, manufacturing, processing, handling, transportation, sales and consumption is a widespread practice in today's world. Manufacturers may require purchasers to register ownership of a product to facilitate possible future recall for safety reasons or warranty fulfilment. Post offices and package delivery companies make widespread use of tracking packages from pickup to delivery, even to destinations on the other side of the world.

Some of the benefits of traceability include:

- ☑ The ability to determine the origin of a product, ingredient or component
- ☑ Simplified problem-solving in the event of defective or contaminated products, ingredients or components
- ☑ Issues can be identified, contained and resolved more quickly
- ☑ Limited losses and reduced costs
- ☑ Public health and safety are protected
- ☑ Trust and confidence are increased in the corresponding products, businesses or systems
- ☑ Confirmation that produce is locally grown
- ☑ Improved operating efficiency for growers, packers and shippers

## 4.2 MOST COMMON TECHNOLOGIES

### 4.2.1 RFID

Radio frequency identification (RFID) is often used with track-and-trace solutions and has a critical role to play in supply chains. RFID is a code-carrying technology that uses a specialized chip. Widespread deployment of RFID has been inhibited by certain limitations of the technology: tag cost, tag readability and privacy issues. The cost of RFID tags currently reduces the economic justification for item-level tagging or case-level tagging in the product industry. Reading RFID tags requires specialized equipment, thus limiting their usefulness for consumers today.



▲  
**Fig 4.1.**  
Traceability:  
RFID Chip

### 4.2.2 BARCODING

Barcoding is a common and cost-effective method that is used to implement traceability at both the item and case level. Variable data in a barcode or a numeric or alphanumeric code format can be applied to the packaging or label.

Packaging converters have a choice of three different classes of technology to print barcodes:

- ☑ Inkjet systems are capable of printing high resolution images
- ☑ Laser marking can be also used and provides the advantage of fine detail and high speed for character printing, with no consumables.

**Fig 4.2.**  
Traceability:  
Traditional  
Barcode



It is important to note that product traceability is also covered by the highest international standards such as ISO 22005, which lays out the principles and specifies the basic requirements for the design and implementation of a food traceability system through packaging. It can be applied by an organization operating at any stage of the food chain.

Traceability makes packaging stand out by highlighting its importance as a carrier and is an excellent tool for tracing products along their life cycle.

### 4.3. PRODUCT SHELF LIFE

Shelf life is defined as the recommended maximum time for which products or fresh (harvested) produce can be stored, during which the defined quality of a specified proportion of the goods remains acceptable under expected (or specified) conditions of distribution, storage and display.

Food packaging plays a vital role in preserving food throughout the distribution chain. Without packaging, the processing of food can become compromised if it is contaminated by direct contact with physical, chemical, and biological contaminants. In recent years, the development of innovative food packaging (modified atmosphere & active packaging) has not only increased the shelf life of foods but also their safety and quality, therefore bringing convenience to consumers. Directly related and interlinked with food packaging is the concept of shelf life, which is the length of time that



**Fig 4.3.**  
Traceability:  
Matrix Barcode

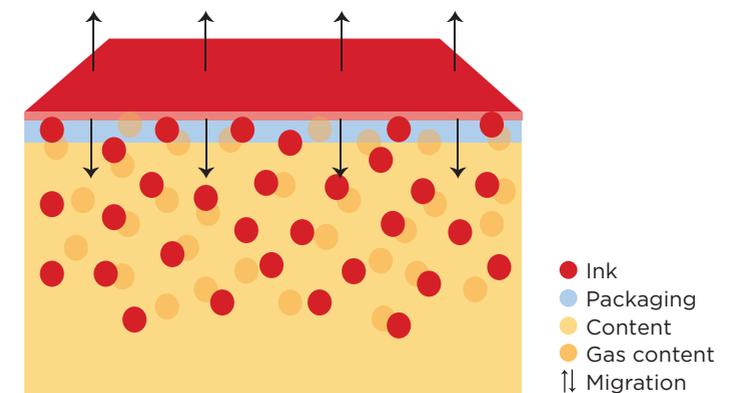
foods, beverages, pharmaceutical drugs, chemicals, and many other perishable items are given before they are considered unsuitable for sale, use, or consumption.

The shelf life of food is controlled by three factors:

- ☑ The product characteristics, including formulation and processing parameters (intrinsic factors)
- ☑ The environment to which the product is exposed during distribution and storage (extrinsic factors)
- ☑ The properties of the packaging

### 4.4. THEORY OF MIGRATION AND PERMEABILITY

**Migration:** Food packaging can be a source of chemical food contaminants. The transfer of chemical contaminants from food contact materials (food packaging) into food is called migration (See **Fig 4.4**). According to some scientists, food contact materials are an underestimated source of chemical food contamination.



**Fig 4.4.**  
Migration

## PACKAGING FUNDAMENTALS

The extent to which migration occurs depends on various factors:

- ☑ The physical and chemical properties of the migrant, the packaging material and the food
- ☑ Temperature
- ☑ Storage time
- ☑ The size of the packaging in proportion to the foodstuff volume

The types of chemicals that can migrate from packaging into food are highly diverse and depend on the type of packaging material. For inert materials (stainless steel, ceramic, glass) only chemicals from the inside surface that are in direct contact with the foodstuff can migrate, transferring from the inner surface to the food by surface exchange. Chemical diffusion from within the packaging material or from the outside (printing inks, adhesives) is not possible. This inertness is due to the chemical structure, with pore sizes that are small and prevent molecules or single atoms from passing through.

Non-inert materials, such as paper, board and plastics, can be a direct source of migrants, and chemicals may also migrate from the outside through the packaging. An example is printing inks, which have been shown to migrate through paper board into dry foods. The large pore size of paper-based materials allows smaller molecules to migrate from the outside to the food inside. The use of non-permeable barrier materials can reduce food contamination significantly.

PAPER CAN BE REGARDED AS PERMEABLE AND IS NORMALLY COATED WITH A PLASTIC POLYMER TO ENSURE BARRIER PROPERTIES FOR THE PACKAGING OF FOODS.

**Permeability:** The materials used to manufacture food packaging comprise a heterogeneous group, including glass, metals, plastics, and paper, with a corresponding range of performance characteristics. When selecting suitable packaging materials for a particular food, the focus is typically on the barrier properties of the packaging material, known as its permeability or transmission rate.

Foods can be classified according to the degree of protection they require, such as the maximum moisture gain or O<sub>2</sub> uptake. Calculations can then be made to determine whether a particular packaging material would provide the barrier required to give the desired product shelf life. Metal cans and glass containers can



be regarded as essentially impermeable to the passage of gases, odours, and water vapour, provided that a metal end has been correctly sealed on in the case of cans or a satisfactory closure applied in the case of glass containers. Aluminium foil has excellent barrier properties, provided it is at least 25 am thick; below this thickness the likelihood of pinholes increases. It is common to laminate plastic polymers to aluminium foil to provide mechanical support and heat sealability. Paper-based packaging materials can be regarded as permeable, and for this reason are normally coated with a plastic polymer to ensure adequate barrier properties for the packaging of foods. This then leaves plastics-based packaging materials, which provide varying

degrees of protection, depending largely on the nature of the polymers used in their manufacture.

The below **Table 4.1** shows the different permeability rates of the different polymers regarding Oxygen and Vapor Transmission:

COMPOUND	VAPOR. (g25 μ/m <sup>2</sup> /24H)	OXYGEN. (g25 μ/m <sup>2</sup> /24H)
Polyvinylidene Dichloride (Saran)	0.9 - 3.4	1.2 - 2.3
Biaxial Oriented Polypropylene (PP)	5.9	2526
HD-Polyethylene	5.9	2325
Polypropylene (PP)	10.7	-
LD Polyethylene (LDPE)	17.7	8586
Biaxial oriented PET	18.6	35.6
Poly (ethylene terephthalate (PET)	20.2	-
Ethylene - Vinyl Alcohol (EVAL G -L)	22 - 124	0.1 - 1.9
Rigid Polyvinyl Chloride (PVC)	46.5	-
Polystyrene (PS)	132	4030
Biaxially Oriented Nylon 6 (Pa6)	158	25.6
Polycarbonate	170.5	-

**Table 4.1** Moisture Vapour and Oxygen Transmission Rates

Fig 4.5 below summarizes the main interactions that might occur between the packaging layer and the food content, also taking into account the external physical conditions:

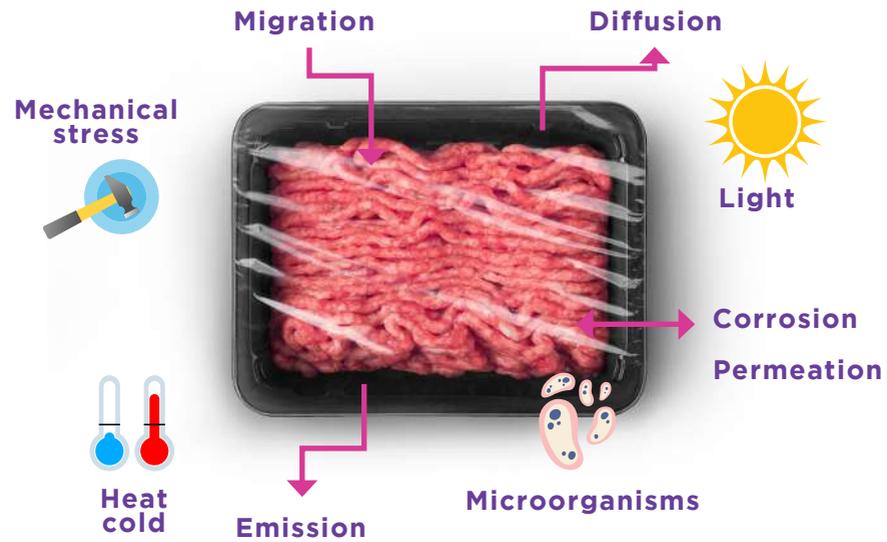


Fig 4.5 Interaction between Packaging and Food Content



## CHAPTER 5



# SRI LANKA FOOD PACKAGING REGULATIONS VS. EU REQUIREMENTS

If you are a **manufacturer**, converter, distribution entity, or even a reseller in Sri Lanka, it is important to know that local governmental entities in Sri Lanka are working on local regulations to protect the integrity of products and food items. These regulations represent an important reference that provides general guidelines about the manufacturing and production of food products in particular

**Table 5.1** below lists the main packaging materials and labelling regulations in Sri Lanka compared against the EU requirements, in case you are planning to export your products to the EU market.

PACKAGING AND LABELLING REGULATIONS	SRI LANKA	EU
Packaging Materials Regulations	1660/30 (Packaging Materials and Articles /2010)	EC-1935/2004 (Food Contact Materials/2004)
		EU - 10/2011 (Plastic Materials for Food Contact/2011)
		94/62/EC (Packaging and Packaging Waste/1994)
		2023/2006 (Good Manufacturing Practices GMP/2006)
Packaging Labelling Regulations	1376/9 (Food Labelling and Advertising /2005)	2000/13/EC (Food Labelling, Presentation and Advertising/2000)
		1169/2011 (Food Information to Consumers/2011)

**Table 5.1** Packaging and Labelling Regulations

IT IS IMPORTANT TO KNOW THAT GOVERNMENTAL ENTITIES IN SRI LANKA ARE WORKING ON LOCAL REGULATIONS TO PROTECT THE INTEGRITY OF PRODUCTS.

One can refer to the above regulations when producing a new product or, more importantly, exporting to the EU. These regulations are available online or at local governmental authorities in Sri Lanka. These regulations and their guidelines need to be implemented in order for a product to be legally eligible to enter local and international markets.

**Packaging Labelling Regulations: The Basics**

Sri Lankan goods to be exported to the European Union should abide by EU requirements for packaging labelling. It is vital to ensure that the necessary data and information is listed on packaging labels before exporting

to the EU, otherwise the goods will be rejected and returned to the country of origin. The main requirements and information that must be present on all food packaging labels are listed below:

- ☑ The name under which the product is sold
- ☑ The list of ingredients (listed in descending order of weight)
- ☑ The quantity of certain ingredients or categories of ingredients
- ☑ The net quantity (in mass for solids, or volume for liquids)
- ☑ The date of minimum durability
- ☑ Any special storage conditions or conditions of use
- ☑ The name or business name and address of the manufacturer
- ☑ Instructions for use
- ☑ Appropriate logos and indicators

SAARC labelling regulations: Food and nutrition labelling regulations vary across SAARC countries. The existing variations are of the utmost concern in cross-border food trade and access. For this reason, experts in the region will draft and finalize guidelines for food safety that include common guidelines for the labelling of foodstuffs. These guidelines will be based on Codex standards and are meant to be used as benchmarks by member countries when preparing or updating national standards.

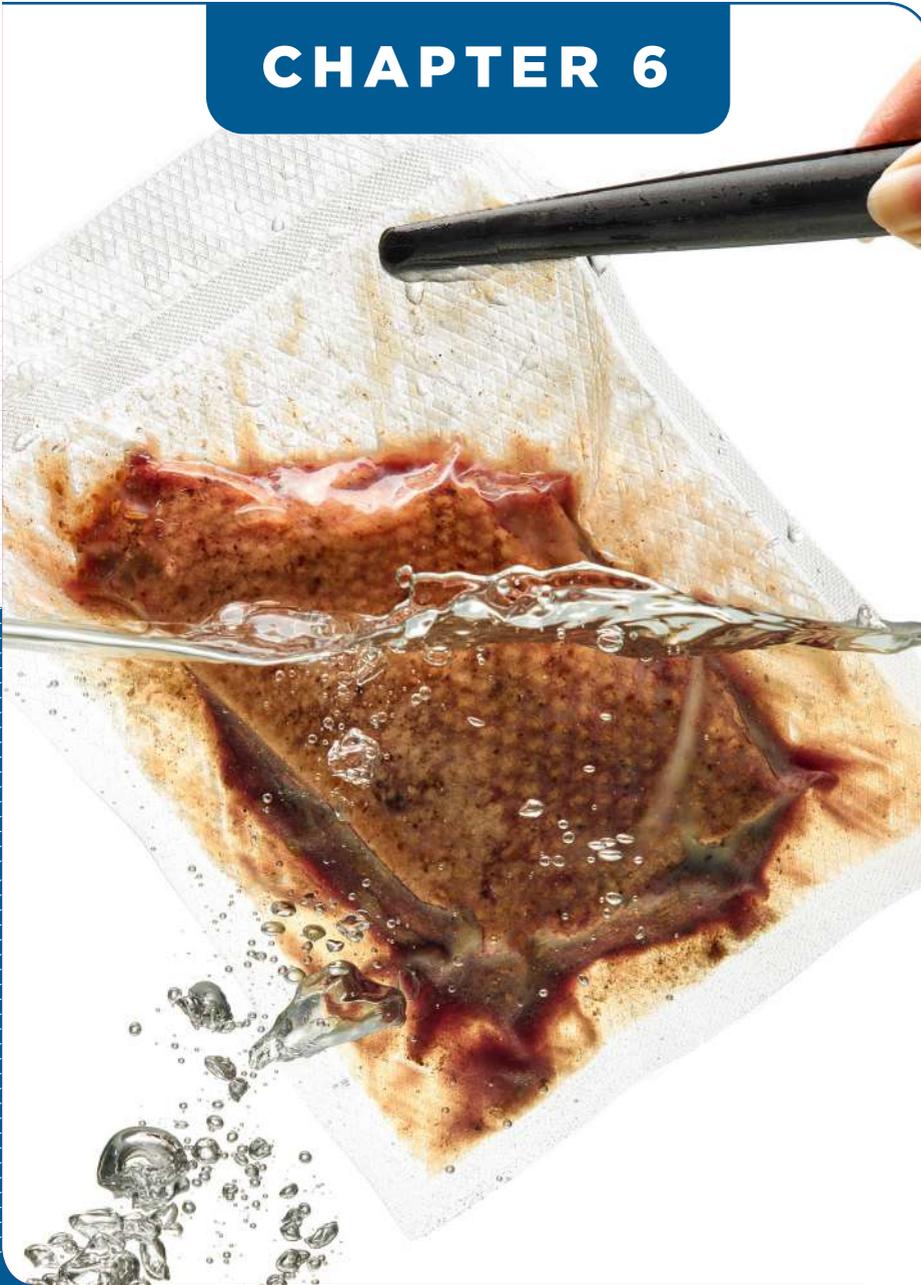
### Packaging Materials Regulations: The Basics

As with labelling regulations, packaging should also follow a number of international regulations covering raw materials and converted items. The most important guidelines that packaging should adhere to for optimal export operations between Sri Lanka and EU countries are described below:

- ☑ No trade of packaging materials which could be harmful to human health, deteriorate organoleptic properties of food or change the nature of the food
- ☑ Storage conditions must be mentioned
- ☑ Raw materials should be certified for food contact
- ☑ Print “for food use” on food packaging materials
- ☑ Plastic laminates and additives should be certified food grade
- ☑ No enamel or glazed materials
- ☑ No vinyl chloride materials
- ☑ Do not use non-food packaging for food purposes
- ☑ No storage of edible oil or fat in metal containers
- ☑ Packaging material labels should never be in contact with food
- ☑ No presence of any sachet (reduced iron) for oxygen absorbance inside the packaging material
- ☑ Plastic materials (multilayers)
- ☑ Specific migration limits
- ☑ Plastic materials (multilayers) overall migration limits
- ☑ Presence of Declaration of Compliance (DoC)



## CHAPTER 6



SRI LANKA

# PACKAGING TESTING CENTRE

**Packaging testing involves** the measurement of a physical or chemical characteristic or property directly related to packaging. This includes packaging materials, packaging components, primary packages, shipping containers and unit loads, as well as the associated processes. Testing measures the effects and interactions of the levels of packaging, the package contents, external forces, and end use.

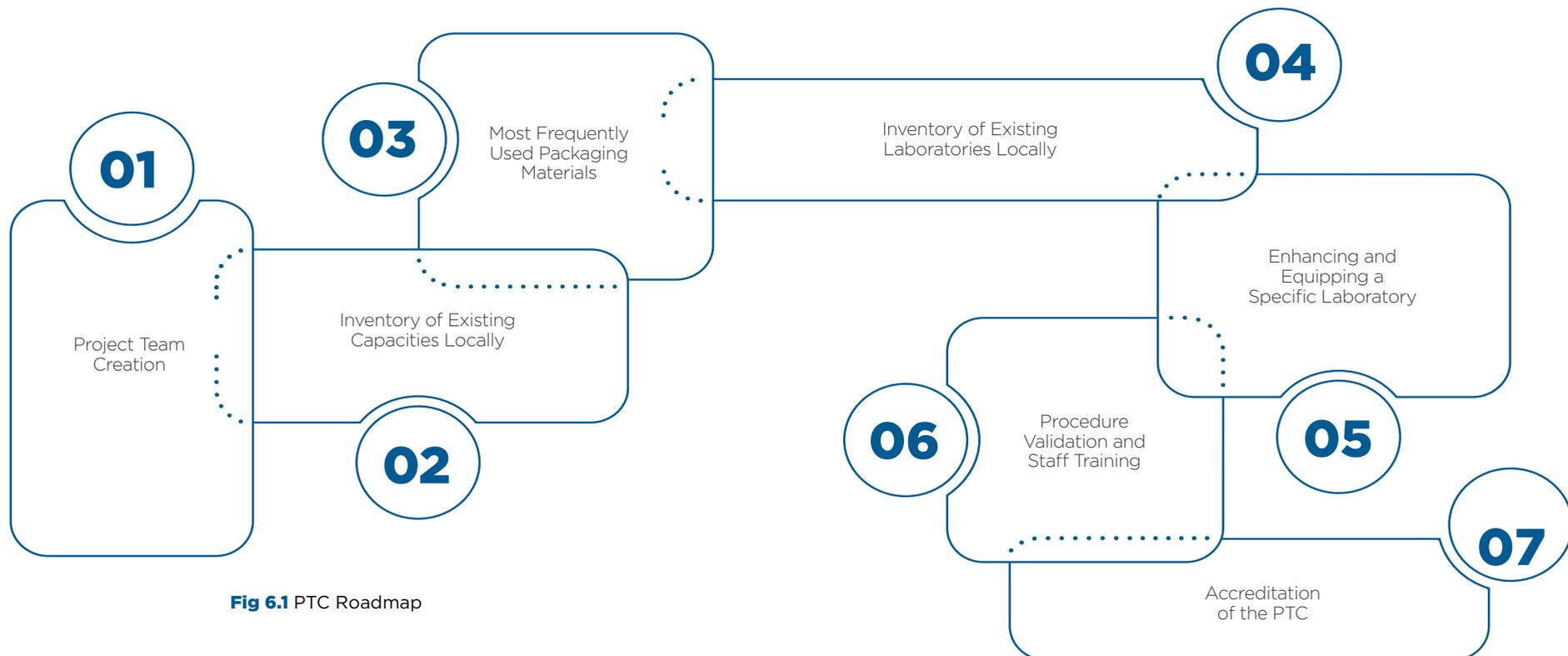
Consequently, and in order to deal with economic changes and international regulations, adequately inform local SMEs of all related regulations. To ensure technical assistance is provided to local SMEs, UNIDO technically guided the establishment of a national Packaging Testing Centre (PTC) at the Industrial Technology Institute (ITI) in Colombo; this effort was funded by the EU within the framework of the EU-Sri Lanka Trade-related Assistance project through the provision of the equipment and technical training. The PTC is able to provide competent

services and technical assistance with food and packaging import/export requirements, and to conduct packaging testing required by international standards and guidelines to meet market requirements. UNIDO also provided ITI with technical support to develop its testing capability and gain accreditation to conduct packaging testing.

The main objective of the PTC is to increase the competitiveness of local products in export markets by improving packaging, and to ensure they comply with international standards for packaging and labelling

through testing. This is implemented through consultancy and training; packaging awareness disseminated to the general public; conformity assessment services of the testing laboratory; and a platform for exchanging ideas and experiences between members and monitoring packaging regulations at the local and international levels.

The roadmap in **Fig 6.1** below shows the different steps taken by UNIDO in cooperation with local authorities in Sri Lanka that helped to establish the PTC in Colombo at ITI facilities. Annex 1 presents additional details for the roadmap.



**Fig 6.1** PTC Roadmap

**6.1 PTC FUNCTIONS**

The PTC covers the complete functions of packaging, representing a **one-stop-shop** that includes consultancies for SMEs, R&D, packaging, structural and graphic design, workshops and training courses, and testing of packaging materials. **Fig 6.2** below shows the main service arms of the PTC that planned for the medium to long term. At this point, the PTC will cover materials testing and provide consultancy services and training workshops related to packaging.



**Fig 6.2.** PTC Functions

**6.2 PTC: PACKAGING MATERIAL TESTINGS**

UNIDO assisted ITI in conducting a survey to gather information from Sri Lankan SMEs on their main export markets, manufacturing fields and the challenges they have faced in packaging testing, among other areas.

**Table 6.1** below shows a summary of the survey which helped to determine the requirements necessary for the establishment of the PTC.

SME BUSINESS	PRODUCTS	PACKAGING MATERIALS (USED FOR EXPORT)	EXPORT MARKETS	TYPES OF TESTS REQUIRED	CHALLENGES / LIMITATIONS
Export	Spices, tea, coconut, cinnamon, processed food, flour	LDPE, HDPE, cardboard, glass, metal can, plastic bags, pouches, laminates, labels, OPP, BOPP, etc.	India Bangladesh EU Australia New Zealand	Food grade certificate	Costs of tests  Lack of governmental policies
Manufacturers	Baked goods, water, carbonated drinks, sweets, rice, etc	LDPE, HDPE, cardboard, glass, metal cans, plastic bags, pouches, laminates, labels, OPP, BOPP, etc	Canada Middle East Asia Russia	Physical parameters	Delay in testing results

**Table 6.1** ITI Survey General Results with Sri Lankan SMEs



According to the survey results shown above, a list of testing equipment was generated and provided to ITI by UNIDO in order to establish the PTC and operate it under the administration and support of ITI in Colombo.

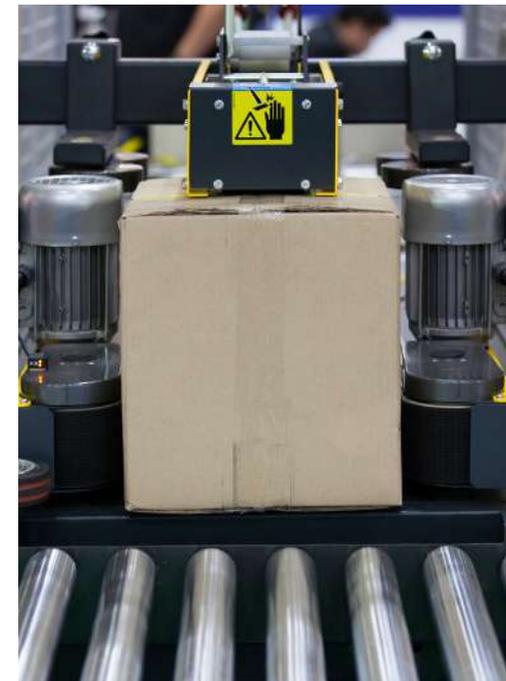
**Table 6.2** below lists the different packaging testing equipment provided by UNIDO and installed at the ITI's PTC. Each test follows specific international standards that include the required procedures and guidelines. This testing equipment will serve local and regional needs, as well as those of import markets like the EU. An official certificate and a testing report are generated by ITI, containing the packaging material test requirements and the accuracy of the test results for international acknowledgement.

TESTING EQUIPMENT		INTERNATIONAL STANDARDS	TEST PURPOSE
1	Light booth (colour visual control)	ASTM/D1729-16	This apparatus is used to test and check the printing quality of packaging under a variety of lighting conditions
2	Colorimeter	ASTM/E1347-06	A light-sensitive device used for measuring the intensity or saturation of a colour
3	COBB tester	TAPPI/T441	Tester used for determining the water absorption of paper
4	GSM testing apparatus	ASTM/D3776M-09a	A scale used for determining the GSM of board, paper-laminated film and various other packaging materials.
5	Puncture resistance apparatus	ISO/3036:1975 IS/4006 - Part II TAPPI/T803	Can be used to measure the sharpness of a point in penetrating a known membrane, or the resistance of a membrane to a known point.
6	Thickness tester	ASTM/D6988-13 ASTM/F2251-13 TAPPI/T411 ISO/534:2011	This device measures the thickness of packaging materials such as plastic films, sheeting, paper and paperboard, foils and metal sheets, etc.
7	Environmental chamber	ASTM/D4332-14 ASTM/E171M-11	Artificially replicates conditions that materials or components might be exposed to. It is also used to accelerate the effects of exposure to the environment.
8	Dart impact tester	ASTM/D1709-16 ISO/7765-1:1988	This tester measures the impact resistance of plastic films, sheets, aluminium foil, paper and cardboard.
9	Torque tester	ASTM/D2063M-10 ASTM/D3474-90	This tester is designed to measure the open force and lock force of the caps of bottles, spout bags and flexible tube packages.
10	Krub tester	ASTM/D5264-98 TAPPI/T803	This instrument can effectively analyse the problems of poor abrasion resistance, ink layers rubbing off, and poor hardness of the coating layers of any printed materials.

**Table 6.2** PTC packaging Materials Testing Equipment and International Standards

TESTING EQUIPMENT		INTERNATIONAL STANDARDS	TEST PURPOSE
11	Hot tack - heat seal tester	ASTM/F2029-16 ASTM/F1921M-12	Designed for hot tack and heat seal performance tests for plastic films, laminated films and other packaging films. It can be used for peel, shear, tension and other tests for adhesives, adhesive tapes, laminated films, plastic films, paper and other flexible materials.
12	Leak tester	ASTM/D3078-02 ASTM/F1140M-13 ASTM/F2096-11	This tester is professionally designed for leak testing packaging for food, drugs, medical instruments, everyday chemical products, cars, electronic components, stationery and other industrial products. It also can be used to test the seal performance of specimens after falling and compression tests.
13	Elmendorf tear strength tester	ASTM/D1922-15 ASTM/D689-17 TAPPI/T414 ISO/6383-1:2015 ISO/6383-2:1983 ISO/1974:2012 GB/T 455:2002 GB/T 16578.2:2009	This tester is designed to tear test films, sheets, flexible PVC, PVDC, waterproof films, woven materials, polypropylene, polyester, paper and cardboard, etc.
14	Compression tester	ASTM/D642-15	The box compression tester measures the compressive strength of packages such as boxes, drums, and cans.
15	Water vapour transmission apparatus	ASTM/E96M-16 ASTM/D1653-13 ISO/2528:2017 TAPPI/T464	The water vapour permeability tester is able to determine the water vapour transmission rate of plastic films, sheets and other materials used in packaging.
16	Gas/oxygen transmission apparatus	ASTM/D1434-82 ISO/2556:1974 ISO/15105-1:2007	The gas permeability tester is able to determine the gas transmission rate of a barrier material (gases such as O <sub>2</sub> , N <sub>2</sub> , CO <sub>2</sub> ).

Packaging materials testing is often needed to identify the critical material characteristics and engineering tolerances. These are used to prepare and enforce specifications. **Fig 6.3** below shows an example of a piece of packaging testing equipment (a compression tester).



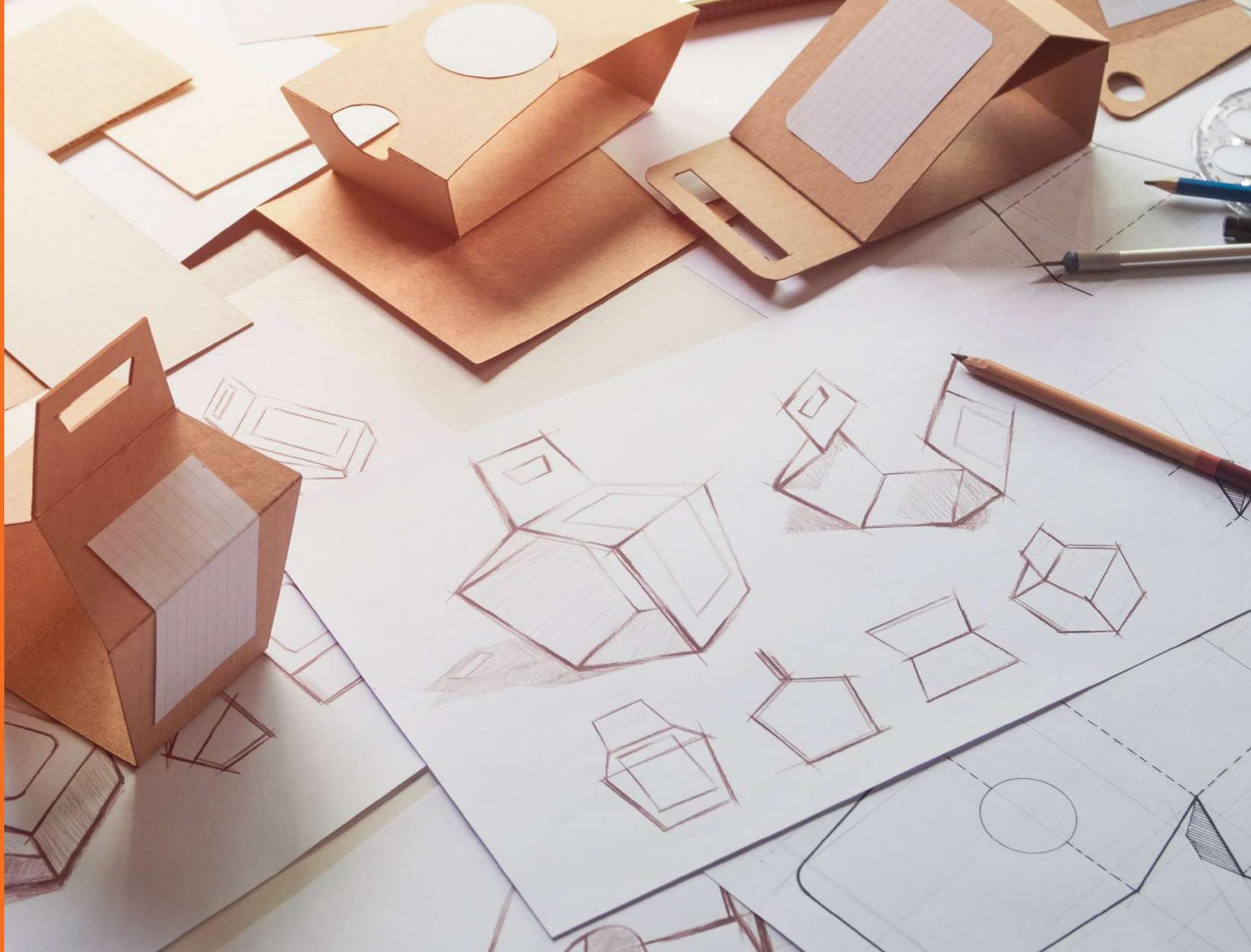
◀ **Fig 6.3**  
Compression Tester

**Table 6.3** below summarizes the tests required for specific materials. The list is non-exhaustive as it differs from one content product to another, depending on the content texture, chemical composition, nature, and so on.

TESTS	PACKAGING MATERIALS
COBB Test	Paper, Paperboard
GSM Testing	Paper, Paperboard (+ Lamination)
Puncture Resistance Test	Paper, Plastic Flexible Films
Thickness Test	Paper, Plastic Flexible Films, Foil
Dart Impact Test	Paper, Plastic Flexible Films, Foil
Torque Test	Plastic Rigid Caps, Tubes, Spout Bags
Ink Rub Test	Printing Ink on Paper and Plastics
Hot Tack - Heat Seal Test	Plastic Flexible Films (+ Lamination)
Leak Test	Plastic Flexible Films, Pouches
Elmendorf Tear Strength Test	Paper, Plastic Flexible Films
Compression Test	Cardboard boxes, Plastic Drums
Water Vapour Transmission Test	Plastic Flexible Films
Gas/Oxygen Transmission Test	Plastic Flexible Films

**Table 6.3**  
Packaging  
Tests by  
Material

In the event of a test not being available at the PTC, the PTC is able to outsource it by carrying out the test internationally with accredited laboratories and submitting a certified testing report to the customer (SME).



## CHAPTER 7



# PACKAGING DEVELOPMENT PROCESS

**Below** are a few tips and key questions that could be of assistance in daily challenges concerning packaging materials and their interaction with content. The next time a new product launch is in progress, the following questions can be asked to facilitate more effective brainstorming:

- ◆ **Packaging Materials:** What material will allow for maximum product freshness and protection?
- ◆ **Packaging Conception:** Which flexible or rigid material can best accommodate the product? How much space do I need on the side of the packaging for labelling?
- ◆ **Ease of Shipping:** How can shape and size help to enable my product to be easily shipped to retailers?
- ◆ **Ease of Storage and Distribution:** Will the product be stored for a long or short period of time before going on display?
- ◆ **Shelf Life:** How long might the product sit on the shelf at retailers before consumption?
- ◆ **Information:** What are the different ingredients, nutritional facts, product benefits, consumer warnings, brand identities and product instructions?

For optimal product packaging, the seven packaging development steps listed below can help to create the most suitable and harmonized packaging and product system. Implementing these seven steps would help to overcome most of the challenges and limitations involved in packaging products:

## Step 1: Project Initiation - The Brief

This stage includes defining the main goal of the new packaging project; assembling a project team and assigning its members with roles; and agreeing on a project timeline, critical success factors, milestones, assumptions and possible risks. At the 'brief' stage, several questions are asked, such as:

- ☑ What is the product I need to pack?
- ☑ What are the different physical and chemical properties of the product?
- ☑ What are the main target markets and audiences?

## Step 2: Identify Packaging Concepts

This stage includes some brainstorming sessions, creative thinking activities and field trips to explore what exists in the market in terms of packaging ideas and designs. At this stage, some initial sketches of the packaging are carried out and a few questions are asked to help narrow down the project goal, such as:

- ☑ What are the different properties the packaging requires?

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- ☑ What is the upper limit of my budget for the packaging and product system?
- ☑ Which packaging materials would I like to use in this packaging?
- ☑ What are the different packaging materials and labelling regulations I have to follow to avoid potential fines and to allow for better export operations?

Once some packaging ideas have been generated, they should be ordered by priority (high, medium and low)

### Step 3: Feasibility Assessment

At this stage, the packaging concepts that have been generated are analysed for technical feasibility, and a cost study is carried out by taking the following questions into account:

- ☑ What is the cost of the packaging materials used in the new packaging concept (type and weight of packaging material)?
- ☑ What are the different operational and production costs for each concept (taking machinery and automation costs into consideration)?
- ☑ What are the different transportation and logistical costs that each concept entails?



- ☑ Which packaging concept is more likely to reach the target audience?
- ☑ Which packaging concept best matches the initial packaging brief drawn up in stage 1?
- ☑ How can I extend the shelf life of my product?
- ☑ What are the different risks that I might encounter if I choose this specific concept?

### Step 4: Concept Development Consumer Testing

This stage involves reaching out to the target audience with packaging prototypes, photos and images of several concepts. Employing a statistical approach will help in choosing the most appropriate concept for a given target market. Consumer testing can be done through mall intercepts, phone interviews, focus groups, market tests and door to door surveys, etc.

## Step 5: Final Concept Evaluation

This stage includes the determination of the best packaging concept, taking the following questions into account:

- ☑ Which concept received the highest score from the audience?
- ☑ Which concept matches the product requirements and pre-assigned budget?
- ☑ Which concept was the best at extending the product's shelf-life?
- ☑ Which packaging idea was the most environmentally friendly?
- ☑ Which concept is the most technically optimized and easiest to manufacture on the production line, taking the lowest cost possible into consideration (labour, supplies, materials, utilities, etc).

## Step 6: Packaging Testing Proving Functionality

At this stage, the final performance criteria are defined for packaging, and physical packaging materials tests to be carried out are determined in order to verify that

the packaging engineering parameters are in line with international regulations (ASTM, TAPPI or ISO). Packaging testing includes checking:

- ☑ Barrier properties (water vapour transmission rate, oxygen/gas transmission rate, etc.)
- ☑ Optical properties (opacity, colour density, glossy appearance, etc.)
- ☑ Mechanical properties (puncture resistance, hot tack sealability, tear strength, etc.)
- ☑ Distribution and storage testing (vibration, physical shock, environmental conditions, etc.)
- ☑ Packaging machineability (how the packaging will perform in the manufacturing facility, from initial resources to final assembly)
- ☑ Retail and consumer concerns (shelf height, on-shelf packaging stability, packaging colours under store lights, ease of opening, evidence of tampering, etc.)

## Step 7: Packaging Launch

Once all the previous stages have been successfully completed and all packaging parameters have been identified and solved, the packaging project concludes with the official launch of the new packaging concept.



# RECOMMENDATIONS

Below are recommendations and guidelines of particular utility for local manufacturers, converters or distributors in Sri Lanka as it will serve as an important reference document for product development and the selection of an optimal packaging material. With regard to packaging-related technical problems, direct contact with recommended entities in this guidebook would facilitate this process:

- ◆ **It is strongly recommended that all interested users and manufacturers in Sri Lanka get in contact with the national Packaging Testing Centre based at ITI premises in Colombo to discuss technical issues related to products and processes. The consultancy sessions at PTC would facilitate the diagnosis of a problem such that the client would be able to choose an optimal packaging solution for the product in question.**

- ◆ **It is recommended to participate in all packaging-related workshops, training sessions and certifications that are administered locally in Sri Lanka and even internationally to keep up-to-date with latest packaging technologies worldwide. Finally,**
- ◆ **we would like to emphasize on the importance of keeping up-to-date on local and international regulations concerning packaging material and labelling requirements. This will undoubtedly help you to bear many factors in mind when choosing the packaging material for the product to be marketed, in particular when it comes to packaging design and efficiency.**





## ANNEX 1

### ANNEX 1

# ROADMAP FOR ENHANCING A PTC IN SRI LANKA

#### A. SAARC PACKAGING TESTING CAPACITIES

It is worth mentioning that SAARC, like the EU, is a target export market to which SME beneficiaries are being supported within the framework of the EU-Sri Lanka Trade-Related Assistance project. At present, there are no packaging materials testing requirements for products exported to SAARC countries (Sri Lanka, Bhutan, Afghanistan, India, Pakistan, Nepal, Bangladesh and the Maldives). It is important to note that only India and Sri Lanka have local packaging testing services.

India is part of SAARC and is a major player in this field. The Indian Institute of Packaging in Mumbai is equipped with a fully-fledged laboratory for

packaging material testing. The laboratory includes the following equipment:

- Tensile - universal testing machine
- Spectro-photometer
- Optical density tester
- Oxygen head space analyser
- Digital-based thickness tester
- Gloss meter
- Differential scanning calorimeter
- Water vapour transmission rate analyser
- Oxygen transmission rate analyser
- Co-efficient of friction tester
- Torque tester
- Smoothness and porosity tester
- Scuff proofness tester
- Viscosity tester
- Melt flow index tester
- Folding endurance tester
- Bursting strength tester (paper & paper Board)
- Stiffness tester
- Hot tack strength tester
- Salt spray chamber
- Rain chamber
- Climatic chamber
- Inclined impact tester
- Vibration tester (mechanical and microprocessor-based)
- Drop tester
- Compression strength tester
- Drum tester
- Haze meter
- UV chambers
- Xenon weather o meter
- Energy X-ray spectrometer
- Verticality tester
- Puncture resistance tester
- Tear strength tester
- Carbon black content tester
- Muffle furnace
- -180 C walk-in chamber
- IBC tester

Private testing centres, such as TUV-NORD India and SGS India, also have well-established testing facilities in India that service the region.

As regards suppliers of packaging material testing apparatus and equipment, India is also a key player as their suppliers compete with European equivalents. These suppliers include PackTest (Gujarat - India), Texcare Instruments (Delhi - India), EIE Instruments (Gujarat - India), Presto Testing Instruments (Delhi - India), Asian Test Equipment (Uttar Pradesh - India), Saurashtra Systopack PVT (Mumbai - India) and many others.

Consequently, at this stage and following in-depth research, SAARC has neither regulations nor specific requirements involving packaging materials testing. Most of the SAARC members, excluding India, do not even have local-specific requirements for packaging testing standards.

As a result, the rest of this study will focus on EU - Sri Lanka export operations and the main requirement of having packaging materials tested before exportation to the EU. Therefore, under UNIDO has guided the establishment a national PTC in Sri Lanka. The following draft roadmap will guide this endeavour.

## B. STAKEHOLDERS INVOLVED

Research was performed to obtain a list of the main stakeholders involved in the food packaging sector and its related activities in Sri Lanka. The aim of this research

is to make sure that all entities involved locally in food packaging are assessed and well-studied throughout the project in order to eventually nominate the right candidate for the establishment of the Sri Lanka PTC. In the field visits carried out in Colombo, Sri Lanka in November 2017, the organizations listed below were identified as those whose facilities could potentially be used as a base for the national PTC. Further parameters and analysis will determine which of these main potential candidates for the PTC project will be chosen:

- ☑ Industrial Technology Institute (ITI)
- ☑ Sri Lanka Institute of Nanotechnology (SLINTEC)
- ☑ Industrial Development Board (IDB)
- ☑ Lanka Fruits & Vegetable Producers, Processors & Exporters Association (LFVPPEA)
- ☑ Export Development Board (EDB)
- ☑ Sri Lanka Food Processors Association (SLFPA)
- ☑ Sri Lanka Institute of Packaging (SLIP)
- ☑ Sri Lanka Standards Institution (SLSI)

### STAKEHOLDERS SERVICES

#### Industrial Technology Institute (ITI)

The ITI is an entity of the Government of Sri Lanka and operates under the jurisdiction of the Ministry of Education. Their services include:

- ☑ Research and development
- ☑ Laboratory testing (packaging materials, microbial and chemical testing)
- ☑ Quality management consultancy

#### Sri Lanka Institute of Nanotechnology (SLINTEC)

The SLINTEC board consists of 15 directors from the Government of Sri Lanka and the private sector. Their services include:

- ☑ Nanoscience-related testing activities
- ☑ Laboratory testing (packaging materials, electrical, chemical and mechanical testing)

#### Industrial Development Board (IDB)

The IDB is a statutory body under the Ministry of Industry and Commerce. Their services include:

- ☑ Engineering workshops
- ☑ A robotics facility and projects
- ☑ Training programs for food processing and building materials
- ☑ Production of raw rubber materials and metal casting finishing
- ☑ Skill development programs and consultancy

#### Lanka Fruits & Vegetable Producers, Processors & Exporters Association (LFVPPEA)

The LFVPPEA was established in 1986 to create a single platform for all the stakeholders involved in the supply chain for the export of fruit and vegetables, both fresh and processed. Their services include:

- ✓ Increasing the production of crops with high export potential through improved agricultural productivity
- ✓ Reducing post-harvest losses
- ✓ Improving the quality and safety of available production
- ✓ Connecting producers and buyers
- ✓ Facilitating imports and exports

#### **Export Development Board (EDB)**

The EDB is Sri Lanka's leading organization for the promotion and development of exports and was established in 1979 through the Sri Lanka Export Development Act No. 40. EDB is the executive arm of the Export Development Council of Ministers, which is the policy-making body of the EDB. Their services include:

- ✓ Export promotion
- ✓ Holding trade shows
- ✓ Training workshops
- ✓ Publishing tenders
- ✓ Dissemination of trade information
- ✓ Publications

#### **Sri Lanka Food Processors Association (SLFPA)**

SLFPA was founded in 1997 as an advocacy group of the Sri Lanka Food Processors Association and consists of over 95 member companies. Their services include:

- ✓ Members participating in international food and beverage fairs
- ✓ Advisory and consultancy services

- ✓ Marketing and promoting members' products
- ✓ Organizing national food and beverage events
- ✓ Providing information to members
- ✓ Conducting training programs and workshops

#### **Sri Lanka Institute of Packaging (SLIP)**

The SLIP was inaugurated in February 1975 with the assistance of the export promotion secretariat. The formation of this institute was the result of a mission carried out in March 1974 by Johan Selin, the ITC functional adviser on export packaging. SLIP is an association of private and public sector organizations and their services include:

- ✓ Workshops and training
- ✓ Packaging consultancy
- ✓ Packaging courses

#### **Sri Lanka Standards Institution (SLSI)**

SLSI is the National Standards Body of Sri Lanka, established under the Bureau of Ceylon Standards Act No. 6 of 1984. The Institution operates under the Ministry of Science, Technology and Research and is governed by a council appointed by the minister. By virtue of being the national standards body in Sri Lanka, SLSI is a member of the Geneva-based International Organization for Standardization (ISO). Their services include:

- ✓ Certification (ISO 9001, ISO 14001, HACCP, Vegetarian, GMP, ISO 50001, OHSAS 18001, ISO 22000)

- ✓ Diploma in Quality Management
- ✓ Food safety management systems
- ✓ Training and workshops for SMEs
- ✓ Producing national standards
- ✓ Laboratory tests for textiles, packaging, chemicals, building materials and microbial and electrical testing.

### **C. LOCAL VISITS IN SRI LANKA: GENERAL FINDINGS OF THE MEETINGS**

The main findings of the visits made to several stakeholders and meetings held with many SMEs (owners, directors, secretaries-general and presidents) are listed below. UNIDO local project team members accompanied the visits.

- ✓ SMEs are experiencing difficulties in export operations due to materials testing to be done outside Sri Lanka, encountering delays and being charged high costs.
- ✓ The need to have a local testing entity is becoming pressing.
- ✓ A few large companies have their own testing facilities, but they are private and non-accredited.
- ✓ There is a need for a packaging diploma in Sri Lanka, and consequently graduates in the packaging field.
- ✓ In most of the entities that have packaging testing machines, the equipment is relatively outdated and needs upgrading.

- ✓ Expertise in packaging functions is generally needed nationwide.
- ✓ Regulations should cover packaging materials testing in order for SMEs to maintain high standards and meet global requirements.
- ✓ High level of concern regarding demand vs. export vs. material testing services.
- ✓ Pull economy vs. push economy.
- ✓ SME owners need better managerial capabilities and improved entrepreneurial potential
- ✓ SMEs need access to markets and better links with local and foreign value chains, subcontracting, etc.
- ✓ SMEs rely on domestic markets, and exportation is still not fully exploited.
- ✓ SMEs lack product compliance with high standards and innovation.



The table below summarizes the capacities of different stakeholders, considering all the necessary parameters for establishing a PTC:

STAKEHOLDER	FACILITY	EXISTING MANPOWER	EXPERTISE IN TESTING	CONNECTIONS TO SMES	FACILITY LOCATION	EXISTING TESTING EQUIPMENT	ACCREDITATION
ITI	yes	yes	yes	yes	Colombo	yes	yes
SLINTEC	yes	yes	limited	no	Homagama	Very limited	no
IDB	possibly	no	no	yes	Colombo	no	-
LFVPPEA	no	no	no	yes	-	no	-
EDB	possibly	no	no	yes	Colombo	no	-
SLFPA	no	no	no	yes	-	no	-
SLSI	yes	yes	limited	yes	Colombo	limited	yes
SLIP	no	no	no	yes	-	no	-

The following analysis will use the findings and summary above in order to prioritize and nominate potential candidates for establishing the PTC. The requirements and basic parameters for establishing a PTC will be further detailed in the following sections.

#### D. LOCAL TESTING CAPACITIES OF STAKEHOLDERS

According to the findings above, the packaging materials testing capacities of ITI, SLINTEC and SLSI are listed below.

#### ITI Packaging Materials Testing Capacities.

- Tensile strength tester
- Box compression machine
- Bursting strength tester
- Water penetration tester
- Water vapour transmission apparatus
- Temperature/humidity chamber
- Thickness gauges
- GSM testing apparatus
- Puncture resistance apparatus
- Porosity measurement apparatus
- FTIR spectrophotometer
- GS-MS

#### SLINTEC Packaging Materials Testing Capacities:

- Compression tester
- Tensile strength tester
- Plastic material extruder testing

#### SLSI Packaging Materials Testing Capacities:

- Cobb tester
- Tensile strength tester
- Bursting strength tester
- Elmendorf tear tester

In addition to the above tests, it should be noted that SLSI is the only local entity with established local packaging standards from 1979 to 2013. There are currently 30 standards, listed in Annex I.

### E. GENERAL PTC REQUIREMENTS AND EQUIPMENT REQUIRED

Generally, when choosing the most suitable entity for establishing the PTC, and in order to be efficient in terms of project delays, time limits, allocating funds, generating results, and achieving the mission, **the following factors should be prioritized:**

1. Existing facilities and infrastructure
2. Existing testing equipment (total number is an asset)
3. Existing expertise in packaging materials testing
4. Existing staff/manpower (to be trained if required)
5. High accessibility to SMEs (to enable easy promotion)
6. Location of the facility (easily accessible / strategic point)
7. Easily acquired accreditation
8. Governmental support (regulatory)

The list below includes the majority of the packaging materials testing equipment and apparatus that should be present in the PTC:

- Peel/tensile tester – universal machine
- Box compression tester
- Mullen bursting strength apparatus
- Water vapour permeability tester

- Gas/oxygen permeability tester
- Environmental chamber
- Thickness micrometre
- Colorimeter
- GSM testing apparatus
- Puncture resistance tester
- Porosity measurement apparatus
- FTIR spectrophotometer
- GS MS and HPLC
- Cobb tester
- Dart impact tester
- Ink rub tester
- Torque tester (caps/closures)
- Heat seal tester
- Leak tester
- Drop tester

In the long term, the PTC should be an entity where testing services represent one activity out of many others. The PTC should eventually cover the complete functions of packaging, becoming a **one-stop-shop** entity that includes: Consultancy for SMEs, R&D, packaging, structural and graphic design, workshops and training courses, and so on. The eventual aim of the PTC is to expand its activities and deliver parallel services to SMEs.

### F. POTENTIAL CANDIDATES FOR ESTABLISHING THE PTC

Following sections 2.2 and 2.3, the main stakeholders involved in food and spice packaging materials are ITI, SLSI and SLINTEC. Based on the requirements in section 2.4 for a successful PTC, the nominated candidate is ITI.

SLSI is ranked in 2nd place as a potential candidate for the PTC project. In the event of the demand for testing increasing in the future, SLSI would certainly be considered for a second PTC project in Sri Lanka to meet

the demands of local SMEs. Consequently, the ITI facilities are recommended for the establishment of the future PTC at its premises and will be supported by the EU-Sri Lanka Trade-Related Assistance project under ER 4.3

The subsequent action plan will focus on ITI as the only potential candidate for the PTC project.

### **G. WORKSHOP AND FINAL VALIDATION**

A workshop concerning the PTC was held on 27 November 2017 in the ITI auditorium, and organizations from the public and private sectors were invited.

## **REFERENCES**

### **ONLINE REFERENCES**

- Academia for Education. (n.d.). Retrieved July 3rd, 2019, from [http://www.academia.edu/6779366/Food\\_Packaging\\_and\\_Shelf\\_Life\\_A\\_Practical\\_Guide](http://www.academia.edu/6779366/Food_Packaging_and_Shelf_Life_A_Practical_Guide)
- COBRO - Packaging Research Institute. (n.d.). Retrieved May 1st, 2019, from <http://www.cobro.org.pl>
- Codex Alimentarius, International Food Standards. (n.d.). Retrieved May 20th, 2019, from <http://www.fao.org>
- Design Hill Scientific Blog. (n.d.). Retrieved May 1st, 2019, from <http://www.designhill.com/design-blog/inspirational-packaging-design-trends/>
- EcoSign Project. (n.d.). Retrieved June 29, 2019, from <http://www.ecosign-proiect.eu>
- Eurofins Scientific. (n.d.). Retrieved May 1st, 2019, from <https://www.eurofins.com>
- European Commission. (n.d.). Retrieved April 15th, 2019, from <https://ec.europa.eu/>
- European Union Law. (n.d.). Retrieved April 26th, 2019, from <https://eur-lex.europa.eu/>
- Food Packaging Labels Online Services. (n.d.). Retrieved May 25th, 2019, from <https://www.foodpackaginglabels.net>
- Government Analyst's Department of Sri Lanka. (n.d.).

Retrieved May 1st, 2019, from <http://www.analyst.gov.lk>

Intertek Company. (n.d.). Retrieved May 1st, 2019, from <http://www.intertek.com>

LabThink WPO Corporate Partner. (n.d.). Retrieved May 11, 2019, from <http://en.labthink.com>

SGS Testing Laboratories. (n.d.). Retrieved May 1st, 2019, from <http://www.sgs.co.uk>

TAPPI International Standards. (n.d.). Retrieved May 3rd, 2019, from <https://www.tappi.org>

The National Academies Press. (n.d.). Retrieved May 1st, 2019, from <http://www.nap.edu>

US Food and Drug Administration. (n.d.). Retrieved May 16th, 2019, from <https://www.fda.gov>

Wellkang® Tech Consulting. (n.d.). Retrieved May 3rd, 2019, from <http://www.ce-marking.org>  
EcoSign Project. (n.d.). Retrieved June 29, 2019, from <http://www.ecosign-proiect.eu>

## INTERNATIONAL PUBLICATIONS

Berryman, P. (2014). *Advances in food and beverages labelling* (1st ed.). Oxford, UK: Woodhead Publishing. Retrieved May 2nd, 2019

Boylston, S. (2009). *Designing sustainable packaging*. Laurence King Publishers.

Calver, G. (2007). *What is packaging design?* Rotovision Publishing.

DeMaria, K. (2000). *The packaging development process*. Technomic Publishing Co.

DuPuis, S., & Silva, J. (2008). *Package design workbook*. Rockport Publishers.

Schueneman, H. (2003). *Paper and corrugated paperboard*. Retrieved from <http://www.yumpu.com/en/document/read/12421616/paper-and-corrugated-paperboard-westpak-inc>

Singh, P. (2017). *Food packaging materials: testing & quality assurance*. CRC Press. Retrieved May 11, 2019, from <http://www.routledge.com/Food-Packaging-Materials-Testing--Quality-Assurance/Singh-Wani-Langowski/p/book/9781466559943>

Soroka, W. (2009). *Fundamentals of packaging technology* (4th ed.). Institute of Packaging Professionals.

Soroka, W. (2009). *Glossary of packaging terminology* (2nd ed.). Institute of Packaging Professionals.

## PACKAGING FUNDAMENTALS GUIDE

CHOOSING THE RIGHT PACKAGING FOR  
YOUR PRODUCT HAS NEVER BEEN EASIER!



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