

The use of nano natural edible coating and films to Prolong Shelf Life of fruit & vegetable

Introduction

Nanotechnology is considered to be materials through which we control the construction of molecules in the specific size and shape, and with the difference of these molecules and compounds, the physical and chemical properties differ from them in the normal case, and from this we can develop nanotechnology at the atomic and molecular level at longitudinal levels from 1-100 nanometers. Thousands of shapes and sizes of different properties are produced for us from the same Nano metric material (depending on the structure of the particles of the material). The physical and chemical properties differ from them in the normal case, and therefore these materials take on new qualities that did not exist before. The modern world has tended to expand the production of nano natural edible coating and films and its technological applications on It is widely used in packaging and covering many types of vegetables and fruits because they do not interact with foodstuffs at room temperature and refrigeration. In gas and steam exchange and prevent corruption food is known as safe food film or functional film, which protects the food product from corruption, resists microbes and prevents oxidation, and in general, it consists of raw materials of plant or animal origin, as it is considered a thin barrier layer used as healthy and safe alternatives to traditional packaging materials harmful to human health and the environment where it is treated the food product, whether fresh or processed.¹

Definition of natural edible coating and films

It is known as the food safety natural edible coating and films or the functional edible coating and films, as it protects the food product from corruption. It also expels microbes and prevents oxidation. In general, it is considered a thin barrier layer. Laminated natural barrier consists of natural edible materials with which the food product is treated, whether it is fresh or manufactured with the aim of protecting the food product. Extending its shelf life and maintaining the quality and safety of packaged food.

Packaging is defined

Packaging is defined as a necessary means to preserve the food product, whether it is fresh or manufactured, for the longest possible period of spoilage, while preserving its natural, chemical and sensory properties without change. Therefore, the packaging must meet three conditions:

- Protect the produced product during storage, storage, and mechanical storage, and find corruption and microorganisms.
- It contains the packaged product in the appropriate size and shape to achieve ease of use and handling for the producer and the consumer
- It sells the product packaged in a well-designed package that is attractive in shape and appearance and announcing the contents of the data, labeling and progress nutritional information that satisfies the consumer's desire.²

Volume 12 Issue 1 - 2022

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Received: January 03, 2022 | **Published:** February 02, 2022

The purpose of natural edible coating and films

- Inhibiting the migration of moisture, oxygen, carbon dioxide, odors and fats
- It provides an additional composition that acts as a carrier for food additives (antioxidants, microbes, nutrients, colorings and flavors) as well as food quality characteristics.
- Preserving the food material through a protective process to reduce waste and control the breathing process for the transfer of moisture and gases and the loss of odors
- Improving the efficiency of transportation and the ease of food handling, and thus reducing the cost associated with the availability of equipment, devices and equipment for storage operations in an atmosphere that controls the breathing process and the preservation of the product during distribution during retail sales
- These food films, when they have good mechanical properties, can replace the synthetic films
- Maintaining the quality of food after disposing of the packaging and after consuming the food material by biological autolysis
- It acts as a barrier or insulator for water, gases and oils, thus it is possible to control the movement of water inside the food and prevent the loss or gain of the Laminated Barrier as a moisture barrier and then maintain the freshness of the food

- viii. Where it works to bind the food material, especially the surface, such as linking the surface of candy and entertaining foods with an adhesive substance from the natural membranes, as well as connecting peanuts, sesame and others
- ix. Regulate and control the activity of water and maintain an appropriate level of water because it has a great impact on the nutritional quality characteristics and limits the autolysis in meat and control of breathing and over-ripening in fruits and vegetables and fruits as well as control of processes and vital transformations The naturalness within the tissues of the fresh material and prolonging the shelf life of fresh and manufactured products as long as possible.

Functions of natural edible coating and films

- a. A safe package that is produced from natural materials, as it is non-toxic, while reducing the need to use industrial materials
- b. It does not interact with the food, thus it maintains the health and safety of the consumer
- c. Extending the shelf life of fresh and manufactured products as long as possible³
- d. It acts as a barrier or a barrier to water, gases and oils, thus it is possible to control the movement of water inside the food and prevent the loss or gain of moisture and thus maintain the freshness of the food
- e. Binding, where it works to bind the food material, especially the surface, such as linking the surface of candy and entertaining foods with an adhesive substance of natural membranes, as well as connecting peanuts, sesame, and others
- f. Regulate and control the activity of water (aw) and maintain an appropriate level of water because it has a great impact on the nutritional quality characteristics as it limits self-decomposition in meat and control of respiration and over-ripening in fruits and vegetables and fruits as well as control of operations And the natural biological transformations within the tissues of fresh matter
- g. Low of weight water: Where the edible coating and films are used to reduce moisture loss and prevent surface drying, especially vegetables and fruits. These membranes have a good effect in limiting aerobic respiration processes, which results in physiological disturbances and accelerates anaerobic respiration processes and the growth of anaerobic microbes that lead to deterioration of fruits and It has lost its quality
- h. Hydrophilic : A term that expresses the non-permeable products of oils and fats, especially when frying in oil, where the membrane works
- i. Surface film : Where the edible coating and films limits the spread of solvents on the surface of foods because it has the property of activity active pack, which plays a role in the activity of antioxidants and microbes and their spread on the surface. One of the scientists used a protein edible coating and films containing sorbic acid as a preservative and it was immersed on the surface of the food with medium moisture, which proved its efficiency in delaying oxidation and microbial growth for a longer period and This is called Bacteriostatic Packaging
- j. Natural edible coating and films are: an essential component of large and complex economic distribution systems that move goods from their original places to their places of consumption.

This definition is important for health and economic distribution.

Applications of nano films on fruits and vegetables

Packaging has a role in the handling of the food product and its safety and the application of global technology, starting with agriculture and exploiting the high competitive advantage to produce high-value plants through manufacturing technology and pre-harvest transactions, then packaging and its conformity to international standards, which leads to an increase in exports with awareness of farmers about modern technology in agriculture and improvement Packaging technology to be a source of control over producers and follow-up of the product during its circulation in the markets while improving the quality of the product and maximizing the use of these plants for organic farming and their impact on society and how to obtain them and present them to the consumer in an appropriate healthy form. Distorted and unpolluted land for production and a source of usable water and then its own packaging, as well as preventing the spread of its sale on sidewalks or small or medium-sized stores. Therefore, it is necessary to develop methods of food packaging and packaging in Egypt with the aim of developing exports and preserving products from damage and loss and prolonging their storage period in addition to their ability to for transportation and marketing, which leads to an increase Exports of agricultural crops. The following are the most important points to be taken into consideration and taken into consideration, from pre-harvest transactions to packaging and food products in order to develop agricultural exports.³

Importance of pre-harvest transactions

I. Selection of suitable varieties for preservation

- a. This is because they retain their flavor, smell, color and strength of cohesion when treated with heat during sterilization. Therefore, it is preferable to collect the fruits when they reach the stage of fruit maturity.⁴
- b. The quality of the raw material, as it determines the characteristics of the product, and thus affects the costs of the product and its preparation, such as the processes of sorting and peeling, affect the final product and therefore production and costs
- c. Agricultural treatments for raw materials such as irrigation, fertilization and pesticides, for example, irrigating the crop shortly before Friday increases the moisture content and fertilizing affects the chemical composition.¹

II. Harvesting

The appropriate maturity stage for each crop is taken into account, as required during the following harvest process.

- a. Avoid any mechanical damage
- b. The length of the harvest season so that the plant is constantly fed
- c. The appropriate agricultural area helps the ripening process at varying dates and for long periods
- d. Harvesting must be done at intervals, as harvesting once leads to the accumulation of huge quantities of raw materials that are difficult to manufacture at once.

III. Storage

Storage receiving and storing the raw material depends on the shape of the food, is it a liquid or solid concentrate, freshness, type

of raw material, method of harvest, type and size of packages, and degree of cleanliness before storage.

The importance of storage

- The continuation of the factory line financing until the work continues 24 hours
- Prolonging the manufacturing season for long periods
- Save the materials when they are available at a reasonable price.

IV. Grading

By size - shape - color - texture - density - chemical composition - fungal insect infestation.

The importance of grading

- Unified products with one value are given for each of the grades to which the food is listed
- Unifying heat preservation and heat treatment, thus reducing production costs
- Outputs of the same type of different value are given, and this helps satisfy the desires of a large number of consumers
- Choosing the appropriate source for preservation and knowing the appropriate maturity stage, because increased maturity turns the food item into a mass during sterilization, and this affects the sensory properties of the preserved substance
- A grading according to the characteristics of the fruit, known as quality grading, or according to size grading, or according to the degree of maturity. The difference in grading affects the small sizes and leads to their shrinkage.

V. Sorting

Where crushed, infected and incomplete fruits are excluded.

The importance of Sorting

- Lifting the soft and damaged material so that it does not run in the line and cause pollution
- Lifting improper materials and removing foreign objects such as stones, twigs and metallic materials, using magnetic machines.

VI. Future vision

The economic studies of the product include all the necessary processes before the packaged food reaches the consumer.

- Interest in increasing the areas registered organically
- Paying attention to the training of workers in this field
- Economic feasibility studies and marketing strategies
- International legislation and export obstacles
- Modern packaging systems
- Food Processing.

Types of natural edible coating and films

First: Polysaccharides edible coating and films.

Alginate - pectin - carrageenans - starch - dextrans - cellulose derivatives - methyl and ethyl cellulose - hydroxypropyl methyl cellulose.

Second: the protein of natural edible coating and films.

Collagen - gelatin - vegetable proteins (wheat soy protein - corn zain - milk proteins (casein and whey).

Third: lipids films acetylated of natural edible coating and films glycerides - waxes - surfactants.

Fourth: Composite of natural edible coating and films moisture-retaining properties - gas - dissolved substances – additives.

Preparation of preparing various different treatments for filling

Fresh fruits and vegetables are dipped for one minute in a disinfectant solution of calcium hypochlorite (0.25 g/L distilled water) and then air dried. fixed in the flask) and the sample was then dried with air. The second group nano-treated solutions: start with the other selected natural membrane solution, then dip the vegetables and fruits and dry the covered layer on the surface of the fruits and not covered with air.^{5,6} The fruits and vegetables covered with the natural edible membrane solution were divided into two groups: the first group Of the fruits are apples and red grapes that were kept in the refrigerator refrigeration at (0-2°C) and relative humidity (RH) 90-95% the other group of vegetables tomatoes and green sweet peppers where they were kept in the refrigerator refrigeration at (8°C) and 90 relative humidity 95% Then all samples were wrapped with parchment paper, then packed in foam dishes or trays with a capacity of 6-8 fruits each and a shrink was made and wrapped with cellophane (0.02 mm thick), except for packing the red grapes 800 grams in a capacity of foam dishes and preserved in carton boxes, then saved the samples after filling. The cooled storage was done in refrigerators in the Post-Harvest Research Department, Horticultural Research Institute, Agricultural Research Center in Giza. During the storage period, samples of fruits and vegetables are withdrawn for examination and analysis in terms of physicochemical properties periodically, covering vegetables and fruits with edible films can be summarized as prolonging the shelf life and maintaining freshness, freshness and quality properties when stored at refrigeration temperature. Therefore, these films are of practical benefit in the field of food industries.

Preparation of nano natural edible coating and films and study of their physical, mechanical and rheological properties

Most of the films consist of a single polymer, whether it is a high molecular weight protein or several sugars that are linked with plasticizers such as glycerol and polyethylene glycol to increase the elastic and elastic properties of the film. Cross-Linking increases the edible coating and films tensile strength and elongation, and this cohesion increases with the increase in the length of the polymeric chains and the increase in the polarity of the electrostatic links. The cohesion with the hydrogen bond within the chain also increases and the ionic equivalence that accompanies the cross links and there are materials that help the links such as citric acid and starch, as antioxidants and antimicrobials are added.

Preparation of nano-emulsion of essential oils with some modifications

Tween was used as a catalyst in reducing non-ionic surfactants and stopping the reaction with oil and distilled water to prepare nano-emulsion with different concentrations, as follows: the concentration of essential oils extract (5% v/v) while Tween 80 was 30% by weight of the aromatic essential oils) for each of Emulsion and nano-emulsion formulations Then prepare the coarse emulsion by gradual

and continuous addition of aromatic essential oils and tween where it acts as surfactants to water with shaking in a homogenizer at 3000 rpm after finishing adding distilled water to the essential oils where stirring continues for 30 minutes and by completing the homogenization process at 6000 rpm for 10 minutes, then the coarse emulsion was subjected to ultrasonic sonication for 15 minutes using an ultrasonic sonication bath device where the shape of the solution is symmetrical in the nano-emulsion at room temperature.⁷

The effect of edible films carrying essential oils on improving the quality of transactions and the minimum permitted by international organizations (WHO and Codex)) for the preparation and characterization of silver nanoparticles

- a. Prepare silver Ag No₃ nanoparticles as follows by adding 1 ml/liter of lavender oil extracted from crude phenolic compounds (as antioxidants), then adding to 45 ml (0.002 M AgNO₃) in conical flasks at room temperature in the dark for some time and then performing the homogenization process In a homogenizer and then exposed to a sonication bath, the production of bacterial nanopolymers to produce edible membranes using bacterial fermentation strains with specialized environments, then the incubation is done in a fermenter or a vibrating incubator at the appropriate temperature and then the product is obtained as a cellular biopolymer product Separate the production of bacterial nano-polymer to produce edible films and the materials used in this experiment, then divide the edible films into different groups. to the solution and leave to mix for 30 minutes and then dissolve until a clear solution is obtained. At the same time, the required amount of alkali is added. Ag No₃ (0.25, 0.50, and 0.75) wt% of CMC synthetic nanoparticles loaded on carboxy methylcellulose (CMC) films in 100 ml deionized distilled water using ultrasonic bath sonication for 30 min Once the CMC was completely dissolved, the Add the suspension of Ag No₃ to it and allow it to mix uniformly.

b. Conversion of starch to nano by hydrolysis process (hydrochloric and sulfuric acid)

sub-gelatinization to the beginning of thermosetting gelatinization and amorphous acid molecules in amorphous regions, Where these materials transform from the ionic image to the nanometric image and form amorphous granules, and thus the size of atoms and molecules decreases in size and shape.

c. Converting protein to nano Glutaraldehyde C₅H₈O₂

It speeds up the reaction, improves it and lowers the average molecular weight.

Linking it with transverse bonds to the particles to increase the properties of the film, its strength and cohesion and stoichiometric ratio , Adjusting the proportions of chemicals that react with each other the tween stops the (Block) of the last aldehyde group from reacting.^{9,10}

Summary

Due to the frequent use of plastic materials in food packaging at the present time, and the occurrence of direct contact between the food and plastic, which may lead to deviation in the properties and contamination of the packaged and wrapped food with some components of the packaging installation during the storage period as a result of the migration of some compounds included in the

composition of the polymer and their transfer to the food matter Which may lead to the spread of carcinogenic diseases and harmful to human health and the environment. Hence, the use of alternative and harmless sources for human health and the environment. These materials are represented in the use of natural membranes as healthy and safe alternatives to traditional packaging materials prepared from plastic materials and other packaging materials harmful to foodstuffs, human health and the environment. These alternatives are natural edible coating and films consisting of materials of plant and animal origin that are of nutritional value and can be wrapped in food and consumed directly, as these natural membranes are safe and harmless to human health with their ability to eat, digest, absorb and benefit the human body from them, and they do not pollute the environment upon disposal.⁸ It is a natural organic matter that is automatically degraded by enzymes in the soil. The modern world has tended to expand the production of these natural membranes and use them in packaging and covering many types of vegetables, fruits, meat, fish and their products, as they do not interact with foodstuffs at room temperature or refrigeration, as these edible coating and films reduce the rate of respiration of living tissues and control gas exchange and steam , which does not affect the quality of the food and prevents its loss or shrinkage, as it preserves the taste, texture and natural flavor of the food, reduces the need to use a preservative and reduces the economic cost of the product. Several primary raw materials are included in the preparation of these natural membranes, including vegetable proteins, starchy materials, fats, waxes, etc., alcoholic sugars, and some materials that improve texture and formation, such as glycerol, polyethylene glycol...etc.

Acknowledgments

None.

Conflicts of interest

The author states there are no conflicts of interest.

Funding

None.

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