No need to get browned off: Edible films keep fruit fresh

September 23 2013, by David Tribe

The shiny surface of an apple is often courtesy of the wax of a Brazilian palm tree. Credit: Micah Taylor

Packaged green salad items, such as lettuce, coleslaw, or spinach sold ready to toss in the salad bowl, are now a frequent item in supermarket trolleys.

With the ongoing popularity of such convenience foods, we are soon likely to see packaged ready-to-eat sliced apple products on supermarket shelves. Ready-to-eat sliced mango could follow.

But as every cook knows, sliced apple turns an unpleasant brown colour

very quickly, and even though they are nutritious and otherwise palatable, brown apple slices usually end up in the rubbish bin. The shelf life of apple slices is thus measured in minutes. How can these minutes be extended into days – or even weeks?

Edible films save the day

Practical ways to completely stop brown discolouration of apple slices have recently been devised by food scientists, and these methods put a new twist on an old idea of adding a protective coating to food.

They rely on addition of a thin edible surface film to the cut fruit which delivers ingredients to arrest the apple discolouration process.

Protective edible films have been used on food for hundreds of years. In 16th century England, cut meat was coated with animal fat ("larded") to prevent drying out. Sausages and cheeses are routinely preserved with surface coatings.

Today, confectionery is protected and improved by cocoa butter surface glazes. Apples and oranges are made more appealingly to consumers by giving them a surface coating with wax from a Brazilian palm tree.

This also extends product life by stopping the fruit from drying out quickly. But waxy films don't stop browning of apple slices, and can be unpalatable to consumers.

For apple slices, there are a number of alternatives to waxy surface coatings. These also offer the advantage of being a suitable carrier for other food ingredients that can prevent browning and increase shelf-life. Such edible film materials include a range of the edible plant gums.

Credit: NathanaelB

The key to success is finding the right edible film ingredients that will effectively stop browning without adversely affecting flavour or aroma. A little background on the relevant food chemistry is helpful for understanding how this can be done.

Some food chemistry

Brown discolouration of cut fruit (and indeed cut fresh vegetables such as carrots and lettuce) comes from oxygen in the air reacting with mostly colourless phenolic compounds that are present in most plant tissues, including fruits.

Plants produce an incredibly wide range of chemically-reactive phenolic compounds, and these have many different roles in plant biology. These

plant chemicals include a diverse group of compounds called flavonoids, which include the pigments of yellow, pink or blue flowers.

Various other plant phenols can protect the plant from stress or predators, act as antioxidants, and prevent microbes from invading plant tissues.

A natural plant flavonoid phenol, for instance, gives astringency to beverages made from green tea leaves, and is believed to have health-promoting properties.

Fruits (and indeed most living plant tissues) contain protein catalysts usually called enzymes.

These plant catalysts actively promote the reaction of oxygen gas from the atmosphere with plant phenols and thus generate brown phenolic oxidation products.

The main enzyme causing brown colour formation is called polyphenol oxidase. This plant catalyst is responsible for the rapid brown discolouration of apple slices by the reaction of oxygen with plant phenols.

Interestingly, the same oxidation process generates brown colours in apple juice, wine, tea, chocolate and coffee, and the colours of these products are perfectly acceptable to consumers.

Vitamin C: Reaction neutraliser

Vitamin C (also called ascorbic acid, and famous for preventing scurvy), has strong antioxidant properties. It has long been known to be a very effective antidote for the polyphenol oxidase enzyme, and thus is an effective way of preventing the browning of apple slices.

Vitamin C can be incorporated into edible gum films and added to sliced apples in thin edible surface films. Such surface films effectively stop the browning reaction without causing any changes to the taste of the apple slices.

These non-waxy colourless films also slow down access of oxygen in air to the sliced apple surface. They are fully compatible with other film ingredients such as food acids which can be used to further enhance palatability and product lifetime of sliced apples.

The practicality of such non-browning apple slices relies on the ready availability of low cost vitamin C, but fortunately other technological innovations have generated efficient ways of making this vitamin by low cost conversion of sugars into ascorbic acid.

A variety of non-browning apple slices trial products, using surface film coating containing vitamin C, have now been rated as attractive to consumers in taste tests.

They can provide a food with a safe product lifetime of as long as two weeks. This food innovation is enticing food companies to consider marketing apple slices as a healthy (and longer-living) snack.

Source: The Conversation