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Undergraduate



# THE FRESH NEW FUTURE OF PRESERVATIVES

BY DIANA NGUYEN

Food is an essential part of life. Unfortunately for us it does not last forever. Before refrigeration, people had to find a way to store food for times of low crop yield, travel across great distances, and times of famine. Honey, salt, sugar, spices, pepper, onion, garlic, and ginger were used throughout history as natural ways to protect food from rotting and make food about to go bad easier and safe to swallow. In fact, keeping food preserved spurred an entire economy in the 14th century as well as European access to the Americas through spice trade. Since then, the Food Drug Association (FDA) in the United States has approved thousands of preservatives from acacia to zoalene for use in commercial food products. However, with recent consumer cautiousness towards artificial preservatives, there is a movement towards a more natural approach to food preservation.

The basis of what makes a preservative work is the inhibition of the growth of microbes and fungi as well as the protection against damaging free radicals which can cause cancer, heart disease, and speed up the aging process, according to Louis & Parke.<sup>1</sup> Therefore, preservatives play with a delicate balance between what can kill certain organisms that cause spoilage without damaging or killing us. A major part of drawing that line is FDA regulated concentrations and restrictions on certain substances to help maintain standards of limited toxicity.

## PRESENT PRESERVATIVES

While the FDA has approved certain preservatives for human consumption, that doesn't mean they are completely free of negative side effects. Sulfur dioxide is legally used with many products, like dried fruits, fruit juices, and some meats. It keeps the fruits from looking discolored and has antimicrobial properties. Though it has been used since ancient times as a preservative, studies have shown some apparent issues of this gas that can be toxic at standard atmosphere. Individuals with asthma should be careful, as sulfur dioxide could aggravate symptoms.<sup>2</sup> However, it is still FDA approved at concentrations lower than .05% in foods.

“The Food Drug Association (FDA) in the United States has approved thousands of preservatives from acacia to zoalene...”

Nitrates are common as well in the industry of food preservation, particularly with processed meats. They help to keep cold cuts and cured meats fresh by inhibiting the enzymes of molds. Nitrite toxicity is due to tissue death from lack of oxygen. Nitrates convert haemoglobin, an oxygen carrying protein in the blood to a defective form known as methaemoglobin. Concerns have been brought up about their use as infants are particularly sensitive and nitrates are also used in mashed vegetable baby food. There is also issues about nitrates being carcinogenic. Studies have shown “interaction of nitrite with a variety of nitrogenous compounds, including secondary amines, either in the food matrix





Figure 1: Apricots treated with sulfur dioxide on the right compared to those untreated on the left

or in the digestive tract,” can result in the creation of nitrosamines within the body which lead to cancer.<sup>3</sup>

In response to consumer’s concerns towards these chemical preservatives and others, there has been a spike in the research towards using bio-based extracts to naturally preserve foods. Scientists are looking at substances like those found in fruit peels and the wall of fungi to aid in helping to keep foods from spoiling. Though some studies are looking purely at the effects of utilizing these plant extracts, some are taking baby steps towards total usage and looking at ways to combine the preservatives of today with newer methods to decrease the levels currently approved to make foods safer.

Areca nuts are one of the most addictive substances in the world. Combined with their medicinal properties and popularity as a leisure food, they are high in demand in South and East Asia. The areca nut is known for its “antiparasitic effects, effects on digestive, nervous and cardiovascular systems, etc.”<sup>4</sup> However, due to the temperatures of the region where they are grown and their sensitivities to cold temperatures due to their tropical nature, it is difficult to keep them fresh enough to preserve the properties for which they are so highly valued.

## ISSUES

To ensure availability outside of the harvest season, microbial growth needs to be controlled. Growth is commonly measured in colony forming units (CFU) per gram. CFUs are the number of bacterial colonies that can be grown on a plate from the sample in question that is analyzed through total plate count. Sulfur dioxide is commonly used to preserve the nuts, as with other produce such as dried mangos.

However, as discussed previously, it can cause issues for those who have difficulty breathing due to pre-existing asthmatic issues. Chitosan may be a natural alternative. Commonly found in the exoskeleton of crustaceans as well as fungi walls, it can activate genes and enzymes in plants that defend against decay. Food can be further fortified with a film on the fruit surface, decreasing the amount of oxygen and carbon dioxide exchanged and preventing fruit respiration and rot.<sup>5</sup> Chitosan offers both outer and inner defenses to protect the freshness of the fruit.

## WHAT NOW?

Though chitosan offers a natural and effective way to keep our foods fresh, there is still a use and need for sulfur dioxide. Chitosan helps keep the fruit safe from damage from the chemical conditions of the environment, but sulfur dioxide plays a large role in inhibiting microbial growth. Both are needed in order for nuts to be fresh and safe to eat. Though they both decrease rate of decay significantly as independently, with chitosan prolonging shelf life slightly more than sole sulfur dioxide. Combined, both treatments can maintain the quality for forty days, almost twice as long as untreated areca nuts.

However, this doesn’t mean that there isn’t a benefit to utilizing chitosan in conjunction as opposed to solely sulfur dioxide as is traditionally done. When using both treatments, the final sulfur dioxide content was 9.3-12.5 mg/kg lower than the upper limit of the approved concentration of 50 mg/kg.<sup>6</sup>

Other methods have been explored to use other alternatives to sulfur dioxide to combine with chitosan to further increase shelf life. Citric acid or licorice extract can



Figure 2: Could chitosan, like that found in mushrooms and shrimp be the solution?

be used like sulfur dioxide to offer the same antimicrobial effects. Both are methods that achieve the same goal as the potentially dangerous substances currently being used.<sup>7</sup>

Besides chemicals and other animal and plant-derived extracts, changes in atmosphere can also be used in conjunction with chitosan to help increase shelf life. Atmosphere packagings of varying levels of carbon dioxide, nitrogen, and oxygen help keep the quality of foods.<sup>8</sup>

While chitosan is a studied substance for food preservation research, other substances are also active in the ability to enhance foods. Pomegranate peel extracts are other additives undergoing research. Biopreservatives are just being to be explored, and through continued research, there will likely be more and more natural extracts that will be able to offer similar or other effects to keep the quality of our foods fresh in a time where the food demand for the ever growing population is on the rise.

There is a ways to go until we can make the conversion to a strictly natural biopreservative industry. The FDA has officially recognized some in their list of allowed preservatives like allspice and spearmint. Hopefully soon we’ll be able to pick up an orange or a fish fillet that has been treated with natural additives.

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