GreenariA
Go Green, Learn Green
An Agricultural Monthly e-Magazine

Volume 02, Issue 06, 2024
ISSN: 2584-153X
Article ID: G-24-0606

INNOVATIVE POST HARVEST TECHNOLOGIES TO ENHANCE THE SHELF LIFE OF FRUITS AND VEGETABLES

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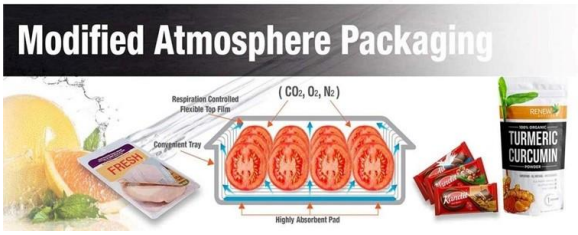
INTRODUCTION

Preserving the freshness and extending the shelf life of fruits and vegetables is paramount in ensuring food security, reducing food waste, and meeting the demands of a growing global population. A national study on postharvest technology under the All India Coordinated Research Project (AICRP) of the Indian Council of Agricultural Research (ICAR) found that approximately 13% of produce is wasted during various farm handling operations such as harvesting, sorting, grading and packing; 6% is wasted during farm storage. As a result, almost one – third of the products grown for horticulture never make it to the final consumer. With the advent of technology, innovative solutions have emerged to address this challenge, ranging from novel packaging techniques to advanced storage methods and sustainable preservation processes.

MODIFIED ATMOSPHERE PACKAGING (MAP)

Modified Atmosphere Packaging involves altering the composition of gases surrounding fruits and vegetables within sealed packages to slow down the ripening process and inhibit microbial growth. By reducing oxygen levels and increasing carbon dioxide concentrations, MAP can significantly extend the shelf life of perishable produce. Furthermore, incorporating moisture-absorbing or ethylene-absorbing materials within the packaging can enhance its effectiveness, ensuring optimal freshness for an extended duration. Common gases used in MAP include nitrogen, carbon dioxide, and oxygen. Advanced MAP systems incorporate gas sensors and automated control mechanisms to maintain optimal gas concentrations throughout the storage period.



Some examples of MAP:

1.Gas flushing:

In this procedure, gas such as nitrogen is injected into the bag before sealing it off to push out any oxygen present in the surrounding environment, which naturally slows down the spoilage rate.

2.Packaging with one way valves:

The packaging includes a one -way valve usually made of a flexible material like rubber or silicon. This valve allows gas to escape from inside the package but prevents air and moisture from entering. Certain products, like freshly roasted coffee beans, release carbon dioxide gas after packaging. If this gas is not allowed to escape, it can build up pressure inside the package, leading to bloating and potentially compromising the freshness of the product.

3.Dessicant packs:

Dessicant packs are small pouches or sachets containing dessicants, substances that absorb moisture from the surrounding environment. Substances like silica–gel, clay, activates charcoal, or molecular sieves are commonly used. These packs contribute to extending the shelf life of products by maintaining their freshness and integrity.

For example, in food packaging, dessicants can helps to prevent spoilage and preserve the crispness of snacks, the freshness of dried fruits, and the stability of powdered products.

4.Barrier packaging films:

Barrier films typically consist of multiple layers, each made of different materials with specific properties. Common materials used in barrier films include polyethylene (PE), polypropylene (PP), Polyester (PET), nylon (PA), ethylene vinyl alcohol (EVOH). It is defined to protect products from external factors such as moisture, oxygen, light and odors..

COLD PLASMA TECHNOLOGY

Cold plasma technology has emerged as a promising non-thermal preservation method for fruits and vegetables. It generates a low–temperature plasma discharge to inactivate microorganisms and pathogens on the surface of fruits and vegetables. Plasma, consisting of ionized gases, reactive species, and UV radiation, interacts with the produce surface to disrupt cell membranes and destroy microbial cells.

Portable and handheld cold plasma devices are being developed for on-site applications in food processing facilities, enabling rapid and flexible treatment of products.

HIGH – PRESSURE PROCESSING (HPP)

It involves subjecting fruits and vegetables to high pressures, typically between 100 to 800 MPa, to inactivate enzymes, pathogens, and spoilage microorganisms. HPP preserves the nutritional integrity, flavor, and texture of the produce while extending its shelf life.

This non-thermal preservation method is suitable for both liquid and solid foods, including juices, purees, and diced fruits and vegetables. HPP is being integrated into novel processing techniques such as pulsed electric fields and ultrasound to further enhance preservation efficacy and reduce processing time.

CONTROLLED ATMOSPHERE STORAGE(CAS)

CAS involves regulating the composition of gases within storage environments to slow down the respiratory metabolism of fruits and vegetables. Temperature, humidity, and gas concentrations are carefully controlled to create optimal storage conditions. This technology is particularly effective for long-term storage of perishable produce, such as apples, pears, and potatoes. CAS helps minimize physiological deterioration, reduce spoilage, and extend shelf life, enabling producers to meet market demands and minimize post-harvest losses.

CONCLUSION

Innovative technologies play a crucial role in revolutionizing the preservation of fruits and vegetables, offering sustainable solutions to extend shelf life, reduce food waste, and ensure food security. From Modified Atmosphere Packaging and Edible Coatings to Cold Plasma Technology, High-Pressure Processing, and Controlled Atmosphere Storage, these advancements offer diverse

approaches to preserving freshness, enhancing safety, and maintaining quality throughout the supply chain. By harnessing the power of technology, we can address the challenges of food preservation in an increasingly interconnected and resource-constrained world, paving the way for a more sustainable and resilient food