

SMART PACKAGING

REVOLUTIONIZING THE ERA OF FOOD PACKAGING

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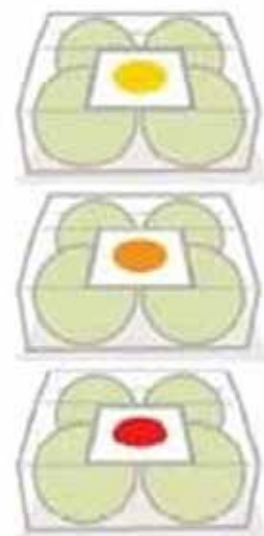
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By 2025, two third of world's population is expected to be urbanized. Urban demand is growing fastest for convenient and value added foods that meet quality standards. To accomplish the totality of these requirements, innovations are needed not only in food processing sector but also in food packaging fields. Though India is one of the largest producers of food and agro based products, 20 % of them gets wasted due to non-availability of proper processing and packaging lines. Food processing sector has the potential of attracting Rs.1,50,000 crores on investment in 10 years and generate employment to 9 million personnel. Presently, Indian packaging industry is growing at a rate of 12 percent per annum. There are roughly 22,000 packaging companies in

the country – from raw material manufacturers to machinery suppliers.

Shelf life of food products are greatly influenced by post-harvest storage conditions. Storage temperature, relative humidity and gas concentrations have direct impact on the spoilage of perishable products. Also, optimum storage conditions vary with the type of foods.





The atmosphere surrounding the food influences the shelf life as well. Lowering levels of oxygen is beneficial for some foods, slowing down discoloration of cured meats, powdered milk and preventing rancidity in nuts and other high fat foods. High carbon dioxide and low oxygen levels can pose a problem in fresh produce leading to anaerobic metabolism and rapid rotting of the food. However, in fresh and processed meats, cheeses and baked goods, carbon dioxide may have a beneficial antimicrobial effect. Thus the success of a food packaging system not only lies in finding out the best suitable package but also in communicating the conditions inside the package to the consumers. This demand is met by the innovative technology termed intelligent packaging.

SMARTNESS IN PACKAGING

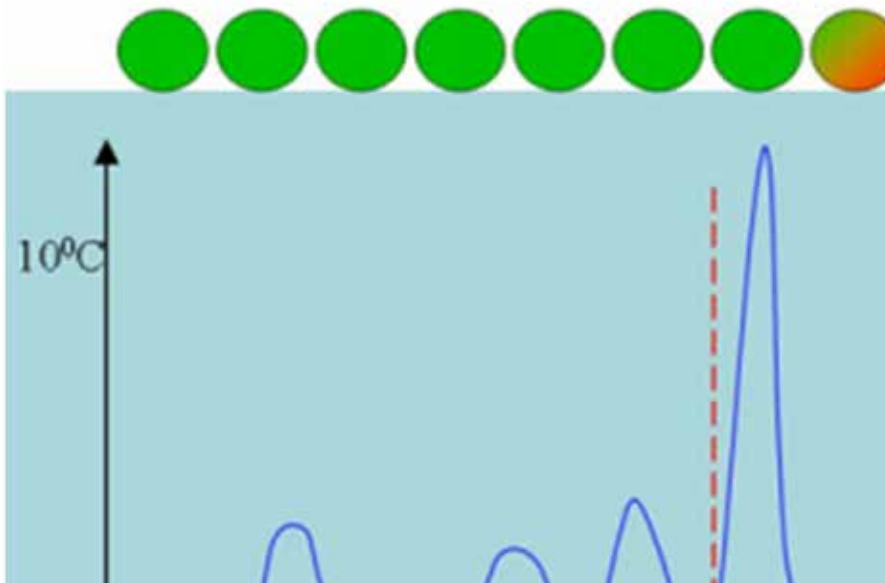
The primary functions of a food packaging system are containment, protection, convenience and communication. Thus an efficient packaging aims at delivering products to the end users in the best condition intended for their use.

Intelligent packaging or smart packaging is an innovative technology that uses the communication function of the package to facilitate decision making to achieve the benefits of enhanced food safety and quality. Intelligent packaging is defined as a packaging system that is capable of carrying out intelligent functions (such as sensing, detecting,

tracing, recording and communicating) to facilitate decision making to extend shelf life, improve quality, enhance safety, provide information, and warn about possible problems.

Components of intelligent packaging system
 Time-Temperature Indicator (TTI): This indicator shows the timely variation in the temperature of the product during storage. If perishable food products are stored above the suitable storage temperature, a rapid microbial growth takes place. The product could be spoiled before the estimated use by date. Time-temperature indicators attached to the package surface are designed to integrate the cumulative time-temperature history of the package throughout the whole distribution chain, and therefore, gives indirect information on the product quality. The time-temperature history is visualized as a colour change. TTIs which are commercially available are based on various reaction mechanisms (diffusion, polymerization or enzyme reaction). The temperature dependent reaction kinetics of the indicator and activation of the indicator at the moment of packaging is a common feature for all concepts. Smart labels or time temperature indicators help consumers recognize when food is at its nutritional best and is safe to eat and when it should be disposed of to avoid ill health. As a result, waste is reduced and consumers have greater confidence in the product. They can be

Colour on a TTI:



Color movement in TTI

used as tamper-evident and anti-counterfeit devices as well. Thermax, Warmmark, etc., are some of the commercially available TTIs that shows a color movement to indicate product spoilage. If the windows in the WarmMark indicator stay white, there's no problem. But if the temperature climbs beyond a certain threshold, a red color gradually moves through the windows of the WarmMark Indicator with the passage of time. If the temperature returns to below the threshold, the color stops moving.

COLOR MOVEMENT IN TTI

Time-Temperature indicator for foods

Oxygen indicator

Oxygen increases the respiratory metabolism in biological products and affects the safe storage. Thus, it is necessary to incorporate smart food packages with oxygen indicators. This indicator

gives information on leakage also as oxygen can get into packages when tampered or damaged during transportation or storage. An oxygen indicator consists of a redox-dye (such as methylene blue), an alkaline compound (such as sodium hydroxide) and a reducing compound (such as reducing sugars). In addition to these, main components such as a solvent (water or an alcohol) and bulking agent (such as silica gel, polymers, cellulose materials, zeolite) are added to the indicator. The indicator can be formulated as a label, a printed layer, a tablet, or it may also be laminated in a polymer film. Some colorimetric oxygen indicators were successfully commercialised (e.g., Ageless Eye produced by the Mitsubishi Gas Chemical Company). Methylene blue (C₁₆H₁₈N₃SC), is a heterocyclic aromatic compound, commonly used as oxygen indicator as it oxidizes to give blue color in presence of oxygen. A typical oxygen indicator is non-toxic, water in soluble and irreversible in action.

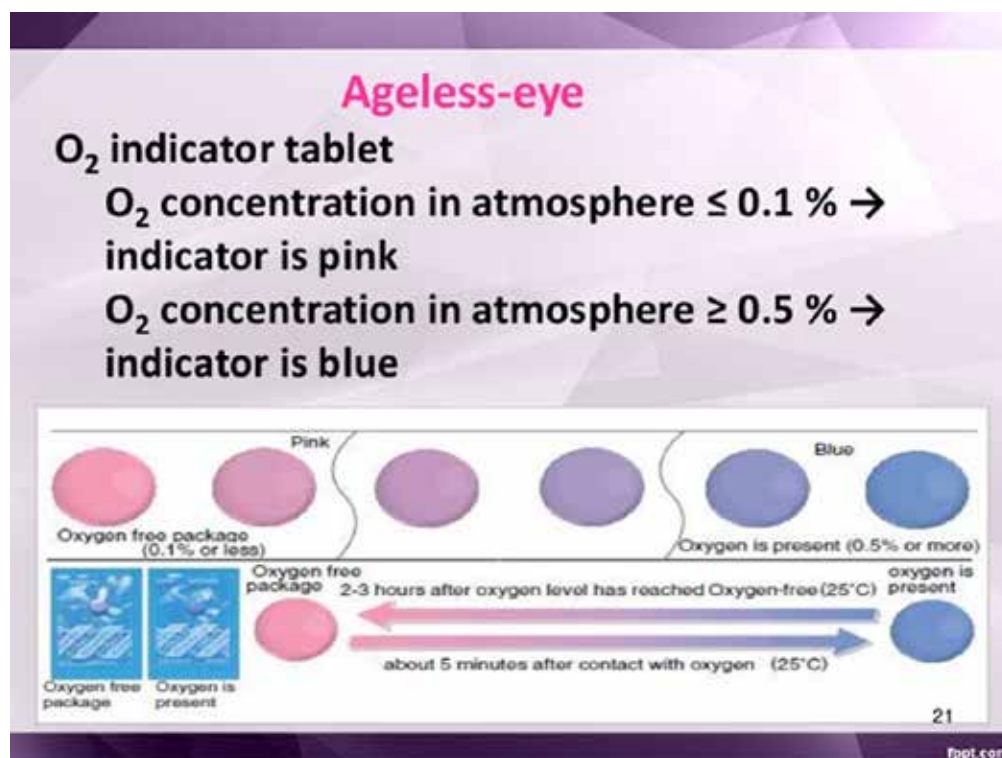
Carbondioxide indicators

These works on electrochemical or optical principles. The electrochemical CO₂ sensors are further sub-categorized into potentiometric, amperometric, and conductometric types. The concept is based on conductivity change as a result of the reaction of carbon dioxide and bicarbonate solution inside a cavity covered with a gas permeable membrane. This kind of sensors can measure CO₂ concentrations between 0 and 11 kPa with a very fast response time. Optical CO₂ sensors



Time-Temperature indicator for foods

can be classified into two types, namely, the sensors which function based on the color (colorimetric) change of a pH indicator dye, such as thymol blue, phenol red, cresol red, etc. The detection process involves mixing of gas to be tested with a chemical reagent/dye which results in a color change/shift of the chemicals. This change of color can be measured and compared to a standard. CO₂ indicators can be used as freshness detectors of fermented foods also. Commercially packed kimchi products are an example. Ripeness/over-ripeness of these cannot be detected by general testing methods without destroying the packaging materials. Therefore, a sensor which can monitor the CO₂ gas continuously, and indicate levels through exhibiting different colors accordingly, non-destructively can be used. Changes in CO₂ concentration within the kimchi package showed a sigmoid increase during fermentation.

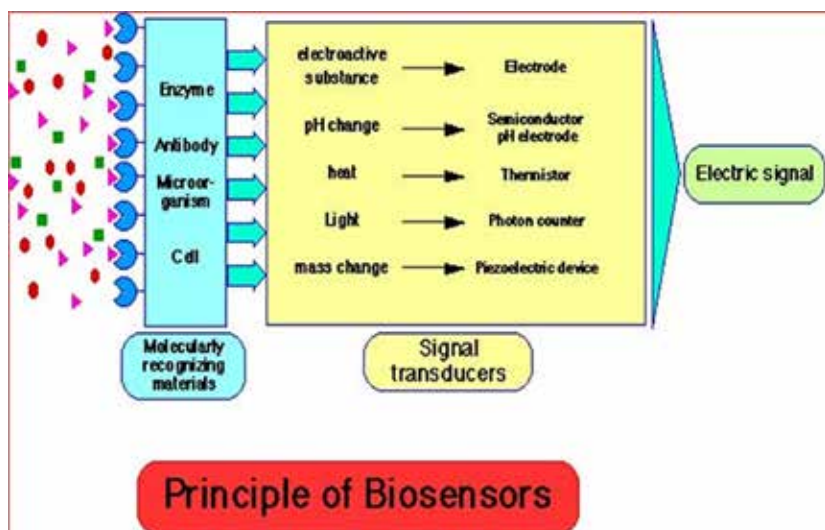


Color movement in TTI

Radio-frequency identification systems

RFID tags are advanced type of data carrier device. It includes: a tag formed by a microchip connected to a tiny antenna; a reader that emits radio signals and receives answers from the tag in return; and middleware (a local network, web server, etc.) that bridges the RFID hardware and enterprise applications. Two distinct features of RFID technology are the high number of various codes that can be stored in the tag and the possibility of transferring and communicating





Principle of Biosensors

information even at a long distance, thus improving automatic product identification and traceability.

BIOSENSOR

Biosensor is an analytical device that combines a biological sensing element with a transducer to produce a signal proportional to the analyte (the sample being analyzed) concentration. This signal results from a change in proton concentration, release or uptake of gases, light emission, light absorption etc. brought about by the metabolism of the target compound by the biological recognition element. The transducer converts this biological signal into a measurable response such as current, potential which can be further amplified, processed, and stored for later analysis. These sensors form an integral component of intelligent packaging systems.

CONCLUSION

Ultimate objective of intelligent packaging is to enhance food safety, biosecurity, food quality and convenience. The emergence of IP has signified another paradigm shift in the concept of food packaging—shifting the package from a mediocre communicator to an intelligent communicator. However, there are many barriers to full-scale implementation of intelligent technologies—namely—high cost, tentative consumer acceptance, getting supply chain partners to work together harmoniously, as well as some complex legislative and standard issues. As alluded earlier, the purpose of introducing smart packaging is to inspire people and to make them benefit from the communication function of packaging in an innovative and useful way.

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Gooseberries are rich sources of Vitamin C and so itself is the best for hair treatment. Honey is a best item containing anti oxidants. It increases immunity and also benefits hair and skin. Gooseberries soaked in honey are done not only for the taste but also for its health benefits. This mixture is very good for liver and also prevents jaundice as well. The presence of antioxidants in gooseberries makes it a good medicine for asthma, bronchitis and other respiratory problems. It is also good solution for common cold, cough & throat infections. It also helps to reduce excess fat from body and to solve digestive problems. It is also useful to maintain youth by controlling wrinkles and adding energy to the body.

PREPARATION OF HONEY AMLA

Ingredients:

Gooseberry	–	1 kg
Sugar	–	1 ½ kg
Honey	–	as required
Citric acid	–	5 g
Slaked lime	–	20 g

Procedure:

1. Wash spotless, undamaged amla in water.
2. Prick them with a needle or fork (iron needle should not be used) after pricking, place the fruits in 2 percent (20g in 1litre water) common salt solution for 24 hours to remove astringency.
3. Put all the fruit in 2 percent slaked lime solution and soak them for another 24 hours until they become sufficiently soft.
4. After that take out all of the soaked amla and wash them twice with water.