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Significance of Nano Bio-sensor in Horticulture Postharvest

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Abstract—*Horticulture science has been defined as a science and an art of cultivating and handling of fruits, vegetables, flowers, and medicinal plants. Human population is increasing rapidly, so providing enough and healthy food is becoming a big and importance issue. Now, increasing production efficiency and decreasing post harvest wastage with using the findings of novel scientific researches such as biotechnology and nanotechnology in products, could be counted as the best solution to this problem. In coming year increasing production efficiency and decaying postharvest wastage with using the finding novel researches such as bio-tech. and nanotech. improves the longevity, resistant of horticulture crop products. Oxygen is a problematic factor in food packaging because it can cause food spoilage and discoloration. In relation with extension of horticultural products shelf life, nanotechnology can help us in some grounds, e. g. controlling growth and development of micro organisms, introducing a new generation of packaging coverage's (Films) and controlling influence of gases and the harmful rays (UV), and developing new plastic for food packaging industry. The nanoparticles are used in the production of these plastics nanoparticles have been found to zigzag in the new plastic, and preventing the penetration of oxygen as barrier. Developing the smart packaging to optimize product shelf life has been the goal of many horticulture crops "Ethylene absorbent is the most important product of nanotech. Which improve shelf life of horticulture packaging product, ethylene materials absorbs to ethylene gas which is product by the fruits crops (decaying increase due to production of ethylene).*

Keywords*: Nano technology, horticultural crops, postharvest, shelf life, biosensor.*

1. INTRODUCTION

Nanotechnology is an increasingly crucial input in the industrialization and development of nations and communities. The shared technologies and innovations of today are giving birth to the radically different Agri-food industries and communities of tomorrow. There is mounting evidence that investments in postharvest research and infrastructure yield Nanotechnology is a fairly new technology and field of study. The techniques of nanotechnology also provide new powerful tools for biomolecular studies. Developments in nanotechnology have resulted from the efforts of scientists and engineers working in separate fields such as chemistry, biotechnology, photonics and microelectronics. For instance, nanofabrication integrates materials science, engineering, and biology. Agriculture is an integral part of the wider biological industry. Given that the world of biology is at the scale of microns and below region where the sphere of nanotechnology resides, the convergence of biotechnology, bioengineering and nanobiology to solve practical problems facing agricultural is logical. Horticultural products waste is estimated around 20-30% in developing countries so even if we manage to reduce this amount for 5-10%, huge saves will be obtained. Now, increasing production efficiency and decreasing post harvest wastage with using novel sciences such as biotechnology and nanotechnology in products, could be counted as the best solution to this problem. Nanotechnologies promise many stimulating changes to enhance health, wealth and quality of life, while reducing the environmental impact. This paper highlights some recent results on the use of nanotechnology for horticultural crops postharvest shelf life improvement.

2. WHAT IS NANOTECHNOLOGY?

Nanotechnology is the design, characterization, production, and application of structures, devices, and systems by controlling the shape and size at the nanometer scale. A nanometer (nm) is one billionth of a meter. Nanotechnology using of particular characteristics of nano-particles can be a very useful technology in all science and industry branches. Understanding and controlling matter at the nanoscale interests researchers in the sciences, medicine, agriculture. In relation with extension of horticultural products shelf life, nanotechnology could be helpful in four aspects described below.

Controlling Growth and Development of Micro Organisms

Numerous microbial, physical, and chemical hazards occur in the human food chain, which contribute to this major safety issue. Concerns over pesticides and other chemical residues have led to the ban of manyagrichemicals used in fruit production and storage. Physical contaminants (foreign materials) such as broken glass, wood, soil, plastic or metal parts such as nuts, bolts and nails can cause illness or injury to the consumer if they become embedded inside fruits. Gray mold disease caused by *Botrytis cinerea* is considered an important postharvest pathogen around the world. It induces decay on a large number of economically important fruit and vegetables during the growing season and during postharvest storage. It is also a major obstacle to long distance transport and storage. This fungal pathogen infects leaves, stems, flowers and fruit, either by direct penetration or through wounds caused by cultivation practices. Control of this disease is especially important during storage because it develops at low temperatures (e. g. -0. 5°C) and spreads quickly among fruit and vegetables. On the other hand, losses can be ameliorated by fungicide treatments which can ensure product protection, but these are permitted for only a few food crop species. Moreover, public awareness of the negative impact of synthetic fungicide residues on human health and environment has prompted deregulation of key chemical fungicides. Another important issue is the appearance of pathogens resistant to the synthetic fungicides. Hence there is growing emphasis on environmentally friendly technologies in the fresh fruit and vegetables industry, and the search for safer alternatives to chemical fungicides has received much attention. Some advantages to using coatings include reduction of water loss, retardation of ripening, reduction of chilling and mechanical injury, reduced decay, and added shine or gloss to the coated products. Coatings can also be used as carriers of useful ingredients such as antimicrobial compounds, color or aroma additives, anti-oxidants, or anti-ripening compounds. Coatings can indirectly induce changes in flavor due to delayed ripening or as a result of anaerobic respiration and accompanying increased ethanol concentrations. Coatings can be made from polysaccharides, proteins, lipids or a combination of these materials. Chitosan (Poly b-(1-4)N-acetyl-d-glucosamine), a deacetylated form of chitin, is a natural antimicrobial compound known to reduce postharvest decay of fruit and vegetables. Application of Chitosan to control pre and postharvest diseases led to an improvement of fruit and vegetables quality and it has enticed much attention due to its low toxicity to mammals and as an environmentally safemean of plant disease control. It has been suggested that Chitosan has a dual effect on host–pathogen interaction antifungal activity and activation of plant defence responses. At present, increasing interest is being devoted to the use of natural substances such as bioactive Chitosan polymers. Nanotechnology is using for antifungal in many fruits and vegetables. A technology has been developed to produce zincoxide nanoparticles using microbial approach. Some nanoparticles have been used for antifungal in vitro culture and postharvest of banana, carrot, tomato, onion and etc.

Introducing a New Generation of Packaging Coverage's (Films) and the Proficient Ability to Control Sway of Gases and Baleful Rays-

By means of the right selection of materials and packaging technologies, it is possible to keep the product quality and freshness during the time required for its commercialization and consumption. The application of nanocomposites promises to expand the use of edible and biodegradable films. Unfortunately, so far the use of biodegradable films for food packaging has been strongly limited because of the poor barrier properties and weak mechanical properties shown by natural polymers. For this reason natural polymers were frequently blended with other synthetic polymers or, less frequently, chemically modified with the aim of extending their applications in more special or severe circumstances. It will help to reduce the packaging waste associated with processed foods and will support the preservation of fresh foods, extending their shelf life. General requirements polymers in fruit and food packaging are summarized in Fig. 1. TiO_2 has been the focus of photo-catalysts under UV irradiation because of its physical and chemical stability, low cost, ease of availability and non-toxicity. The nano- TiO_2 with light catalyzing capability can oxidize Ethylene into water and CO_2. Moreover, nano-Ag has the function of absorbing and decomposing ethylene.

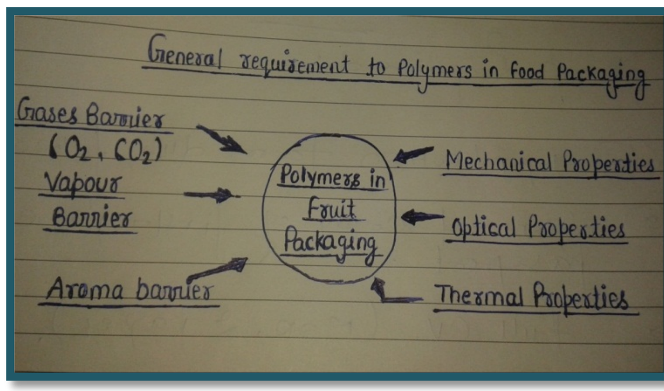

Fig. 1: General requirements to polymers in fruit and food packaging.

In hancing Strength, Quality of Packaging -

A big effort to extend the shelf life and enhance food quality while reducing packaging waste has encouraged the exploration of new bio-based packaging materials, such as edible and biodegradable films from renewable resources. The use of these materials, due to their biodegradable nature, could at least to some extent solve the waste problem. Nanotechnology has been widely applied to the food industry. Fuji apples with Nano-SiOx/chitosan preservation agents had good quality according to the research of Li and Wang (2006). Green tea, with nano-packing, had better maintenance of vitamin C, chlorophyll, polyphenols and amino acids than with normal packing. The objective of this work was to prepare a novel nanopacking material and investigate its effect on preservation of Chinese jujube during room temperature storage. In Table 1 Physical properties of normal packing and nano-packing materials has been demonstrated. In spite of the great possibilities existing for packaging in bio-based nanocomposite materials, the future scenario is difficult to predict. At this stage, we can only imagine that simple traditional packing will be replaced with multifunctional intelligent packaging. The next generation of packaging materials will be able to fit the requirements of preserving fruit, vegetable, beverage, wine and other foods. By adding appropriate nano-particles, it will be possible to produce packages with stronger mechanical, barrier and thermal performance. To food safety, nano-structured materials will prevent the invasion of bacteria and micro-organisms. Embedded nano-sensors in the packaging will alert the consumer if a food has gone bad. Hydrocolloids serve numerous diverse roles such as providing hardness, crispness, compactness, thickening quality, viscosity, adhesiveness, gel-forming ability and mouthfeel. As the fundamental components of fruits, functional ingredients such as vitamins, antimicrobials, antioxidants, flavorings, and preservatives come in various molecular and physical forms. Because they are rarely used in their purest form, functional ingredients are usually part of a delivery system. A delivery system has numerous functions, only one of which is to transport a functional ingredient to its desired site. Besides being compatible with fruit product attributes such as taste, texture, and shelf life, other functions of a delivery system include protecting an ingredient from chemical or biological degradation, such as oxidation, and controlling the functional ingredient’s rate of release under specific environmental conditions Because they can effectively perform all these tasks, nanodispersions and nanocapsules are ideal mechanisms for delivery of functional ingredients. These types of nanostructures include association colloids, nanoemulsions, and biopolymeric nanoparticles. Nanoemulsions: An emulsion is a mixture of two or more liquids (such as oil and water) that do not easily combine. Therefore, a nanoemulsion is an emulsion in which the diameters of the disperse nanolaminates. Consisting of two or more layers of material with nanometer dimensions, a nanolaminate is an extremely thin food-grade film (1-100 nm/layer) that has physically bonded or chemically bonded dimensions. Because of its advantages in the preparation of edible films, a nanolaminate has a number of important food-industry applications. Edible films are present on a wide variety of foods: fruits, vegetables, meats, chocolate, candies, baked goods, and French fries. Such films protect foods from moisture, lipids, and gases, or they can improve the textural properties of fruits and serve as carriers of colors, flavors, antioxidants, nutrients, and antimicrobials.

Table 1: Physical properties of normal packing and nano-packing materials (Li et al., 2009).

Packing	Relative humidity transmission rate (g/m2 24 h)	O2 transmission rate (cm3/m2 24 h_0. 1 MPa)	Longitudinal strength (MPa)
Normal packing	2. 85	12. 83	32. 35
Nano-packing	2. 05	12. 56	40. 16

Using the Nanobiosensors for Appellation of Products-

Biodegradable sensors in food products – In this way the Sensor changes the colour when the pH changes because of contamination or spoilage “Release on command” preservative packaging operated by means of a nanobioswitch. In Figure 2 ongoing pathway of labels in fruits postharvest has been demonstrated. As it applies to the food industry, nanotechnology involves using biological molecules such as sugars or proteins as target-recognition groups for nanostructures that could be used, for example, as biosensors on foods. Such biosensors could serve as detectors of food pathogens and other contaminants and as devices to track food products. Nanotechnology may also be useful in encapsulation systems for protection against environmental factors. In addition, it can be used in the design of food ingredients such as flavors and antioxidants. The goal is to improve the functionality of such ingredients while minimizing their concentration. As the infusion of novel ingredients into foods gains popularity, greater exploration of delivery and controlled-release systems for nutraceuticals will occur. Some application of nanobiosensors including: Virus recognition using antibody sensor arrays on self-assembled Nanoscale Block Copolymer Patterns, the Detection of Food-Borne Toxins with multifunctional nanoparticles.

3. CONCLUSIONS

It is resulted that the nano technology played a crucial role in post harvesting technoogy management. Several researches are supporting that nano-packing materials had completely useful effescts on physiochemical and physiological quality compared with normal packing material. Furthermore, these nano-packing materials have the advantages of simple processing and industrial viability in oppose with other storages, some of which are time-consuming, costly and alter color and flavor. consequently, the nano-packing may furnish an attractive variant to improve the preservation qualities of fruits, vegetables and other valuable horticultural crops during extended storage. In addition, researches are still needed to clarify the exact nano-packing mechanism on stored products to facilitate the application of nanotechnology over a broader range in future.

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