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Technologies for Increasing Shelf Life and Value of Agro-Produce

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Abstract: This review addresses the challenges of postharvest losses in perishable horticultural crops, focusing on fruits and vegetables. Despite being rich in phytochemicals, these crops experience significant losses, particularly in developing countries like India. The paper discusses advanced postharvest technologies such as active packaging, genetic engineering, non-destructive monitoring methods, and cold storage facilities to minimize losses, improve food security, and enhance nutritional quality. Additionally, emerging trends like edible film, probiotics, UV-C, ultrasound, and high hydrostatic pressure are explored for extending the shelf life of agroproduce. The review also includes a case study of Sahyadri Farmer Producing Company, providing practical insights into the application of these technologies in real-world scenarios. Ongoing research aims to identify practical applications with optimal safety and efficacy.[1][2]

Index Terms **- Postharvest losses, perishable horticultural crops, phytochemicals, advanced postharvest technologies, genetic engineering, cold storage facilities, edible film.**

INTRODUCTION

Fruits, which easily spoil and have lots of water, are crucial crops mainly grown in warm areas worldwide. They're not only a big part of global farming but also a way for people to make money. Fruits are known for being good for health because they have lots of important nutrients and natural chemicals. However, these fruits face formidable challenges, including postharvest losses and restricted shelf life during marketing, storage, and transportation.

Fixing these problems is really important, and the solution is to use good methods after picking the fruits to stop them from losing weight and make them last longer. Fresh fruits naturally go through changes like breathing, getting old, and ripening, and these changes need to be slowed down to make the fruits last longer. Fixing the problem of losing fruits after picking is not just about using good technology; it's also a big step to make sure there's enough food everywhere, especially in places where it's hard to get enough.

This paper looks at how people all over the world and in India are trying to make fruits and vegetables last longer. It talks about using new ways after picking fruits, using science to change crops, and doing things to keep the food safe. A real example from Sahyadri Farmer Producer Company Ltd. (SFPCL)shows how these ideas work in India. The goal is to understand the big problems everyone faces and to see why it's so important to find good ways to keep food fresh, help the environment, and make sure people everywhere have enough good food to eat.[2]

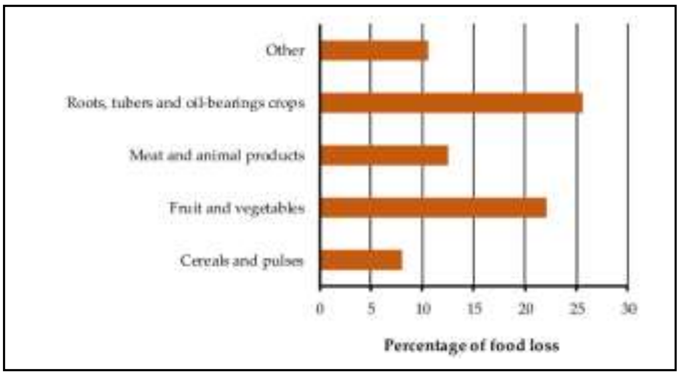

Fig. 1 Graph Showing Percentage of Food Loss

2.0 Methods –

Fig. 2 Cause of Post-Harvest Losses of Fruits and Vegetables

2.1. Cold Storage Facilities:
Description: Cold storage facilities utilize refrigeration and freezing to lower temperatures, thereby slowing down enzymatic and microbial activity in perishable foods. Refrigeration (0°C to 5°C) retards spoilage, while freezing (-18°C or lower) halts microbial growth altogether. [2]

Application: Well-suited for preserving fruits, vegetables, dairy products, and meats. Specific temperature and humidity conditions are tailored to each commodity for optimal preservation.

2.2. Active Packaging:
Description: Active packaging integrates substances such as oxygen absorbers, moisture regulators, and antimicrobial agents into packaging materials. These components actively interact with the food to extend shelf life by controlling factors like oxidation, moisture, and microbial growth.[2]

Application: Applied across various industries, including the packaging of fresh produce, bakery items, and snacks. Oxygen scavengers, for instance, prove effective in preserving the quality of packaged products.

2.3. Genetic Engineering:
Description: Genetic engineering involves the modification of the genetic makeup of crops to enhance desirable traits. In the context of shelf life, genetic modifications may include introducing genes for pest resistance, disease tolerance, or delayed ripening.

Application: Utilized for crops such as tomatoes, which can be engineered to resist bruising and extend shelf life. Similarly, apples with delayed browning traits have been developed through genetic engineering.

2.4. Edible Coatings:
Description: Edible coatings consist of thin layers of natural materials like waxes, proteins, or polysaccharides applied to the surface of food items. These coatings form a protective barrier, preventing moisture loss, gas exchange, and microbial contamination.

Application: Commonly applied to fruits, vegetables, and certain confectionery items. Edible coatings enhance appearance, reduce weight loss, and extend the shelf life of perishable goods.

2.5. Postharvest Thermal Treatments:
Description: Postharvest thermal treatments use controlled heat to reduce microbial activity and enzymatic reactions in food. Techniques include blanching, pasteurization, and hot water treatments. [2]

Application: Applied to fruits, vegetables, and dairy products. For instance, blanching is employed to deactivate enzymes in vegetables, while pasteurization ensures safety and extends shelf life in juices and dairy items.

2.6. Non-Thermal Treatments:
Description: Non-thermal treatments, such as pulsed electric fields (PEF), use electrical pulses to inactivate microorganisms and enzymes without relying on heat. PEF treatments maintain the sensory and nutritional qualities of foods.

Application: Applied to various liquid foods like fruit juices, milk, and liquid eggs. PEF technology is recognized for preserving the quality of heat-sensitive liquids.

2.7. Dipping in Food-Grade Chemicals:
Description: Dipping involves immersing food items in solutions containing food-grade chemicals like organic acids or antimicrobial agents. This process reduces microbial contamination and slows down deterioration processes.

Application: Used for fruits, vegetables, and seafood. Dipping in solutions containing citric acid, chlorine, or other safe chemicals helps maintain food safety and quality.

2.8. Shrink Wrapping:
Description: Shrink wrapping employs plastic film that, when heat is applied, shrinks tightly around the food product, creating a protective barrier. This helps prevent exposure to external contaminants and maintains product freshness.

Application: Widely used for packaging fresh produce, meats, cheeses, and other perishable goods. Shrink wrapping assists in reducing dehydration and extending shelf life.

These technologies collectively contribute to the preservation and extension of the shelf life of a wide range of food products, addressing the challenges of postharvest losses and enhancing overall food security.

3. Case Study of "Sahyadri Farmer Producer Company Ltd. (SFPCL)"

3.1 Introduction:

Sahyadri Farmer Producer Company Ltd. (SFPCL) was established in 2011 with a commitment to providing fair returns to farmers and delivering safe, quality food to consumers. Operating under the tagline "of the farmers, by the farmers, for the farmers," the company, led by Chairman Shri. Vilas Shinde, originated as a movement focused on the welfare of farmers. Shri. Shinde's entrepreneurial journey began with cultivating export-quality grapes, aiming to address the disparity in prices paid by export agents. Facing rejection of a consignment in 2010, Shri. Shinde paid ₹7 crore to farmers, fostering enduring trust. The enterprise aimed to procure all fruits and vegetables adhering to food safety standards, addressing challenges by providing infrastructure and promoting Good Agriculture Practices (GAP). The brand 'Sahyadri' was established with a focus on building goodwill by "seeding goodness."[2]

3.2 Infrastructure:

Sahyadri Farms' infrastructure includes construction completed and in progress, with a total capacity of 850 MT per Day. Notable facilities include Precooling Rooms, Cold Storage for Fast-Moving and Frozen Products, Advanced Ripening Chambers, Aseptic Processing Facility, and more. These facilities, designed to handle fruits and vegetables, contribute to the company's impressive handling capacity and storage capabilities. [2]

3.3 Problem Statement

In the year 2010, the entire consignment of grapes exported from India was rejected and all the exporters incurred heavy losses. Further, most of the exporters passed on their losses to the farmers.[2]

3.4 Processing Technologies:

3.4.1 Aseptic Processing:

- Products: Mango Pulp, Guava Pulp, Papaya Pulp, Tomato Puree, and more.
- Technology: Sterilization and aseptic packaging for longer shelf life without preservatives.

3.4.2 Frozen Fruit Pulps/Purees:

- Products: Mango Pulp, Guava Pulp, Alphonso Mango Pulp, and more.
- Technology: Plate freezers for rapid and even freezing, preserving natural parameters.

3.4.3 Individual Quick Frozen (IQF):

- Fruits: Mango Dices, Papaya Dices, Pomegranate Arils, and more.
- Vegetables: Sweet Corn, Cut Okra, Onion Dices, and more.
- Technology: Ultra-rapid freezing at low temperatures (-30°C to -40°C), preserving color, flavor, and texture for extended shelf life.

This comprehensive approach underscores Sahyadri Farms' commitment to advanced technologies, ensuring the production of high-quality, safe, and longer shelf-life agricultural products.

4.0 Conclusion

In conclusion, advanced postharvest technologies, including cold storage, active packaging, genetic engineering, and emerging trends like UV-C and ultrasound, play a pivotal role in extending the shelf life of agroproduce. The case study of Sahyadri Farmer Producing Company exemplifies the practical application of these technologies, showcasing their effectiveness in real-world scenarios. Ongoing research aims to optimize safety and efficacy, emphasizing the continuous evolution of postharvest methods. Collaboration among researchers, farmers, and industry stakeholders is crucial for widespread adoption, fostering a resilient and sustainable agricultural system. Implementing these technologies is vital for reducing food waste, meeting nutritional needs, and ensuring a stable food supply for the future.

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