Tulsi Based Coating for Preservation of Vegetables and Fruits

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Abstract

Microbial spoilage of food is one of the leading causes of food scarcity worldwide, which could have devastated effect on the social economy of any country. Around 20-30% of total fruits and vegetables produced with in a year gets lost because of food spoilage. Chemical preservatives can extend the food last longer without being contaminated but many chemicals are associated with adverse effects in humans, which can involve an unpleasant reaction in people sensitive to a particular additive or a potential risk of cancer. Sodium benzoate, also called benzoic acid, is used in acidic foods to keep away from microorganisms. In sensitive individuals, it can cause asthma, hives and other allergic reactions also when combined with ascorbic acid in acidic foods it can produce benzene, which may slightly increase the risk of Leukemia and other types of cancer. In the present study we develop a medicinal plant-based fruits and vegetable dipping solution to reduce the adverse effects exhibited by the chemicals that are currently used in the market as preservation technique. Hence, a new innovative method for the preservation of vegetables and fruits known as "holy basil coating for the preservation of vegetables and fruits". The ability of Tulsi to protect against the damaging effects of various toxicants has been documented. Tulsi has anti-bacterial, anti-viral and anti-fungal activity that includes activity against many pathogens. Hence the present study may open a new channel for food preservation and reduce the risk of cancer.

Keywords: Microbial spoilage, preservatives, anti-bacterial, anti-viral and anti-fungal, Tulsi,

Introduction

Plant based foods are in high demand because nutritional epidemiology has linked them to improve wellbeing and longevity. Spoilage of plant commodities routinely occurs all over the world due to various factors leading to significant wastage. Factors that contribute to and influence spoilage of fruits, vegetables and cereals including environmental factors such as pH, temperature and oxygen, as well as other factors such as some consumer attitudes. Bacterial spoilage first causes softening of tissues as pectin are degraded and the whole vegetable may eventually degenerate into a slimy mass. Starches and sugars are metabolized next and unpleasant odors and flavors develop along with lactic acid and ethanol. Besides *E. carotovora*, several *Pseudomonas* spp. and lactic acid bacteria are important spoilage bacteria. Molds belonging to several genera, including Rhizopus, Alternaria and Botrytis, cause a number of vegetable rots described by their color, texture, or acidic products (1). The higher moisture content of vegetables as compared to grains allows different fungi to proliferate, but some species of Aspergillus attack onions.

Intact, healthy fruits have many microbes on their surfaces but can usually inhibit their growth until after harvest. Ripening weakens cell walls and decreases the amounts of antifungal chemicals in fruits, and physical damage during harvesting causes breaks in outer protective layers of fruits that spoilage organisms can exploit (2). Molds are tolerant of acidic conditions and low water activity and are involved in spoilage of citrus fruits, apples, pears, and other fruits. Penicillium, Botrytis, and Rhizopus are frequently isolated from spoiled fruits. Yeasts and some bacteria, including Erwinia and Xanthomonas, can also spoil some fruits and these may particularly be a problem for fresh cut packaged fruits. Fruits juices generally have relatively high levels of sugar and a low pH and this favors growth of yeasts, molds and some acid-tolerant bacteria.

A range of polymers can be used in edible coatings formulation. However, their mechanical and barrier properties are intrinsically linked to the physical and chemical characteristics of their constituents. The polymers most used in the preparation (alone or in combinations) of edible films and coatings are (Fig. 1):

- Polysaccharides (starch, pectin, cellulose, alginate, and carrageenan)
- Proteins (gelatin, casein, wheat gluten and zein)
- Lipids (stearic acid, waxes, and fatty acid esters)

Spoilage may be established as surface pellicles or fibrous mats of molds, cloudiness and off-flavors. Lack of oxygen in bottled and canned drinks limits mold growth. Saccharomyces and Zygosaccharomyces are resistant to thermal processing and are found in some spoiled juices. *Alicyclobacillus* spp., an acidophilic and thermophilic spore-forming bacteria, has emerged as

an important spoilage microbe, causing a smoky taint and other off-flavors in pasteurized juices Propionibacterium cyclohexanicum, an acid- tolerant non-spore forming bacterium also survives heating and grows in a variety of fruit juices. Lactic acid bacteria can spoil orange and tomato juices, and some pseudomonads and Enterobacteriaceae also spoil juices (3).

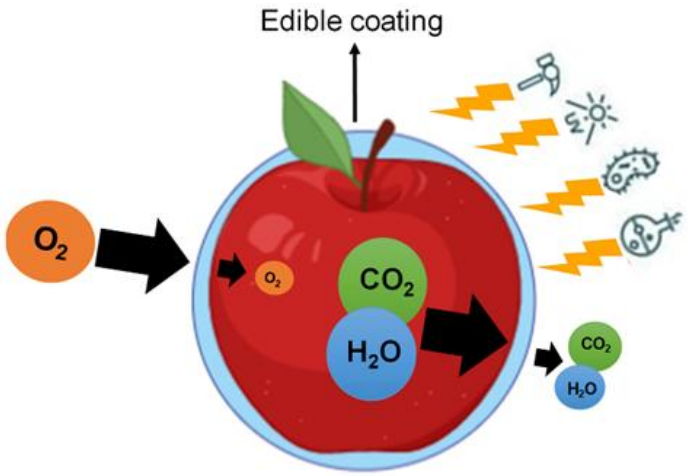

Fig. 1. Mechanism of edible coating

Ocimum tenuiflorum (synonym *Ocimum sanctum*), commonly known as holy basil, tulasi (sometimes spelled thulasi) or tulsi, is an aromatic perennial plant in the family Lamiaceae. It is native to the Indian subcontinent and widespread as a cultivated plant throughout the Southeast Asiantropics.

O. sanctum grow up to 60 cm high with red or purple sub quadrangular branches. Leaves are simple, serrate and hairy. Flowers are purple in color. Fruits are smooth and not mucilaginous when wetted. It is propagated by means of seeds. Seeds are planted directly in the ground. Young plants are transplanted when they attain 8-10 cm height Krishna Tulsi has purple leaves while Shri Tulsi has green leaves. Tulsi is used to reduce skin disorders, pain, swelling, headache and disease of the head and neck. Tulsi leaves are very useful for lung, intestinal and cardiovascular diseases. They are also effective in reducing stress, blood sugar and blood cholesterol (4).

According to Indian Agricultural Research Data Book 2004, the losses in fruits and vegetables are to the tune of 30 per cent. Taking estimated production of fruits and vegetables in India at 150 million tones, the total waste generated comes to 50 million tons per annum. The post-harvest technologies for perishable horticultural produce serve as an effective tool for getting better return to the produce and also help in avoiding wastage both at production site and distribution centers, which will help in regulating the market infrastructure. Like any other food, fruits and vegetables are also prone to microbial spoilage caused by fungi, bacteria, yeast and molds.

Antioxidant properties

According to the previous report from the Journal of Advanced Pharmacy Education & Research showed that ethanol extract - *Ocimum basilicum* - had more antioxidant activity than standard antioxidants.

Antibacterial properties

Studies have demonstrated that basil has antibacterial properties various concentration of tulsi extract this may be because of the volatile oils it contains, which include estragole, linalool, cineole, eugenol, sabinene, myrcene, and limone, restricts the growth of numerous bacteria.

Existing preservation techniques and their disadvantages

One of the most common and effective ways to fruit preservation is that, fruits and vegetables are to prepare and place them in air-tight containers, which are then heated. The high temperatures ensure that microorganisms are killed and the enzymes are inactivated. Any remaining spores will not have the right conditions to grow into bacteria and microbial contamination from outside is prevented. However, it is important to remember that some micro-organisms are unfortunately less sensitive to heat: *Clostridium* and *Staphylococcus* can still multiply and spoil the food through the poisonous substances they produce. Clostridium can cause botulism and result in tragic deaths (5). This bacterium does not thrive as well in more acidic products such as fruit (pH < 4.5).

The heating method for fruit is different than for most vegetables. As noted above, fruit has a low pH level. It can be heated in boiling water (100°C), whereas most vegetables have to be heated at temperatures above 100°C, because they have a higher pH and are thus more susceptible to bacterial contamination (6). This preservation method produces the best results, but only if fresh products are used and the instructions for heating are followed exactly. As with other methods, heating has advantages and disadvantages as outlined below.

Advantages

- Most micro-organisms are destroyed so there is less chance of spoilage

- After being sterilized and stored the food can be kept longer and more safely.

Disadvantages

- Heat-resistant storage containers (which can be difficult to obtain) such as cans or glass jars. The latter are preferred because they can be reused, nontoxic nonreactive.
- Cooking utensils, such as a steamer

Extraction of Tulsi by Soxhlet extraction

The dried powder of Tulsi was placed in the thimble of Soxhlet apparatus 500 ml of distilled water was used as a solvent. The extraction was continued till clear solvent was seen in the thimble. The extract was concentrated using Rotavapor. Then the extract was dried in a digital water bath till a dark green residue was obtained. The extracts were kept in the refrigerator till further use.

Extraction of starch

- Allow the starch to settle for about 20 minutes. As time goes on, the water will start to turn clear again. The starch will settle at the bottom of the pot.
- Pour out the excess water, mixt it well to in order to dissolve completely and discard excess amount of water.
- Add fresh water to the container and wait another 20 minutes. Pour equal amount of water into the container. Let the starch settle to the bottom another 20 minutes.

Drying of starch

- Spread the starch out onto a butter paper with a rubber spatula. You can also use a wide baking pan or casserole dish. The thinner you spread the starch, the faster it will dry.
- Allow the starch to dry and harden. Coverer the starch with a sheet of paper, wax paper, or parchment paper to avoid using plastic wrap in order to prevent moisture contamination, incubate for 24 hours to dry the starch, dried powder can be stored in the dry and clean bottles.

Coating method

Tulsi extract, glycerol, starch are taken as a in the ratio of 3:1:1 was coated in selected vegetables. Dipping is the common coating method used for coating the extract. Coating is achieved by dipping products in coating solutions and drain the excess extract from the coated vegetables as it dried and solidifies (Fig. 2).

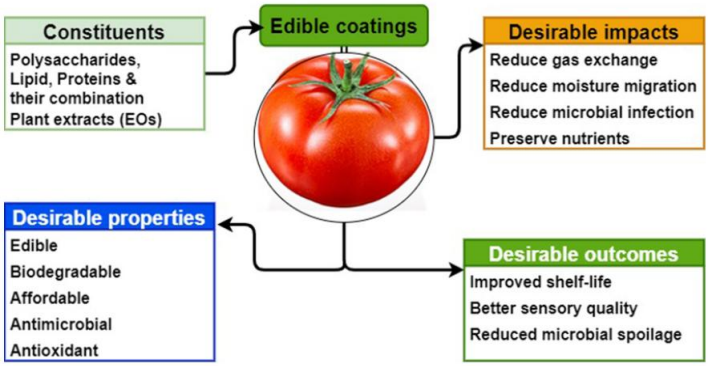

Fig. 2. Potential applications and limitations of edible coatings for maintaining tomato quality and shelf life

Advantages of edible coatings over other post-harvest treatment in context of health

- The coatings can be consumed with the packaged products, which reduces the use of synthetic packaging material. As there are no materials to discard and even if left over will degrade more readily than synthetic one leads to the reduction of environmental pollution.

Improvement in cosmetic appeal

- Edible coating technology support the reduction of organoleptic properties of fruits and vegetables by giving additional shine to the fruit surface besides act as flavoring agent and sweetener. In addition to this the edible coating reduces weight loss and keep the fruit stable so that it keeps the fruit fresh.

In context of improvement in shelf life

- The coating reduces the respiration rate as well as senescence by delaying and reducing ethylene production (Partial barrier to gas exchange (6). It also prevents fruits and vegetables against different storage disorders including chilling injuries mainly in tropical crops. It can be also be used successfully for individual packaging of small products such as pears, beans, nuts and strawberries for increasing shelf life.

In context of being Intermediate technology

- Edible coatings serve as an intermediate and linking technology viz., this can be used as carrier technology for other applications.

It acts as a base for different postharvest chemical treatments like the addition of anti-microbial compounds, aroma compounds and fortification. Encapsulation of different aroma compounds, antioxidants, pigments, ions with edible coats can reduce the browning reactions and enhance the shelf-life of fruits and vegetables (7). Different nutritional substances such as vitamins and minerals can also be added to enrich the product. They enhance the nutritional composition of fruits and vegetables without affecting its quality.

Results and Discussion

Tulsi based starch coating shows a good performance that is achieved along with starch in different fruits and vegetables, forming edible barriers at a cost. Starch based coatings decreased the respiration rate, preserving mechanical properties and colour characteristics of vegetables(tomato). In general, coating help to retain active compounds incorporated into their formulation, such as anti-microbial and antioxidant properties on the product surface for longer storage times, thus enhancing their effectiveness.

Starch-based coatings exhibit water solubility and poor water vapor barrier properties and helps in the preservation of fresh horticultural products. The additives added are of antimicrobial activity thus keeping the horticulture products from decaying. At present the shelf life of organic fruits and vegetables is a major problem and by introducing such edible starch-based preservation technique the maintenance of quality and safety during storage can be ensured. Hence, the present study we mainly focused on the development of effective coating materials with bioactive compounds to extend shelf life and improve the quality of the food. These coatings would be act as a barrier and prevent the releasing novel bioactive components like vitamins, nutraceuticals, enzymes, probiotics etc, into the food matrix throughout time.

Recent studies point to the application of micro and nano technologies to develop coatings which incorporate encapsulated compounds that are released by a certain stimulus such as pH, temperature, or osmotic changes in the medium. Hence the present study may open a new channel to prevent the large-scale spoilage of fruits and vegetable and can conserve for future days.

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