Ingenious e-Brain

Nurturing Innovations - Fostering Business

# Disruptive Technology Trends

## Packaging Sector

January 08, 2021

# Top 10 Technology Disruptive Trends in Packaging Domain

*IEBS has identified the top 10 disruptive technology trends in the packaging sector for 2021*

- Recycling has been in the industry for decades. However, the 3 –R model reduces, reuse, and recycles still a part of the sustainability movement.
- With over 400 organizations signing New Plastic Economic Global Commitment, companies have committed to increasing their recycling packaging by 25% by 2025.

**Recycled Packaging**

- Digitalization is responsible for upgrading the packaging sector with the integration of various technologies like the internet of things (IoT), robotics automation, etc., across multiple stages, including warehouse management, manufacturing, etc.
- Through connectivity and digital accuracy, it can ease the burden of staff oversight and improve efficiency.

**Integration of Digital Solutions (Internet of Things/Robotics)**

- Minimal packaging is becoming increasingly popular among consumers due to growing concerns about the environment. Consumers prefer products without extra wrapping and packaging.
- They prefer labels with only relevant information on the product.

**Minimalized Packaging**

- Biodegradable packaging is increasingly finding adopted in various industries due to its lower environmental impact.
- These solutions can enable natural degradation without the need for a catalyst.
- Meeting requirements towards reducing waste to counter the environmental impact.

**Biodegradable Packaging**

- 3d printing, also known as additive manufacturing, is a great benefit to improve the manufacturing process by enabling the rapid prototyping of machine parts.
- Additive technology can help in producing robotic arms for use in the packaging process.

**3D Printing**

- Digital printing contributes to making customized packaging much more comfortable by adding personalization to the product.
- The personalized packaging allows individuals to identify with a brand's product.
- It can prove to be an innovative way of building the brand image.

**Personalized Packaging**

- Advancement in e-commerce packaging results from growing consumer preference towards online purchasing due to the ease and convenience it provides to its customers.
- It can replace the primary packaging which contributed to gage customers at retail outlets.

**Evolution of E-commerce Packaging**

- Smart packaging plays a significant role in improving user safety about perishable products.
- For example, badge technology applied to product labels helps detect a product's $CO_2$ level indicating the freshness of food product for its consumption.

**Smart Packaging (QR codes, RFID, sensors, etc.)**

- Antimicrobial agents help improve the quality of the packaged food products and reduce the use of additives and preservatives in packaged products.
- Growing consumption for short shelf-life products is resulting in the growth of the antimicrobial packaging market.

**Antimicrobial Food Packaging**

- Nanoparticles are mixed with polymer chains to improve the gas barrier properties and temperature and humidity resistance of packaging.
- Nanoparticles can alert consumers about the safety of the product.
- It can also release preservatives in the food to improve its shelf life.

**Use of Nanotechnology in Packaging**

# 1. Recycled Packaging

## *Shifting consumers focus on recycling packaging*

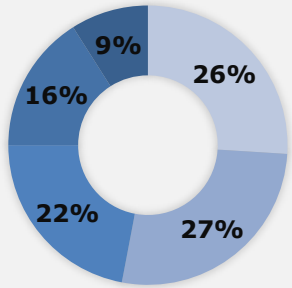
•Recycled packaging is the most convenient way to achieve **a sustainable** and circular packaging system. Public authorities and consumers are focused on sustainable packaging in which they are more concentrated on **recycled packaging**.

•Recycling of packaging materials has seen **rapid expansion** over the last decades in several countries. Advances in technologies and systems for **collecting, sorting, and reprocessing recyclable materials** are creating **new opportunities** for recycling.

**Impact of Recycled Packaging on Packaging Sector**

### Impact on Consumers

**Consumer's Willingness to Pay for Recycled Packaging**




**Extra Cost of Recycled Packaging**

- 0%
- 2.5%-5.0%
- 5.0%-10%.0
- 10.0%-20.0%
- More than 20%

Source

### Packaging Players Initiatives to Promote Recycled Packaging


### Regulations Supporting Recycled Packaging

| Regulation | Country | Recent Steps |
|---|---|---|
| **Focus on optimizing recycling** | Australia | Target of 100% recyclable compostable packaging |
| **Legislation favors recyclable packaging** | India | Focused on increasing collection point |
| - | China | Proposal to ban single-use plastic by 2022 |
| **Bans on Non-Recyclable plastic bag** | U.S. | Bills for reducing single-use plastic |
| **Packaging and Waste Directive** | - | Ban on selected single-use plastic |

•**#1 -** A survey conducted by **Trivium Packaging** in the **U.S., Europe, and South America** in April 2020 shows that nearly **1/3rd consumers** are **willing to pay extra cost** for **recycled packaging,** indicating shifting focus consumers towards recycled packaging across the developed economies.

•**#2** - For instance, **buyback model** promotes consumer to bring **post consumed packaging** to **the collection point** to ensure easy recycling and **consumer** gets rewards in return. This model is prevalent among consumers in the **U.K., Norway, and Australia.**

•**#3 - Regulatory framework** of various countries is also focused on promoting recycled packaging by **banning single-use plastics**, regulatory favors to recycled packaging, and other means.

•**#4 -** Several initiatives by packaging companies, regulatory policies, and evolving consumer preferences indicate that **the recycling packaging** trend is disruptive in the packaging domain.

# 2. Integration of Digitalized Solutions (Robotics, AI, IoT, etc.)

## *Digital Era Transforming the Packaging Sector*

The **packaging industry** is undergoing a **profound transformation** by integrating various **digital technologies** like **artificial intelligence (AI), the internet of things (IoT), robotics automation,** etc. For instance, the **interconnectedness of machinery and materials** and **the sharing of real time data** can drastically affect the **efficiency** and the **evolution** of the product. One of the critical **potential areas** in the **packaging sector** is **warehouse management**.

**Impact of Digital Solutions on Packaging Sector**

### Impact of Digital Technologies in Warehouse Management

**IoT in Warehouse**

- Improved connectivity and digital accuracy
- Ease the burden of staff oversight and improve efficiency

**Robots in Warehouse**

- Minimize dangerous tasks for workers
- Reduces risk of contamination
- Reduced cost and improved output

**Artificial Intelligence in Warehouse Management**

- Temperature management for sensitive products
- Initiating lockdown in case of security risk and oversee inventory

### Impact of Integration of Robotics in Packaging Sector

**Flexibility**

- In the case of robotics, an operator can quickly change the outline for a case or pallet with a simple click of a button, which otherwise takes longer if done manually.

**Enhanced Productivity**

- Reduced labor and safety cost along with the ability of a robot to perform multiple tasks in far lesser time and greater accuracy

**Minimal Maintenance**

- Robots are tireless and thus require minimal maintenance. It can work at high speed for 70,000 hours or more before requiring mechanical failure maintenance or chance.

### Impact of Artificial Intelligence (AI) in Driving the Packaging Industry Forward

- AI Integration in packaging helps in improving system efficiency by **detecting 90% more defects than humans.**

**Improved Efficiency**

- AI helps in **environmental footprint reduction** and helps attain sustainability, a key trend in the packaging sector.

**Reduced Footprint**

- AI helps in **predicting demand** and **consumption**. For example, weather data helps in **improving food supply efficiency** by **reducing** avoidable **food losses.**

**Reduced Losses**

# 3. Minimal Packaging

## *Using minimal packaging material to ensure environment safety*

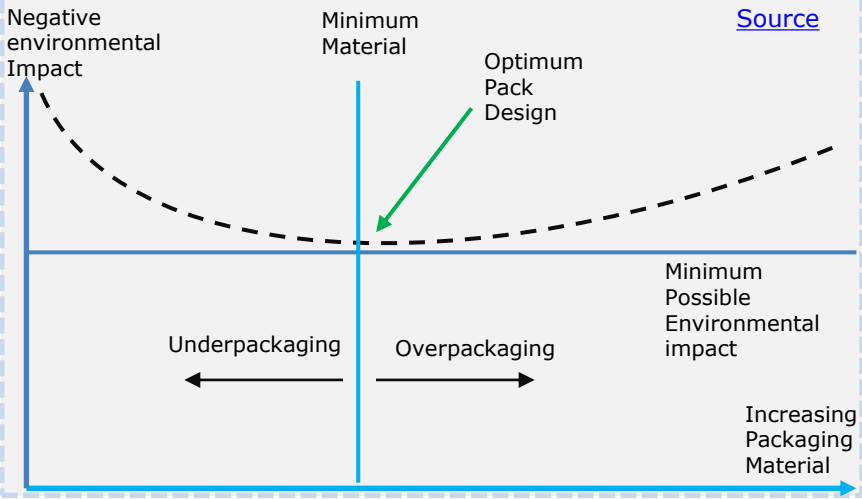
- **Minimal packaging** or reduction in packaging material has become progressively popular while talking about **sustainable packaging**, especially in **the food and beverages** industry.
- Many influencers in the industry have pointed to **Millennials** as the biggest reason for the increase in Minimalism in packaging.

Millennials often choose brands that **are eco-sensitive, plain-spoken, and focused on simple and natural ingredients**.

- The motto of Minimalism is "omit needless things." For consumer packaging, this would entail paring down packaging materials and the visual aspects of the design.

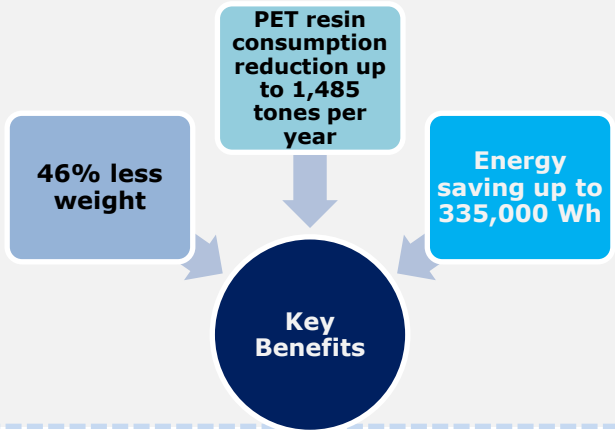
**Impact of Minimal Packaging on Packaging Sector**

### Impact on Environment




### Packaging Players Innovation

**Sidle's X-Lite – 500 ml PET Packaging for Still Water**




### Benefits of Minimal Over Traditional Packaging

**Minimal Packaging**

- Light weight
- Low Raw Material Consumption
- Up to 70% lesser space required
- Easy Disposal

**Traditional Packaging**

- Heavy Weight
- High raw material consumption
- Large amount of storage space required
- Difficult to dispose

### Increasing Recycling Efficiency

**Reducing Adhesives**

Minimal packaging allows companies to remove additional graphics colors and other packaging content, which reduces adhesives, making the recycling process more manageable, convenient, and reducing the economic burden.

**Easiness for Sorting**

Minimal packaging eliminates the label or other additional items from packaging, which helps determine the material type for both manual and automated recycling plants, saving time, effort, and energy during recycling and increasing recycling efficiency.

# 4. Biodegradable Packaging

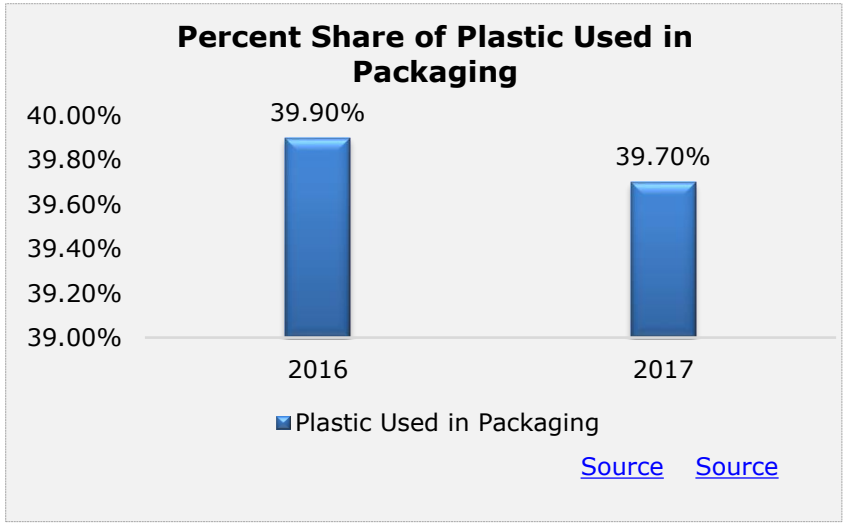
## *Eliminating the plastic waste from the environment*

•Widespread use **of plastic packaging** has resulted in a staggering amount of **plastic waste and pollution** in the human-made and natural environment. This is majorly due to the **challenges** associated with conventional **plastic degradation. Biodegradable** packaging is the most suitable **way** to tackle **waste** and **pollution** due to plastic packaging.

•They can be easily degraded in the environment with the action of microorganisms. Thus, they are **increasingly used** in the form of **packaging** for reducing traditional **plastic consumption**.

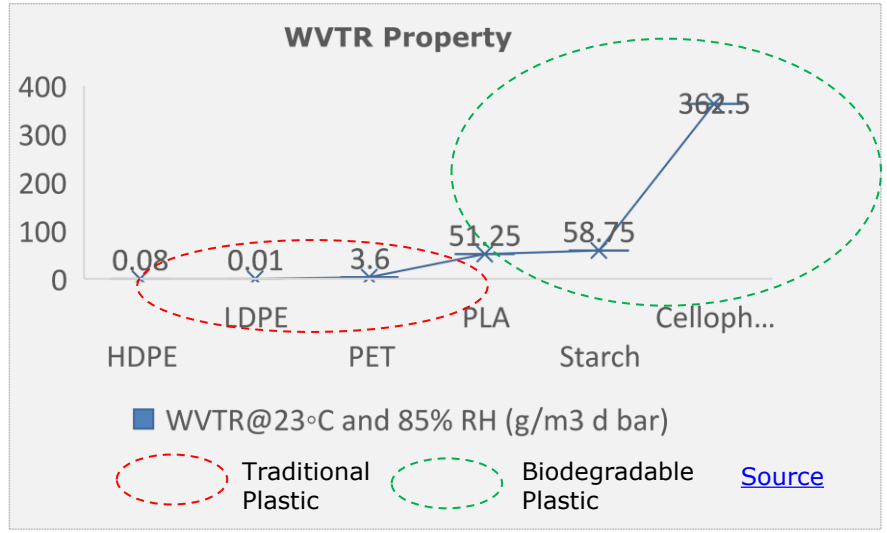
## Impact of Biodegradable Packaging on Packaging Sector

### Impact on Industry




•**#1 -** The **decrease** in demand for **plastic packaging** shows the industry's shifting trend towards **biodegradable packaging**. This shift of packaging material is the result of **awareness** towards the s**ustainability** of packaging material.

### Barrier Property Benefits




**#2 -** The study conducted by **Wageningen University and Research** on **water vapor transmission resistance** of traditional plastic and biodegradable plastic shows the advancement of **biodegradable plastic properties,** which is more moisture resistant and highly useful in packaging industry specially for food & beverages and pharmaceutical industry packaging.

### Regulations Supporting Biodegradable Packaging

The EU's commitment to the circular economy model in Europe has accelerated the growth of the bioplastics industry in Europe


In 2018, the European institutions adopted a revised EU waste package that encourages member States to support biodegradable packaging.

Waste Framework Directive allows biodegradable packaging to be collected with the bio-waste and recycled in industrial composting and anaerobic digestion.

**#3 -** Regulatory framework of **the European Union,** such as commitment to the **circular economy,** shows **governing authorities' inclination** towards **biodegradable Packaging.**

# 5. 3D Printing

## *Achieving Sustainability through 3D Printing in Packaging Sector*

•3D printing technology helps companies make **environment-friendly packaging** as it plays a critical role in **reducing plastic pollution. In** this case, waste can be cleaned, dried, shredded, and extruded into a printable filament that can again be recycled into a 3d printer for a **new product.**

•Generating less waste is environmentally friendly as well as **economical**.

### Impact of 3D Printing on Packaging Sector

#### Benefits Offered by 3D Printing Technology in Packaging Sector

**Potential Cost Reduction**

- 3D Printing is far more efficient at producing packages than any other current method.
- Uses minimal material and gives greater output
- Cost of 3d printing may go down with growing adoption in the future.

**Quicker Prototyping Process**

- It makes the manufacturing process more efficient by saving on material and labor as different packaging models prepared by designers can be prototyped using 3d printer and allow designers to fine-tune and refine their packaging.

**Easy Recycling and No Waste of Material**

- 3d printing generates no waste
- Does not require separate processes for creating packaging and adding printing.
- Experimenting with different materials like plastic, nylon, metals, wax, etc., is possible.

#### 3D Printing Contribution towards Packaging – Use Cases

**1. 3D printing helped Pepsi in developing an advanced design**

Global brand Pepsi used 3d printing technology to create a replica of the Black Panther mask for soda cans as a **promotional campaign**.

**2. Heineken used 3d printing to optimize manufacturing line.**

A well-known, brewery brand **Heineken** used Ultimaker's extrusion 3d printing technology to **save time and money** by customizing optimized **parts** and **tools** for its production line. For example, a metal can pusher used to reject and direct bottles, a **stopper tool** that applies bottle labels, etc.

#### 3d printing technology impact on packaging

•According to **Packaging Digest**, 3d printing packaging market is expected to make an **impact** of **USD 550 billion each year by 2025**. The potential impact of this technology is enormous, and companies are noticing it.

#### Adoption rate of 3d printing technology

•**66.7%** of manufacturers are **expected to adopt 3d printing** technology in some capacity, as indicated by PwC.

•In the next three years, 24.7% of manufacturers plan to adopt 3d printing technology.

#### 3d printing revolutionizing food packaging design prototyping

•**3d printing technology** can include full-color text and graphics. The necessary design changes (label, shape, content, etc.) can be incorporated very quickly compared to traditional methods.

# 6. Personalized Packaging

## *Providing customized solution to customers*

- Personalized packaging is custom packaging **featuring the name, image, or other customer's features**. Personalized packaging allows consumers, products, and companies to **make their unique package** versus standard packaging that is the same as any other.
- Personalized or customized packaging helps companies **add a personal touch, enabling companies** to connect **with customers**. This leads to brand loyalty and, eventually, higher revenues.

## Impact of Personalized Packaging on Packaging Sector

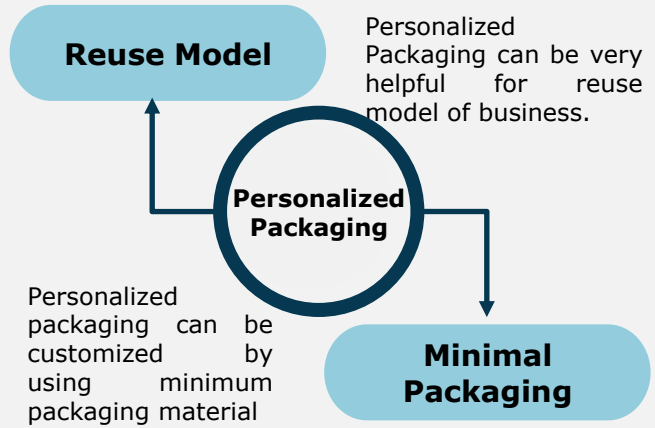
### Role in Marketing

| | |
|---|---|
| **Custom Packaging Sizes and Dimensions** | Personalized packaging can be designed to fit any shape and shape, which regular packaging does not provide. |
| **Technical Details** | Personalized packaging can help to provide technical details of product without using any additional label and adhesives. |
| **Brand Awareness** | Personalized packaging helps in increasing brand awareness. Personalized packaging enables products to be eminent from other products. |

### Role in Winning Customer

| Product Shelf Life | Making Customers Feel Special |
|---|---|
| Personalized Packaging can be made according to product shelf life and composition to remain safe for a long time. Thus, the customer will choose the product due to its freshness and quality. | Personalized Packaging can make customers feel special by adding their details and a special message on Packaging. This can be achieved by e-portals or specials orders |

### Achieving Sustainability




## Benefits in Multi-use Model and Subscription based Business

| | | |
|---|---|---|
| **Distinguished Empty Package Store** | **Personalized packaging** can be helpful in stand out alone in an empty package store for a multi-use model. The empty container can be sorted base on the product and easily transport to that product's warehouse. | **01** |
| **02** | **Personalized packaging** can help companies separate the customized product by adding the product and consumer details on the package, increasing efficiency by reducing the time in identifying a suitable place and logistic route. | **Personalized Product According to customer** |

# 7. Evolution of E-commerce Packaging

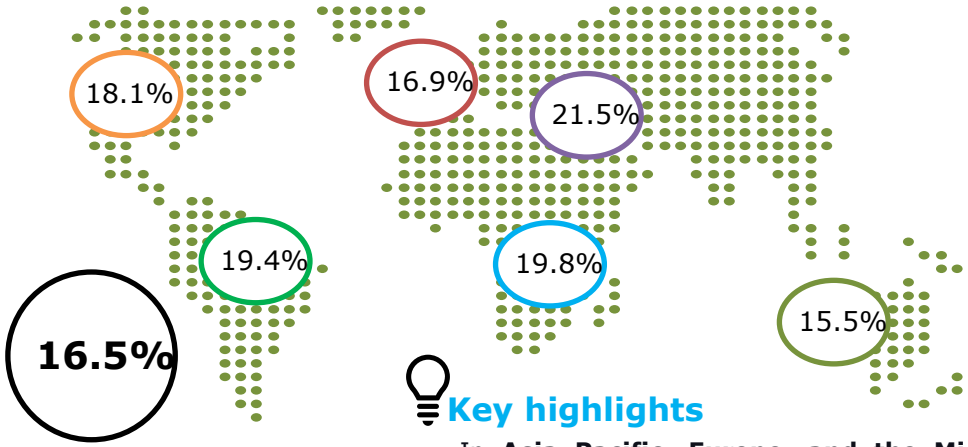
## *Improved online purchase triggered the e-commerce packaging*

•E-commerce sector was sailing on an all-time high in **2020** with the lockdowns, travel bans, and retail closure, which brought consumers online, and retailers started to follow. However, the companies were not entirely prepared to provide an excellent customer experience.

•Now, to compete in the marketplace, companies are planning to **enhance the customer's experiences** for online purchases, making a subsequent **positive impact on the e-commerce sector.**

## Impact of Growing E-commerce on Packaging Sector

### E-commerce Sales Growth, by Region, 2020




- North America
- Western Europe
- Central & Eastern Europe
- Middle East & Africa
- Asia Pacific
- Latin America
- Global

### Key highlights

•In **Asia Pacific, Europe, and the Middle East**, **growth** in e-commerce will be faster than in the U.S. in the **first half of the decade.**

•Nearly 150 million people shopped online for the first time in the **pandemic**, and the number of e-commerce buyers will continue to rise.

•The **packaging sector** has experienced positive gains with substantial growth in **e-commerce sales**.

Source

### Influence of E-commerce on Packaging Industry – Key Parameters

**Speed & Efficiency**

•Growing online sales has triggered the need to achieve **higher speed** for **packaging** and **printing** to ensure **a quick delivery.**

•With speed, **quality**, or packaging **efficiency** would be critically important for consumers to **receive right condition products.**

**Versatility**

•**Extensive packaging range** must be available to cope with the explosive growth in the e-commerce sector in 2020.

•**Corrugated boxes** availability in **various sizes** would be important as it offers strength, **high durability, and recyclability.**

**Automation**

•With strong growth in the e-commerce sector, those distributed to online customers had to incorporate or **develop systems** that use **automation** and **machine technology.**

•With **industry 4.0**, the possibility of **intelligent monitoring of machine** components providing the user with the status on work.

**Environment Friendly**

•With **growing online sales**, the need for **sustainable environment-friendly solutions** has also seen a rise, majorly the recyclable ones.

•Companies are encouraging the **optimum use of plastic,** which means **lesser packaging waste** and thus a le**sser impact on the environment.**

# 8. Smart Packaging (QR codes, RFID, etc.)

## *Smart solutions changing the brand's perception*

- Smart solutions like **QR codes, RFID, sensors, NFC technology**, etc., are amongst the **disrupting solutions** in the packaging sector. These solutions are responsible for instilling a positive effect on brand perception by catering to a larger audience.
- Increasing use of smartphones has triggered the concept of QR codes on the packaging. Upon scanning, it gives its consumers the details on the product offerings, including its **shelf life, composition, etc.** Smart packaging solutions also help in **preventing product piracy.**

### Impact of Smart Packaging Solutions on Packaging Sector

**Active Packaging – Provides Functionality like moisture and oxygen control – Sensor labels**


**Intelligent Packaging – Communicating product changes and other information using QR codes, Specialist bar codes, etc.**


**1. Coca Cola improved its customer engagement with QR codes**

The Coca-Cola Company

With QR codes scanned, customers were able to scan the following:

- Product's origin
- Content
- Loyalty programs
- Expiration dates/recipes/tutorials
- Coupon discount
- Closest point of purchase in case of repurchase

# 9. Antimicrobial Food Packaging

## *Ensuring proper safety measures for packaged food*

- Antimicrobial packaging is a type of **active packaging** that **prevents pathogenic microorganisms** on food products to remain **safe** for consumption for a long time.
- Antimicrobial packaging can be **achieved** by **coating** such **antimicrobial products** on packaging surfaces that are safe for food. The renewed **interest** in antimicrobial **packaging arises** from **consumer interest** in the quality and freshness of food.

## Impact of Antimicrobial Food Packaging on Packaging Sector

### Driving Factors

**Awareness of Food Waste**

Public Authorities and customers are now more concerned about reducing food waste; antimicrobial food packaging can increase the self-life of food by preventing microorganisms' growth. Thus, antimicrobial food packaging can help in a tackle with the problem of food wastage.

**Growing Demand of Sustainable Food**

Customers are now more focused on their health. That is why they seek sustainable food that must be free from chemical preservatives; antimicrobial food packaging can eliminate the use of chemicals in food and beverage for food safety. for achieving sustainable food.

### Additional Benefits

**Barrier Property**

Antimicrobial agents also have barrier properties against oxygen and moisture, which helps companies eliminate additional coating material on the packaging, thus its safe cost and time.

**Sustainability**

Most antimicrobial coating agents are biobased, which are either edible or biodegradable, and in this way, antimicrobial food packaging promotes both types of sustainable food packaging, edible and biodegradable.

### SilverShield by Microban

**Key Benefits**

**Efficiency** : Reduces up to 99.9% of *Salmonella enterica, E. coli*, MRSA and VRE

**Compatibility**: Microban® silver technology is suitable for materials such as polymers, coatings, ceramics, and more.

**Durability** : Remains effective even if a treated object is nicked or scratched

**Non-Leaching:** Stays inert until it meets bacteria

### Emerging Technology

- The antimicrobial food packaging is an emerging technology. The current applications of antimicrobial food packaging are somewhat limited, although promising. This is because of the legal status of the tested additives.
- Research on antimicrobial packaging is focused on developing various methods and model systems, which will work as fuel on the fire for antimicrobial food packaging in the upcoming time.

# 10. Nanotechnology in Food Packaging

## *Improving shelf life and reducing food waste*

- Nanotechnology is the science of minimal **materials** that significantly impact **the food industry,** including packaging. A variety of nanomaterials such as silver nanoparticles, titanium nitride nanoparticles, nano-titanium dioxide, nano zinc oxide, and nanoclay are introduced as **functional additives** to **food packaging**.
- The rapid **advancement of nanotechnology** has provided opportunities for developing new **sensing and food packaging** solutions, addressing long-standing challenges in the food sector to **extend shelf-life, reduce waste, assess the safety,** and improve the quality of food.

**Impact of Antimicrobial Food Packaging on Packaging Sector**

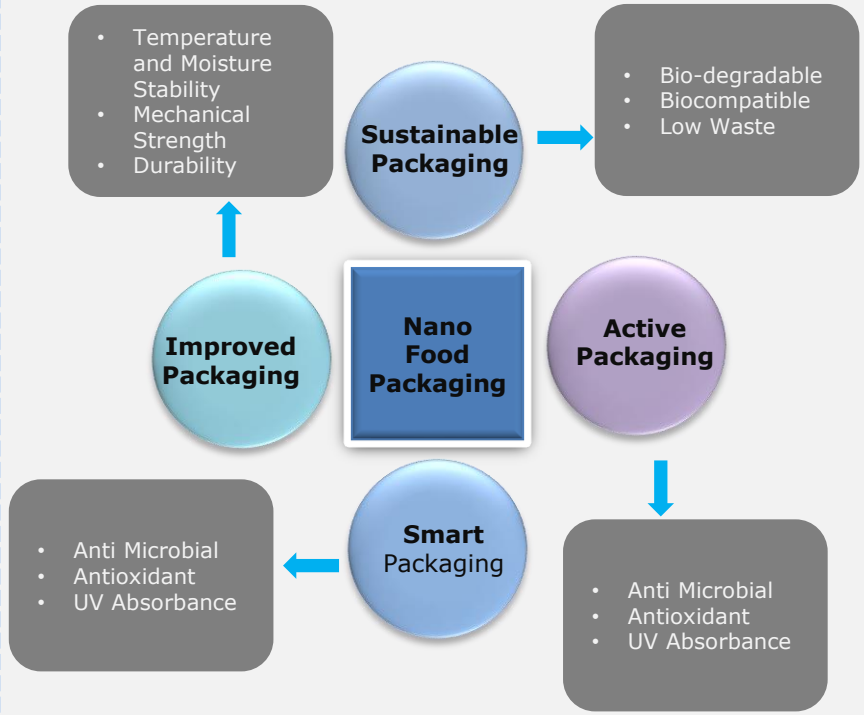
### Benefits of Nano Technology

**•Interactive:** Packaging with nano-sensors helps identify internal and external conditions of food and containers throughout the supply chain. Also, in plastic packaging, nano-sensors can detect gases in nutrition when it spoils, and as a result, packaging changes the color to alert the consumer.

**•Barrier Property:** Films packed with silicate nano-particles can lessen the flow of oxygen into the pack and leak moisture out of the pack. As a result, it protects the package from spoilage. Packaging waste associated with processed food can be reduced by nanotechnology and hence assist the preservation of fresh food

**•Product Shelf Life:** Nanotechnology is used to produce smart packaging for extending the shelf life of a product, and the product can be transported further. The antimicrobials and nano-sensors are developed in intelligent packaging to detect food spoilage and release nano antimicrobials to extend shelf life.

### Combination of All Packaging




### Authority Initiative

**NanoPAck**

**NanoPack** is an **EU-funded project**, which aims to develop and demonstrate **a solution for extending food shelf life** by using novel **antimicrobial surfaces** applied in **active food packaging** products with the help of **nanotechnology**

The used technology will **minimize** the number of **preservatives** required to **maintain freshness**, add value and assure safety to the entire supply chain. The project will employ **natural Halloysite Nanotubes (HNTs)** as reliable and safe carriers of **bio-active compounds** which are **unable to migrate** from the food packaging **into food**

**NanoPack** will help **reduce** the **staggering 1.3 billion tones of food wasted each year**, which cause major **economic loss** and significant harm to the world's natural resources. The project intends to present better performing, safer and smarter products that will position Europe as the leader in food nanotechnology and smart antimicrobial packaging while **increasing competitiveness** and **growth**.

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