Volume 2, Issue 9
September I 2024

Agri Roots
e- Magazine

www.agrirootsmagazine.in

ISSN: 2583-9071

New Trends and Techniques in Packaging of Fresh Fruits

ARTICLE ID: 0128

Shashi Kala

Food Sc. and Postharvest Technology, Bihar Agricultural University, Sabour, Bhaglpur-813210

Packaging of fresh fruits not only ensures safe delivery of the produce to the consumer in good condition but also reduces losses during handling and transportation. Packaging is one of the most crucial steps in the long and complex journey from farmer to consumer. As India is the largest producer of fruits and vegetables, there is a significant gap between production and availability due to substantial postharvest losses. Therefore, enhanced packaging along with effective handling and transportation are important strategies to mitigate these losses. The containment safeguards the produce by keeping it intact and protecting it from weather, transport shock, vibration, and microbial decay. The package also includes pertinent information about the produce. Recently new technologies for pre-packaging and packaging have been adopted which are advanced, sustainable and consumer friendly.

Pre-packaging

Pre-packaging, often referred to as packaging commodities in consumer-sized units before transport to terminal markets, involves techniques such as cleaning and trimming of fruits and packing them in polyethylene bags. This enhances the visual appeal of the produce and also reduces shipping loss thus extends shelf life. Examples: polyethylene or Polyvinyl chloride in form of shrink-wrap, stretch film/cling film, plastic net, cotton mesh etc.

Packaging of Fruits

Packaging Materials	Fresh Fruit Commodity
CFB (Corrugated Fiber Board)	Mango, Apple, Grape, Pomegranate, export fruits
Wooden boxes	Mango, Apple, Litchi, Plum, Pear, Mandarin
Plastic crates	Loose fruits for consumer distribution system
Bamboo basket	Guava, Mango, Grape, Papaya, Mandarin
Gunny bags	Ber, Lemon, Lime, Oranges, Raw mango
Earthen pots	Grapes, Custard apple
Net bags	Citrus, Ber, Oranges
Plastic punnet	Kiwi, Strawberry, Grapes
Foam wrap	Apples, Pear

Packaging of fruits in various types of packaging materials Source : web

Cushioning Materials

Cushioning materials fix the produce inside the packages and prevent them to move during vibration while transporting. Cushioning dissipates heat of respiration of the produce. Traditionally, dried or fresh leaves, paddy straw, grasses, saw dust and paper shreds are used for packaging fruits and vegetables. Nowadays shallow trays of moulded pulp, injection moulded plastic trays, plastic bubble sheets, peeled wood basket, paperboard, foam plastic sheet, polystyrene trays and shredded wood are being used.

Modern Techniques of Packaging

Active Packaging

Active packaging (AP) materials are designed to inhibit microbial growth and reduce the undesirable chemical reactions and interacts with the internal gas environment to extend the shelf life and quality of a produce. Oxidation is another cause of spoilage after microbial infection. High lipid content fruits are susceptible to oxidation. AP involves technologies like absorbing or releasing substances into the packed items or in its environment. Materials like Oxygen scavengers, moisture absorbers, antioxidants, antimicrobial packaging, Sulphur dioxide fumigation, ethylene absorbers ($KMnO_4$, 1-MCP), smell capturers (zeolites, clays, activated charcoal), humidity control (silica gel, zeolite etc), flavour emitters and temperature control packaging are commonly used in AP to keep the produce fresh for longer periods.

Modified Atmospheric Packaging (MAP)

MAP involves adjusting the levels of Oxygen, Carbon dioxide and Nitrogen gas within the packaging to slow down the respiration rate and delay the ripening process of fruits. Lower level of O_2 and higher level of CO_2 leads to inhibition of growth of spoilage causing microorganisms. Thus, MAP helps to maintain longer shelf life of the produce and retain the colour, texture and aroma of the fresh fruit commodity even during transportation. Polyethylene (low density and high density) are commonly used for MAP. Polypropylene (PP) are known for high clarity and good barrier properties. PP are good for packing fruits that requires high moisture retention. Multilayer and composite films are also used due to their superior O_2 barrier properties. Breathable films like microperforated films, laser perforated films have tiny holes for customized gas exchange rates. These are suitable for high respiration fruits like barriers.

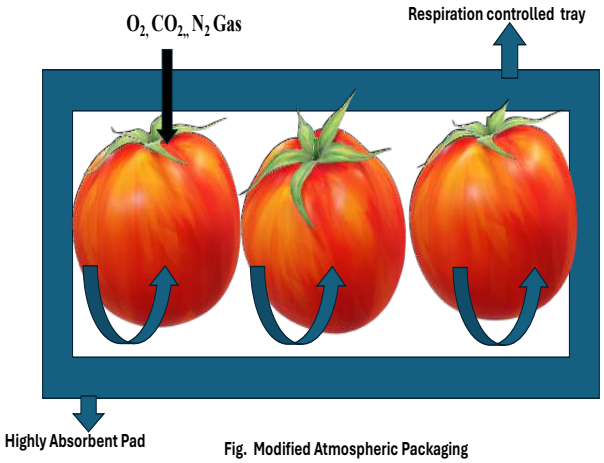
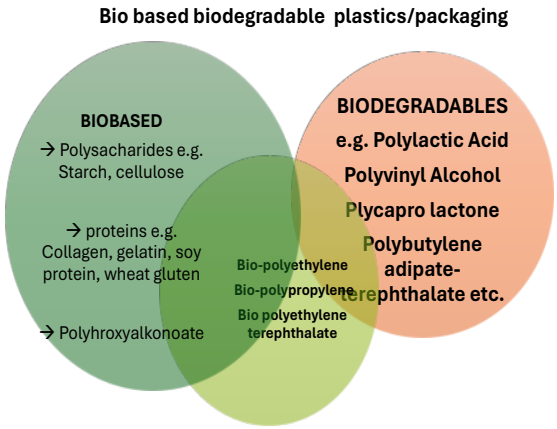


Fig. Modified Atmospheric Packaging

Biodegradable Packaging

Bio-based polymers like polyesters, polyester amides and polyvinyl alcohol are derived from petrochemical monomers are used for packaging. However, bio-based polymers like starch materials, cellulose materials, polylactic acid and polyhydroxyalkanoates are additional materials. Polylactic acid is very promising and become very popular green alternative for packaging and often outperforms the synthetic materials.



Antimicrobial Packaging

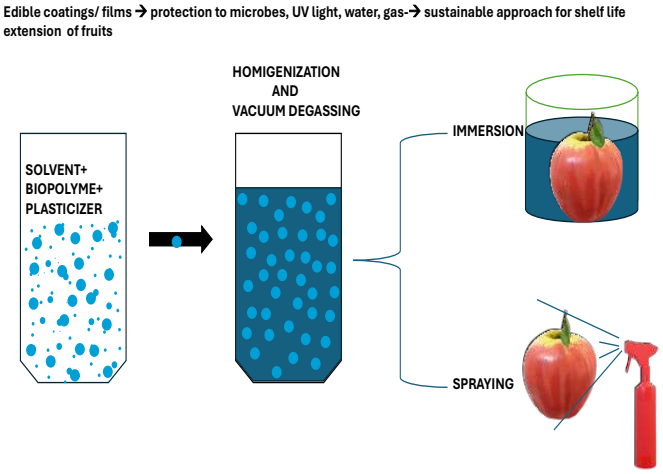
Antimicrobial packaging improves fresh-cut produce safety by incorporating antimicrobial compounds into edible coatings, inhibiting spoilage and pathogenic bacteria. Common antimicrobials include organic acids, fatty acid esters, polypeptides, essential oils, and nitrites, though essential oils may alter fruit taste.

Vacuum Packaging

Vacuum packaging offers robust protection against corrosion, oxidation, moisture, dust, UV rays, mechanical damage, and fungal growth, making it especially beneficial in tropical regions with high humidity. In this process, the product is placed in a vacuum bag, evacuated in a vacuum chamber, and hermetically sealed to prevent air and moisture ingress. For products sensitive to atmospheric pressure, the packages are flushed with inert gases such as nitrogen and CO2 after evacuation.

Edible Coating

Edible coatings are thin layer of edible materials which should not be more than 0.3 mm in size. The layer restrict loss of water, oxygen and other soluble material of fruits. Effective coatings depend on proper wettability and uniform spreading on the produce surface, forming durable layers. These coatings are typically made from proteins, lipids, and polysaccharides like starch, cellulose derivatives, chitosan, pectin, alginate, and gums. Commercial formulations, such as those with carboxymethyl cellulose and sucrose fatty acid esters, have been applied to pears and cherries.



Nanotechnology

Common nanocomposites include polymer clay nanoclay and silica nano silver composites. Nano clay enhances stiffness, strength, flame retardancy while nano silver offers excellent antibacterial properties. Nanotechnology, though relatively new in the food industry, shows great potential in improving food quality and safety. Polymer/clay nanocomposites, containing less than 5% nano clay, enhance packaging mechanical and barrier properties. Biopolymer-based edible films act as barriers to solutes and gases but have poor mechanical properties due to their hydrophilic nature. Hybrid materials with layered silicates like montmorillonite improve these properties. Biopolymer-based nanocomposites, such as those from starch, chitosan, and proteins like soy and whey, exhibit improved mechanical and barrier properties.

Smart Or Intelligent Packaging

Smart packaging enhances product functionality through advanced features, such as mechanical,

electronic, and responsive ink elements. It includes two main categories: packaging with integrated circuits (ICs) and chip less smart packaging, which incorporates diagnostic indicators for monitoring conditions like vibration, acidity, and temperature. Smart packaging is particularly valuable for fresh-cut produce, which requires breathable films to manage high respiration rates and extend freshness. Intelligent packaging can also change colour to indicate freshness and detect spoilage due to temperature changes or packaging leaks. Time temperature integrators (TTIs) are devices that show irreversible changes, such as colour shifts, in response to temperature history. Examples, the ripeSense™ is an intelligent ripeness indicator label that provides real-time ripeness information. RFID (radio frequency identification) tags, anticipated for future use, will enable advanced tracking and identification of products.

Conclusion

India is among the top five country for packaged food in the world and second largest country in Asia. The packaging consumption in India has increased by 200% in the past decade. So, the advance packaging is the need of the present and future India. Future of packaging will operate as a smart packaging system incorporating both smart and conventional materials, adding value and benefits across the packaging supply chain. Future and recent trends for fruit packaging include active packaging, biodegradable packaging, edible packaging, recyclable packaging, customized packaging, packaging automation, digital printing, 3d printing, internet packaging and nanotechnology.

References

1. Alam AU, Rathi P, Beshai H, Sarabha GK, Deen MJ. Fruit Quality Monitoring with Smart Packaging. Sensors. 2021; 21(4):1509. https://doi.org/10.3390/s21041509