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Emerging Technologies for Post Harvesting to Extend Fruits and Vegetables Shelf-Life

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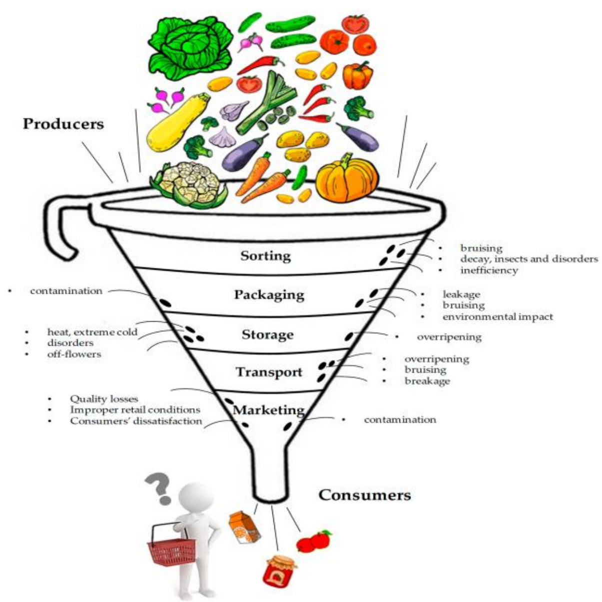
ABSTRACT

Fresh produce's quality and shelf life frequently deteriorate during the postharvest phase due to inadequate postharvest facilities. Modern postharvest techniques, such as pulsed electric field (PEF), active packaging, vacuum impregnation, dipping, conventional heating, high hydrostatic pressure (HPP), and cold plasma, as well as biocontrol methods, have been used in recent decades to maintain the safety and nutritional value of fresh produce. Implementing these strategies after harvesting helps to address the loss of product quality caused by the drawn-out transit of goods to distant markets. New technologies like near-infrared spectroscopy, electronic noses, and image analysis are prime examples of non-invasive, contactless approaches to quality control. These methods have many benefits over conventional, damaging processes and are essential for maintaining fresh produce's freshness, cutting down on losses, and minimizing waste. This article explores the post-harvest approaches to increasing the self-life of fruits and vegetables. Moreover, edible packaging, artificial intelligence technologies including e-nose and quality monitoring also be discussed.

INTRODUCTION

Essential nutrients like vitamins and minerals along with phytochemicals and antioxidants found in plenty of fresh fruit and vegetables. Since consumers are now aware of these products' potential to prevent certain non-communicable diseases, they have been increasingly likely to use them in recent decades. Harvested plant materials always metabolic active and are highly perishable. Due to the moisture content presents in the horticultural produces, the ripening and senescence stages leads to them to lose quality. These processes are often associated with the development of spoilage bacteria and other unwanted events that must be controlled in order to preserve the product's quality and extend its shelf life during storage. Improved nutritional and sensory qualities in fruits and vegetables give them significant economic value. Therefore, inadequate preservation methods can considerably lower nutritional content and quality traits while also having a detrimental financial impact on growers, consumers, and the entire supply chain.



I. POSTHARVEST APPROACHES TO EXTEND THE SHELF-LIFE OF FRUIT AND VEGETABLES

1. PHYSICAL TREATMENTS

In recent years, novel non-thermal processing technologies have gained attention as potential replacements for standard thermal postharvest processing methods. In addition to using a lot of water, the traditional methods may have negative consequences on the quality of the fresh commodities. These innovative technologies may guarantee the total absence of chemicals in the processed product, decrease the environmental effect, boost food quality, raise consumer acceptability, and prolong shelf life and maintain the freshness. These cutting-edge techniques includes microwave heating, cold plasma, high hydrostatic pressure, high hydrostatic pressure and pulsed electric fields. By lowering the microbial load, these techniques help maintain the freshness and high-quality attributes of fruits and vegetables.

2. MICROWAVE

Typically, heating methods like hot water, hot air, high heat for brief periods, and radio waves can lead to a decrease in important nutrients and compounds related to taste, because of the heat and its slow spread through plant cells through direct contact or heat transfer. Microwaving was used here as a different approach to traditional heating methods, to raise the temperature quickly and efficiently without creating uneven heat distribution. This method quickly heats fruits and vegetables to control the growth of microorganisms during the entire products processing, reducing quality loss while ensuring the least impact on the environment and no leftover residues in the heated product.

3. PULSED ELECTRIC FIELD

PEF innovation gained significant attention recently due to its potential to produce safe food with less heat production by employing high electric field intensity pulses. This method has been applied extensively. On foods that are prepared by the form of liquid, semi-solid, or solid; also, smoothies and juices from fruits and vegetables. The PEF settings that need to be adjusted to achieve enzymatic and microbiological inactivation in fresh goods are indicated by the electric field's intensity, the duration of treatment, as well as the pulses' polarity, frequency, or form.

4. COLD PLASMA

It is a fourth state of matter after solids, liquid and gases. A materials state shifts from solid to liquid and then back to third stage (gas), when it is exposed to constant energy. The gas molecules exposed to high energy, it becomes ionized and generates free electrons and ions. This results state that plasma. The sun and lightning during rainfall are two examples of naturally formed plasmas. Thermal and non-thermal, or cold, atmospheric plasma are the two different forms of plasmas. Cold plasma is created when a gas is partially ionized at atmospheric pressure or low vacuum.

A plasma that is not in thermodynamic equilibrium, known as non-thermal, chilly, cold atmospheric, or non-equilibrium, occurs when the temperature of the electrons is significantly higher than that of the heavier species (ions and neutrals). Plasma technology is based on the partial ionization of gas-containing molecules, free radicals, charged particles (including electrons and photons), and positive and negative ions. When a process gas is exposed to an electric field, cold plasma is produced at atmospheric pressure. Impact ionization processes are caused by electrons from the ionization process that are accelerated in this area. When gas atoms and free electrons collide, the energy of the collision is transferred, creating extremely reactive species that can interact with the food surface.

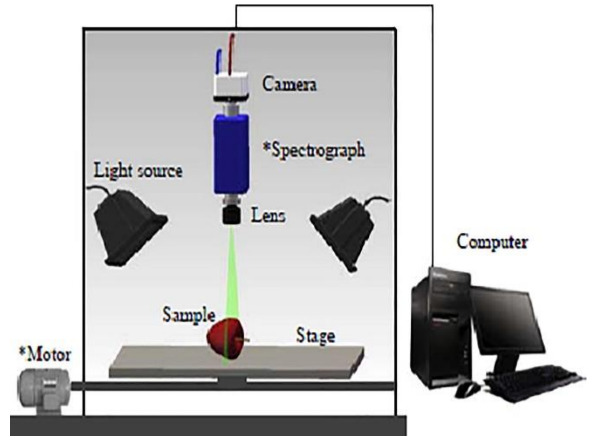
II. EDIBLE ACTIVE PACKAGING, BASED ON NATURAL COMPOUNDS

Natural antioxidants are incorporated into edible polymers to provide edible active packaging. Edible coatings have shown to be a successful primary packaging material for postponing of ripening, maintaining nutritional value, and avoiding quality loss through a reduced number of organic respiration. It has been shown recently that the effectiveness of by adding active natural ingredients, edible coatings can be greatly enhanced. These packaging items are referred to as active and made to react with meals by releasing substances that have biological attributes. Active chemicals are incorporated into biopolymer matrices to improve food product oxidation stability and prevent the formation of food-borne pathogens, adding further safety features to the food products even when refrigeration is not available.

III. ADVANCED NON-DESTRUCTIVE TECHNIQUES FOR THE QUALITY MONITORING OF FRUIT AND VEGETABLES

1. Image analysis through a computer vision system

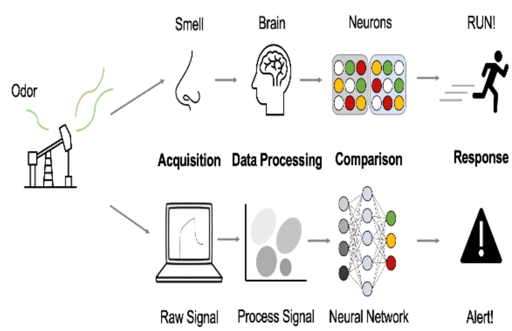
Computer vision systems (CVSs) are a cutting-edge, nondestructive, contactless technology that is commonly used for in-line fruit and vegetable grading. It is based on conventional imaging in the visible range of the electromagnetic spectrum.



Novel technologies are included in CVSs to automatically extract the pertinent visual information from image. Details about the product's aesthetic quality: They are employed in grading and classifying to evaluate the quality, find flaws, and calculate the intrinsic characteristics. These tasks can be completed by using appropriate image analysis methods and regression or classification models.

The main advantages of widespread, uniform, and objective food management throughout the supply chain that this technology provides, from the manufacturers to the ultimate consumers, are a decrease in waste and loss and an improvement in customer satisfaction.

2. E-nose



Odor sensing technology is widely employed in many fields, including medical, public security, food freshness management, military applications, indoor air quality monitoring, and hazardous gas detection. In the context of agriculture, fruits produce distinct volatile organic compounds (VOCs) at different stages of maturation in varying amounts. This is a widely accepted biologically based indicator of fruit ripeness. Farmers still use experience to judge the maturity and quality of their crops, which is inefficient and unscientific in most regions where horticulture is the main source of income. As a result, creating a scientific way to track fruit ripeness has emerged as a key issue in contemporary agriculture. The use of smell (E-nose) is a non-destructive approach of determining fruit maturity, which makes it more appealing than most standard methods that measure firmness, pH, and sugar contents. The quantities of volatile organic compounds (VOCs) are determined by the distinct smell of each fruit. Throughout the maturity process, post-harvest fruit's VOCs content varies constantly. Another useful marker of the various ripeness stages of fruit is the color of the fruit peel.

CONCLUSION

Making appropriate use of post-harvest technologies can improve fruit and vegetable safety and adherence to quality standards in both domestic and foreign markets. We must prevent or remove microorganisms (both bacteria and mold) on fruit surfaces, as this directly affects the freshness of the fruits. After harvesting, we must employ innovative technologies such as controlled maturation, edible coatings, and temperature control, among others. Even though many post-harvest technologies remain unpopular in India, they play a crucial role in reducing losses, enhancing food security, and eradicating poverty. Choosing the optimal method for postharvest handling of fruits and vegetables requires a comprehensive understanding of both the coating matrix and the fruit's surface properties.

REFERENCES

Bhargava, A.; Bansal, A. Fruits and Vegetables Quality Evaluation Using Computer Vision: A Review. *J. King Saud Univ. - Comput. Inf. Sci.* 2021, *33*, 243–257.

Dar, A.H.; Shams, R.; ul Eain Hyder Rizvi, Q.; Majid, I. *Microwave and Ohmic Heating of Fresh Cut Fruits and Vegetable Products*; Elsevier Inc.: Amsterdam, The Netherlands, 2019; ISBN 9780128161845.

Li, J.; Shi, J.; Huang, X.; Wang, T.; Zou, X.; Li, Z.; Zhang, D.; Zhang, W.; Xu, Y. Effects of Pulsed Electric Field Pretreatment on Frying Quality of Fresh-Cut Lotus Root Slices. *LWT* 2020, *132*, 109873.