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Waxing and Post Life Management in Climatic Fruits

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Waxing and post-life management are crucial elements in preserving the quality, extending the shelf life, and maintaining the marketability of climacteric fruits. Climacteric fruits, such as apples, bananas, avocados, pears, peaches, and tomatoes, continue to ripen after harvest and undergo changes that make them more susceptible to spoilage. Proper handling techniques, including waxing and postharvest management, can significantly enhance their storage life and freshness.

1. Waxing of Climacteric Fruits

Waxing is a postharvest treatment applied to fruits to create a protective coating that reduces moisture loss, enhances appearance, and provides some protection against physical damage and pathogens. Here's an overview of the waxing process and its benefits:

Process of Waxing:

- **Application:** After harvesting, fruits are typically washed and sometimes dipped in a warm water solution to remove dirt and any pesticide residues. Once cleaned, they are coated with an edible wax formulation.

- **Types of Wax:** There are various types of wax used for fruits:

Carnauba wax: Derived from the leaves of the Brazilian carnauba palm, it is one of the most common and effective waxes used for apples, pears, and citrus fruits.

Beeswax: A natural wax that is often used in combination with other waxes for certain fruits like apples and avocados.

Shellac and Candelilla wax: Both are used for fruits that require more durable coatings.

Modified Natural Waxes: These may include combinations of carnauba or candelilla wax mixed with other compounds to improve texture, gloss, and adhesion.

- **Methods:** The waxing can be done in several ways:

Spraying: A fine mist of wax is sprayed onto the fruit.

Dipping: Fruits are submerged in a wax solution.

Brushing: The wax is applied directly to the surface using a brush or other mechanical applicator.

Benefits of Waxing:

Moisture Retention: Wax forms a thin film over the fruit's surface, reducing water loss, which helps maintain fruit turgidity and texture.

Enhanced Appearance: Waxing gives fruits a glossy, appealing finish that improves their marketability.

Protection Against Pathogens: The wax coating can act as a barrier against pathogens and minor mechanical damage that might occur during handling or transport.

Extended Shelf Life: By reducing respiration and moisture loss, waxing slows down the ripening process and extends storage time, which is particularly important for fruits like apples, pears, and citrus.

Reduction of Bruising: Wax helps protect the fruit from bruising and minor physical damage during handling or transportation.

Considerations and Challenges:

Consumer Concerns: Some consumers prefer not to consume waxed fruit due to health concerns. In response, some producers use "organic" or "natural" waxes, which are free from synthetic additives.

Wax Residue: If not properly applied or cleaned, residual wax can affect the taste or texture of the fruit. It is crucial that any excess wax is removed or that the wax is used in moderation.

Type of Fruit: Not all climacteric fruits are waxed. For example, bananas and tomatoes are usually not waxed, as the wax can interfere with their ripening processes or affect their appearance.

2. Post-Life Management of Climacteric Fruits

Post-life management refers to the practices and technologies used after harvest to preserve the quality, appearance, and nutritional value of fruits, especially climacteric fruits. These fruits continue to ripen after harvesting, and without proper management, they can spoil quickly due to their high metabolic rate.

Key Components of Post-Life Management:

A. Temperature Management (Cold Storage):

Controlled Atmosphere (CA) and Modified Atmosphere (MA): These techniques are essential for extending the shelf life of climacteric fruits. CA storage involves adjusting oxygen, carbon dioxide, and humidity levels to slow down respiration and delay ripening. MA packaging uses films that control the gas exchange around the fruit to reduce ripening speed.

Low-Temperature Storage: Storing fruits at lower temperatures (but above freezing) slows down their metabolism, which helps extend shelf life. Apples, pears, and grapes benefit from this method.

Ethylene Management: Climacteric fruits produce ethylene gas, which is a key hormone that drives ripening. Managing ethylene exposure is crucial for extending storage life. Refrigeration and ethylene scrubbers can help reduce the effects of this gas, thus slowing ripening.

B. Humidity Control:

Humidity Regulation: Fruits lose water through transpiration, which leads to shriveling and weight loss. Maintaining an optimal relative humidity of 90–95% is crucial for most climacteric fruits to prevent dehydration. This is especially important for apples, pears, and citrus.

Packaging: The use of packaging materials that allow for proper air exchange or moisture control, such as perforated plastic films, can help maintain fruit freshness and prevent dehydration during storage.

C. Ethylene Management:

Ethylene Gas Control: Since climacteric fruits continue to produce ethylene after harvest, it is essential to manage its levels to prevent premature ripening. Special facilities may use ethylene absorbers (such as potassium permanganate) or controlled ventilation systems to reduce ethylene concentration in storage areas.

Use of Ripening Chambers: For fruits like bananas, tomatoes, and avocados that are typically harvested unripe, ripening chambers are used to control temperature, humidity, and ethylene exposure to ensure uniform and timely ripening.

D. Gaseous Treatments:

1-Methylcyclopropene (1-MCP): This compound is widely used to inhibit the action of ethylene, effectively extending the shelf life of climacteric fruits like apples and pears. It works by blocking the ethylene receptors in the fruit, slowing down ripening processes.

Controlled Atmosphere Storage: In addition to regulating oxygen and carbon dioxide, CA storage can also involve lowering the temperature and controlling humidity, which all combine to reduce respiration and slow the ripening process of climacteric fruits.

E. Pre-Cooling and Post-Harvest Handling:

Pre-cooling: After harvest, fruits should be cooled rapidly to remove field heat. This prevents the fruits from ripening too quickly and reduces the risk of spoilage. Methods like forced air cooling or hydrocooling can be used, depending on the type of fruit.

Careful Handling: Minimizing physical damage during harvesting, packing, and transportation is key to maintaining fruit quality. Bruises, cuts, and other physical damage can lead to faster decay and reduced shelf life.

F. Packaging:

Modified Atmosphere Packaging (MAP): For climacteric fruits like apples, peaches, and tomatoes, MAP uses bags or containers that control the exchange of gases (oxygen and carbon dioxide) to reduce respiration rates and slow down ripening.

Protective Packaging: For sensitive fruits like peaches or avocados, protective packaging (such as foam netting or trays) can prevent bruising and physical damage.

G. Ripening Control:

Ethylene Application: Some climacteric fruits, like bananas and avocados, are harvested while still unripe. Ripening can be induced by controlled exposure to ethylene gas in a ripening chamber.

Temperature Control: Managing temperature during the ripening phase is essential to ensure fruits ripen uniformly and within a desired timeframe.

3. Post-Life Management Best Practices

Regular Monitoring: Frequent inspection of fruits during storage is essential to detect any signs of spoilage, disease, or damage, allowing for quick intervention.

Proper Ventilation: Ensure proper airflow in storage areas to prevent the build-up of excess moisture and CO₂, both of which can promote premature ripening and mold growth.

Use of Natural or Synthetic Coatings: In addition to waxing, other natural coatings, such as chitosan (derived from shellfish), are being researched for their potential to protect fruit without affecting taste or texture.

Conclusion

Waxing and post-life management are integral to preserving the quality and extending the shelf life of climacteric fruits. Waxing provides a physical barrier that reduces moisture loss, enhances appearance, and protects against pathogens. In parallel, post-life management techniques, including temperature control, ethylene regulation, humidity management, and careful handling, play a critical role in maintaining fruit quality during storage and transportation. By combining these techniques, producers can ensure that climacteric fruits remain fresh, visually appealing, and marketable for extended periods after harvest.