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Have an apple a day - without a spot of brown

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Imagine being able to slice apples on Sunday afternoon and use them in your kids' lunches for the week. It's something we just don't do, since those apples would be unappetizing in a short time, due to polyphenol oxidase (PPO) - the natural enzyme driving the chemical reaction that causes browning. Okanagan Specialty Fruits (OSF) has found a way to silence the PPO gene, resulting in an apple that won't turn brown. A sliced apple that stays nice and white is now a reality.

On June 2, members of Saskatoon's bio-community gathered to welcome OSF to the city. Neal Carter, the company's president and CEO, spoke at Ag-West Bio's first Saskatchewan Life Science Showcase event. OSF recently moved its R&D operations to NRC-PBI in Saskatoon from Summerland, BC, where the company carried out lab activities at the Pacific Agri-Food Research Centre of Agriculture Canada since 1997.

OSF is a unique company, privately owned, with shareholders largely from the tree fruit industry. The firm holds licensed technologies that permit it to introduce novel attributes into new or existing apple, pear, cherry, peach, nectarine and apricot fruit trees. OSF is one of the first firms pursuing genetic engineering and/or precision breeding in the commercial tree fruit industry.

Carter says the "home-grown" company has worked hard to establish a core of motivated, highly skilled individuals who drive the business forward. They have expertise in molecular biology, genomics, bioinformatics, and microbiology. Embracing new technology, the company has focused on developing products and taking them to market. OSF would be happy using and commercializing existing technology, Carter claims, but what they need is just not available. This has led to much collaboration; with Cornell University, the U.S. Department of Agriculture, Agriculture Canada, as well as groups in Australia and New Zealand.

Carter says the apple market has been flat for some time. In the last 10 years, China has completely taken over the Asian apple market, once dominated by Washington State and British Columbia.
The company looked at carrots as a model. Tumbled carrots were introduced in 1988, but the product was "kind of wet and dismal and not very successful," until the early '90s, when the industry finally produced an appealing "baby" carrot. Within six years, consumption of carrots doubled.

With consumers seeking healthy snack choices, fresh-cut fruit and vegetable consumption has increased, and the fresh cut apple industry has gone from nothing to about 4 million of the 200 million boxes of apples consumed each year. Keeping ordinary apples from going brown by using antioxidants and various dipping solutions is expensive – as much as 25 to 40% of the cost. Food service accounts for only about 1-2% of apple use. OSF

identified the fresh-cut market as an obvious opportunity – and a way to get people to eat more apples. Using biotechnology tools, they set out to produce an apple to address this market niche.

The process of developing the non-browning apple took seven years, and Carter recounts the excitement staff felt when they realized they had succeeded. “We would bash two apples together, bounce them around in a truck,” he recalls. (They’ve since come up with more scientific methods to characterize the non-browning effects, he laughs.)

Carter makes it clear that there is a difference between low-browning and non-browning apples. It takes a bit longer, but low-browning apples do go brown. The low-browning quality has nothing to do with PPO or the inhibition of the enzyme; it has more to do with cell-wall integrity, and low-substrate level. They are typically late season apples, where the DNA has degraded and there is less activity in general in the apple.

OSF has dubbed its non-browning apple the “Arctic” apple, a name that brings to mind the freshness of the pristine north. The non-browning effect can be produced in any apple variety – for example, the Arctic Gala or the Arctic Golden.

Carter says OSF technology is based on sound science. In creating non-browning apples, a family of genes existing in the apple is turned off. The resulting trees grow like normal apple trees, and produce apples that look and taste like normal apples.

There are benefits throughout the value chain. For growers and packers there is less cullage due to harvest and postharvest superficial bruising; for retailers, there is less shrinkage due to consumer handling that causes cosmetic scuffs – resulting in otherwise good fruit to be picked over and tossed out at the end of the day. This shrinkage accounts for up to 15% product loss.

Results of market surveys and focus groups have been positive: Overall, there is a 75% rate for both product appeal and company interest, with a high of 97% appeal in the food service sector.

Consumer focus groups were conducted in Seattle, WA, and Syracuse, NY. Grocery shoppers with no knowledge of the Arctic variety were shown a number of apples. Discussing their likes and dislikes of apples, almost all participants agreed that browning was a turn off. Many didn’t like the idea genetically engineered food, but after seeing the control apples - the color of chocolate after being sliced and sitting for 90 minutes - they were quite excited about the Arctic apples, which had maintained their white flesh. Carter recalls that in every focus group, every single slice was eaten.

OSF has submitted their Arctic Golden and Granny Smith apple for the science based, rigorous process of deregulation in the U.S. (FDA and AFIS) and will be submitting in Canada later this year (Health Canada and CFIA). Regulations are “complicated, time consuming, onerous and expensive,” but Carter says OSF is well prepared for the tough due diligence they are expecting.

OSF has embarked on commercial partnering, with a goal to establish six to eight field test plots outside of the company’s own field trials. 20,000 trees are being propagated for that purpose. Carter expects Arctic apples to be available to consumers by 2015.

They are now exploring using transient gene silencing to create an interstem that can be grafted onto any tree. This would mean the plant currently undergoing deregulation could be used, making it unnecessary to go through the process multiple times.

OSF is also working on disease resistance in fruit trees, especially trying to combat fire blight, a bacterial disease that can infect thousands of trees in an afternoon (Gala and Honeycrisp apples are very susceptible). Once infected, it takes about eight months for the tree to die, a “slow and painful thing to watch,” Carter says. The approach is to silence existing receptor genes in the apple variety so the disease does not have a means to attack the plant.

Carter says they are happy to be in Saskatoon, where he believes there is great synergy and opportunities for collaboration. John Armstrong is lab manager at NRC-PBI. For more information about OSF, visit their website: www.okspecialtyfruits.com