NEW ERA AGRICULTURE MAGAZINE

Empowering Horticulture: The Role of Novel Storage Techniques in Global Food Security

Rohit Kumar[1], Amit Kumar[2], Shubham Gangwar[1] and Hritul Kumar Gautam[3]

Introduction

India holds the second position in horticultural crop production globally; a large portion of such products is lost owing to bad storage practices, insects, and pests. The post-harvest losses associated with fruits and vegetables have been put in the range of about 6-20%. Appropriate storage environment can improve the quality and marketability of horticultural produce. To obtain a suitable atmosphere for the produce, advanced provisions like temperature, air circulation, and relative humidity (RH) control could be made. In addition, the composition of air in the storage area could be regulated. Storage plays a pivotal role in various industries, encompassing everything from agriculture to manufacturing and beyond. It is a critical component of the supply chain, serving as the bridge between production and consumption. Effective storage solutions are essential for preserving the quality and integrity of goods, whether they are raw materials awaiting processing, finished products awaiting distribution, or perishable items awaiting sale.

The efficiency and sustainability of storage practices directly affect the reliability of the supply chain, minimizing waste, ensuring product availability, and contributing to overall economic stability. In this context, exploring various storage methods and technologies becomes crucial to meeting the demands of a rapidly evolving global market.

Type of Novel Storage Technique:-

Some of the novel storage techniques have been discussed below:

Controlled Atmosphere Storage:

Controlled Atmosphere Storage (CAS) is a revolutionary approach transforming the post-harvest storage landscape for horticultural crops. This technique involves precisely regulating the levels of oxygen, carbon dioxide, and humidity in storage environments

Rohit Kumar[1], Amit Kumar[2], Shubham Gangwar[1] and Hritul Kumar Gautam[3]
[1]Ph.D. Scholar, Department of Post Harvest Technology, BUA&T, Banda (U.P.)
[2]P.G. Scholar, Department of Post Harvest Technology, BUA&T, Banda (U.P.)
[3]P.G. Scholar, Department of Fruit Science, BUA&T, Banda (U.P.)

to create conditions that slow down the natural ripening and aging processes of fruits and vegetables. By manipulating the storage atmosphere, particularly by reducing oxygen and increasing carbon dioxide, the activity of ethylene, a key plant hormone responsible for ripening, is inhibited. This results in a significant extension of the shelf life of stored produce. CAS not only helps in minimizing post-harvest losses but also allows for the preservation of the nutritional quality and overall freshness of horticultural crops. This method represents a sustainable and environmentally friendly solution, reducing the reliance on chemical preservatives and contributing to the global efforts towards more efficient and responsible agricultural practices.

- **Modified Atmosphere/ Environment Storage:**

Modified Atmosphere Storage (MAS) or Modified Environment Storage (MES) is a technology employed in the preservation and storage of perishable goods, particularly in the agriculture and horticulture sectors. This method involves manipulating the composition of the air surrounding the stored products to slow down the natural aging and decay processes. By adjusting the levels of oxygen, carbon dioxide, and humidity, the storage environment is optimize to create conditions that deter the growth of microorganisms and reduce the rate of biochemical reactions. This helps to extend the shelf life of fruits, vegetables, and other sensitive produce, maintaining their quality, flavor, and nutritional value for a more prolonged period. Modified Atmosphere Storage is a valuable tool in the post-harvest supply chain, allowing for better management of inventory, reduced spoilage, and minimized food waste. The technique plays a crucial role in ensuring a steady and reliable supply of fresh produce to consumers while promoting sustainability by curbing unnecessary losses in the agricultural sector.

- **Hypobaric storage:**

Hypobaric storage, also known as low-pressure storage, is an advanced technology employed in the preservation of perishable goods, particularly fruits and vegetables. Unlike traditional storage methods, hypobaric storage involves maintaining a reduced atmospheric pressure within the storage environment. By lowering the pressure, the concentration of oxygen is effective decreased, slowing down the respiration rate and metabolic processes of stored produce. This innovative storage technique helps extend the shelf life of fruits and vegetables by minimizing the occurrence of physiological disorders and inhibiting the growth of microorganisms. Hypobaric storage is particularly effective in preserving the quality, freshness, and nutritional content of sensitive

produce. Additionally, this method reduces the need for chemical preservatives, making it an environmentally friendly option in the post-harvest supply chain. The application of hypobaric storage represents a significant advancement in the field of food preservation, offering a promising solution for improving the efficiency and sustainability of the agricultural industry.

- **Bio-based Coatings:**

Traditional methods of preserving horticultural crops often involve the use of synthetic chemicals, which can have environmental and health implications. Bio-based coatings offer an eco-friendly alternative. These coatings, derived from natural compounds such as chitosan and edible proteins, create a protective layer on the surface of fruits and vegetables, reducing moisture loss and microbial attack. Bio-based coatings not only extend shelf life but also enhance the overall safety and quality of stored produce.

- **Pusa Farm Sun Fridge (Pusa-FSF):**

Scientists from the ICAR-Indian Agricultural Research Institute (IARI) have developed an on-farm green energy refrigeration system (Pusa-FSF). Pusa Farm Sun Fridge (Pusa-FSF) is a 100% solar-powered battery-fewer cold stores that can preserve around 2 tons of freshly-harvested produce at 3-4°C during the day and 8-12°C at night time. It has rooftop solar panels that generate 5 kilowatt (KW) power, which helps in running air conditioning. The panels also power a 105-watt submersible pump circulating about 1,000 liters of water from a tank through overhead PVC pipes. At night, there is only passive evaporative cooling, with the water chilled during the day acting as a natural heat sink. All farmers with solar pumps are a potential market for the Pusa-FSF.

- **Smart Sensor Technologies:**

The integration of smart sensor technologies is revolutionizing the monitoring and management of horticultural crop storage. These sensors, equipped with various functionalities such as temperature and humidity control, gas analysis, and ethylene detection, provide real-time data on the condition of stored produce. Farmers and distributors can use this information to make informed decisions, optimizing storage conditions and minimizing waste. Additionally, smart sensors help in identifying potential issues early, enabling prompt intervention to prevent spoilage.

Advantage of Novel Storage Techniques:-

A novel storage technique of horticultural crops provides several advantages that contribute to the sustainability of practices and the stability of the food supply chain. Some advantages include:

- **Extended Shelf Life:** Proper storage conditions help slow down the natural aging and deterioration processes of horticultural crops, extending their shelf life and allowing for a more extended period of availability.
- **Stabilizing Supply and Demand:** Storage helps balance supply and demand by allowing farmers to store excess produce during times of abundance and release it gradually when demand is higher, reducing the risk of market gluts.
- **Preservation of Quality:** Controlled storage conditions, such as temperature and humidity control, help preserve the quality, flavor, texture, and nutritional content of horticultural crops. This ensures that consumers receive fresh and high-quality produce.
- **Minimizing Wastage:** Proper storage practices significantly reduce post-harvest losses due to spoilage, rot or physical damage. This is crucial for maximizing the economic return on the farmer's efforts and resources.
- **Risk Management:** Storage acts as a risk management tool, providing a buffer against unforeseen events such as market fluctuations, transportation delays, or adverse weather conditions that might otherwise influence the timely sale of fresh produce.
- **Meeting Off-Season Demand:** Stored crops can be release during off-seasons meeting consumer demand when the natural production is low or non-existent. This helps maintain a consistent supply throughout the year.
- **Global Trade:** Storage facilitates the export of horticultural crops, allowing producers to participate in global markets by ensuring that the produce meets international quality standards and can withstand longer transportation times.