



## Active and Intelligent Packaging

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This article discusses active and intelligent packaging, highlighting their definitions, functions, benefits, and applications in food preservation and safety.

### Introduction

For a long time packaging had an active role in processing and preservation of quality of foods. Variation in the way food products are produced, circulate in App Store reflecting the continuing increase in consumer demand for improved safety, quality and self life for packaged foods are assigning greater demands on the performance of the food packaging. Consumers want to be assured that the packaging is fulfilling its function of protecting the quality, freshness and safety of foods. Thus advances in food packaging are both anticipated and expected. Society is becoming increasingly complex and innovative packaging is the outcome of consumers demand for packaging that is more advanced and creative than what is currently offered. Active packaging and intelligent packaging are the result of innovative thinking in packaging.

### Definition of Active and Intelligent packaging

#### Active packaging

Packaging in which subsidiary constituents have been deliberately included in or on either the packaging material or the package headspace to enhance the performance of the package system. It can be used to remove an unwanted compound (eg,  $C_2H_4$  produce by respiring fruits, or  $O_2$  present inside a package), add a desirable compound (eg,  $CO_2$  or ethanol to inhibit microbial growth), prevent microbial growth (eg, incorporate a chemical into a film), change a films permeability to gases as the temperature changes by several of orders of magnitude greater than normal polymeric films or change the physical conditions inside the package (eg, remove water vapour by absorption or change the temperature of the food).

#### Intelligent packaging

Packaging that contents an external or internal indicator to provide information about aspects of the history of the package and / or the quality of the food. It can inform the consumer about the quality of the food by indicating when it is ripe or fresh, or whether it's self life has expired; it can indicate the temperature of the food through the use of thermo chromics inks or Microwave Doneness Indicators (MDIs). It can indicate the temperature history of the food through the use of TTIs and it can indicate whether a package has been tampered with. In other words, intelligent packaging senses some properties of the food it encloses or the environment in which the package is kept and it able to inform the manufacturer, retailer or consumer of the state of these properties.

### Difference between Active and intelligent packaging

Intelligent packaging is capable of informing the consumer or other within the food supply chain about the state of the food or the environment that the food has been kept in eg., some forms of intelligent packaging incorporate a sticker that changes colour if the product is kept above or below critical temperatures as this could indicate it might be unsafe for

consumption. Researchers are also investigating indicators that detect different aspects of food quality as these could potentially replace use by dates. Microbiological and chemical test of the product are regularly performed at the company level during production and before delivery. But in most cases there is no such control after delivery to the supermarket. Intelligent packaging will close this gap as they are able to monitor and display the quality status from the point of manufacture up to the consumer. This permanent monitoring not only minimizes unnecessary food waste but also protect consumer against potential food poisoning maximizes the efficiency of the food industries and improve traceability. In general there are 3 main technologies which are used for intelligent packaging systems are data careers, indicators and sensors.

Active packaging is a solution in which the packaging, the product and the environment interact. These are the systems which actively change condition of the packaged food, extension of its sustainability and thus its self life and guarantee or significantly improved the microbial safety on or sensory properties while maintaining its quality. In contrast to the traditional packaging materials active packaging causes extending the shelf life of food and preserving its higher quality during reactions with the internal atmosphere and the product. Active packaging is designed either as an active layer incorporated onto traditional packaging material or as secrets containing active compounds, are included inside the packaging. The following active packaging systems are used in the food industries:

- i. Oxygen, Carbon Dioxide and Ethylene scavengers
- ii. Carbon Dioxide emitters
- iii. Odour emitter and absorbers
- iv. Relative humidity regulators
- v. Antibacterial substances

### Objective of Active and Intelligent Packaging

- i. **Extend shelf life:** Active packaging helps maintain product freshness by controlling factors like oxygen, moisture and temperature.
- ii. **Improve safety:** intelligent packaging detects potential issues such as spoilage or contamination and alerts consumers or manufacturers.
- iii. **Enhance quality:** Active packaging preserves the quality of Products by preventing degradation or spoilage.
- iv. **Provide information:** Intelligent packaging offers real – time data own products conditions such as temperature, humidity or tampering.

### Advantages of Action and Intelligent Packaging

- i. **Reduce food waste:** Active and intelligent packaging helps prevent spoilage and extend shelf life.
- ii. **Improve product safety:** Intelligent packaging detects potential issues and alerts consumers or manufacturers.
- iii. **Enhance customer experience:** Smart packaging provides valuable information and insights to consumer.
- iv. **Increase efficiency:** Active and intelligent packaging streamlines supply chain management and logistics.

### Utilization of active and intelligent packaging

#### Active packaging:

- **Absorption:** Can absorb compounds
- **Oxygen absorption:** Reduce oxygen level to inhibit oxidative spoilage and maintain desire colours
- **Ethylene removers:** Remove ethylene, a gas that accelerated the ripening and spoilage of fruits and vegetables
- Control moisture levels within the package to prevent microbial growth and maintain texture.

- **Addition:** Can add desirable compounds
- **Carbon dioxide emitters:** Inhibit microbial growth by increasing CO<sub>2</sub> levels
- **Antimicrobial:** Incorporated substances into the packaging to prevent microbial growth on the food surface.

**Intelligent packaging:**

- **Sensor and indicators:** These are built into the packaging to detect and signal changes
- **Time temperature indicator (TTIs):** So if a product has been exposed to unsafe temperatures, indicating spoilage.
- **Gas indicators:** Detect changes in the internal atmosphere of the package, providing information on freshness
- **Biosensor:** Monitor the degradation of food, warning about potential health risk and quality issues.

**Conclusion**

Intelligent and active packaging has evolved to provide enhanced communication and information at optimized cost. The definition of intelligent and active packaging is in one way concise and in another comprehensive. Each adds a little to the understanding and from all the facts assembled, there arises certain grandeur. With all these packaging formats, it will definitely improve the effectiveness of packaging for food products.