

by David Despain

Fruit-Focused Formulating

Would that everyone had the fortune of taking a daily summer's walk through an apple orchard, a grape vineyard, or along a strawberry field—to catch a whiff of the ripening fruit and to be guided along solely by one's senses to his or her choice of fresh, sweet, mouth-watering goodness. Perhaps, then, there wouldn't exist the need to worry over weight gain, obesity, and its health consequences or the devastation that is brought on by chronic disease.

Whether consumers appreciate the value of eating more fruits and vegetables for their health is not in question. The Centers for Disease Control and Prevention reported a growing awareness—from 8% in 1991 to 40% in 2004—of the multiple benefits of eating “five a day.” But gains in knowledge did not change behavior during this time, with intake of vegetables even decreasing slightly. As the figures from CDC stand, the average U.S. adult currently consumes about 1.1 servings of fruit and 1.8 servings of vegetables daily, far short of dietary recommendations.

Despite the grim figures, the scientific evidence surrounding fruit and vegetable benefits is convincing enough that encouraging people to consume more daily continues to be a priority. The *2010 U.S. Dept. of Agriculture Dietary Guidelines for Americans* lists three reasons for getting at least nine servings daily: fruits and vegetables contribute a number of nutrients lacking in U.S. diets including vitamins A, C, K, folate, potassium, fiber, and magnesium, as well as health-protecting

phytochemicals; they are relatively low in calories and can aid in weight management; and they are associated with reduced risk of several chronic diseases such as heart disease, stroke, high blood pressure, diabetes, and some cancers. These are the motives behind USDA's calls to “focus on fruits” and “vary your veggies” and their promotion of MyPlate, which emphasizes making half of breakfast, lunch, and dinner plates fruits and vegetables.

However, one of the major constraints of meeting goals to increase intake in the United States is accessibility and affordability. Recognizing this hurdle, the CDC in 2011 detailed 10 strategies, most of which were designed to combat the existence of so-called “food deserts.” These strategies have had some success. According to a *State Indicator Report 2013*, many states (such as California) are improving access to fruits and vegetables and making it easier to get them into communities, schools, and child care. The change in trends has not escaped the attention of Dan McCormick, founder of Bowl of Heaven LLC, based in Orange County, Calif. His small franchise, which offers consumers their

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choice of bowls of frozen fruits, smoothies, and fruit juices has seen record growth over the last few years. “People are becoming more aware now about the benefits, so we try to deliver them their healthiest meal of the day,” he said. But



McCormick notes that consumers are very particular about their product. He said, “They look at texture, taste, and mouthfeel. It has to taste right and be affordable to them.”

That's where food science and technology is key. Strangely absent within nationwide efforts and in CDC's strategies is the role of indus-

Fruit has been linked to myriad health and disease risk reduction benefits.

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Mary Ann Lila, Plants for Human Health Institute Director, presents samples of protein powders and flours infused with nutritious compounds from fruits and vegetables, which can be used to create food products that are healthful, shelf-stable, and tasty. Photo courtesy of North Carolina State University Plants for Human Health Institute

solutions for improving shelf life of fresh fruits, preservation of nutrients in dried fruits, reducing calories in fruit juices, and the creation of fruit-derived ingredients that can easily be incorporated into processed and packaged foods.

Fruit That's Army Strong

Take a proprietary technology developed by researchers at North Carolina State and Rutgers University that infuses bioactive compounds from muscadine grapes and kale greens into protein powders for use in U.S. soldier rations. The research was sponsored by a grant from The Center for Advanced Processing and Packaging Studies (CAPPS) and is expected to benefit The U.S. Army Natick Soldier Systems Center, the Army's organization responsible for developing and managing soldier-support items like food, clothing, and shelters.

Look no further for a "food desert" than the actual deserts of the Middle East and Africa where U.S. troops are stationed. According to Mary Ann Lila, Ph.D., director of the Plants for Human Health Institute at

North Carolina State University, these soldiers often find themselves in the harshest of conditions, going for months at a time without any access to fruits and vegetables. The challenge is principally in the difficulties of storage and transportation. Although the soldiers are charged with maintaining peak physical condition, their rations lack the nourishment from fruits and vegetables necessary to best protect their immune systems and to reduce risk of illness and injury. The unfortunate consequence for these undernourished soldiers is that they have decreased mental and physical performance as well as greater risk of chronic disease. By concentrating muscadine grapes and kale bioactive compounds into protein powders such as whey isolate, Lila says the rations will better serve soldiers' immune systems and muscle maintenance.

The simple "kitchen-table technology" the researchers use requires no solvents or sophisticated lab equipment. It's this technology that has interested Lila for more than a decade. Her focus initially was to develop the method of concentrating bioactives for use in third-world countries as part of a Bill and Melinda Gates Foundation project in Zambia. In Zambia, where there's little refrigeration, fruits and vegetables are only available for six months out of the year. To help prevent stunting in children through improved nutrition, Lila developed a method of concentrating mango-derived carotenoids into peanut flour, making nutrients such as beta-carotene (vitamin A) available at low cost year-round. Now the same technology will provide U.S. soldiers with a hefty amount of immune-protective phytochemicals in their rations in a way that is shelf-stable and that can be incorporated easily into prepared foods such as bars.

The proprietary process is based on the principle that the pigments in fruits and vegetables—which are medium-polarity compounds such as

polyphenols, anthocyanins, and proanthocyanidins—have a natural affinity for protein powders such as hemp, soy, and whey isolates. "They will bind together non-covalently," she said. "We are able to concentrate them into the protein, a natural binding that both stabilizes the protein and the phytoactives. The other water, sugar, and fats leached off." The lightweight flour that's left is all the protein infused with polyphenols that is free of sugar and fat.

Why the choice of kale, muscadine grapes, and whey protein for soldiers? The kale is ideal for savory preparations and for its sulphur-containing compounds called glucosinolates found mainly in cruciferous vegetables that are associated with reduced risk of some cancers. Muscadine grapes, in particular, are ideal for sweet preparations such as health bars, and (unlike regular table grapes) they have tough, thick skins that are rich in pigments associated with a number of health benefits including better mental and physical performance. The protein powder formulations are also now available through Nutrasorb LLC (<http://nutrasorb.com/>), North Brunswick, N.J., which was founded by Lila and her colleagues at Rutgers.

Towering Dried Fruit Powder Quality

On the other side of the Atlantic exists another kind of technology that was developed to spray-dry apples, tomatoes, and carrots into powder while preserving not only their nutrients, but also their flavor, color, and texture. What some might say transcends standards of spray-drying is the BIRS tower located in Burgdorf, Switzerland, and named after the famous Birs river that flows through the area. Reaching a height of 250 feet, the BIRS tower is the tallest spray-drying facility in the world.

According to Frederic Randet, Business Manager at Naturex (www.naturex.com), Avignon, France, droplets of pulp are sent

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A new shelf-life-extending formulation from NatureSeal was developed specifically for the delicate characteristics of avocados and is well suited for applications like this avocado-accented sushi. Photo courtesy of NatureSeal

from the top of the tower, and ground airflow counters their fall, allowing for gentle drying at temperatures of less than 50°C. The result is a cold-temperature processed natural powder containing no additional carriers. In contrast, usual spray-drying systems generally involve juice concentrates mixed with maltodextrin and heat greater than 130°C that leads to loss of nutrients, flavor, color, and texture. "This cold drying takes more than a minute because it takes a long time for the pulp to lose water and become a natural powder," Randet says. "We really preserve all the nutrients due to the high tower. It's like a garden in powder with all the aspects of nutrients, colors, flavor, and taste."

The BIRS-quality powders work well in applications such as dehydrated soups and sauces, bakery goods, and in baby food. Baby food is one of the biggest markets for the products because of fondness for clean labeling, as well as the nature and flavor of the product. The difference rests in starting from pulp instead of juice concentrate mixed with maltodextrin. "The best example is apple sauce," Randet says. "Customers are really impressed by the natural feel and texture of the sauce. You really recover the pulp, and there's no clumping."

Bringing Field and Tree Top Freshness to the Masses

Back on the U.S. west coast, a newly built facility in California has Doug

Webster, Director of Product Development, Treetop Inc. (www.treetop.com), Selah, Wash., enthusiastic about the future. The company's new plant, he says, allows for pasteurization of strawberries. "What you've seen in the past is unpasteurized fruit. You take it from the field, freeze it, and put it into products. Now you can pasteurize it," Webster said. For the consumer it will mean greater shelf life of the raw fruits used in products such as yogurts, beverages, and ice cream.

The company is also making headway into creation of fruit clusters. Taking from the tradition of cereal clusters, they have introduced dried fruit clusters with a range of 40% to 100% fruit. The finished form can be offered in cereals, as snacks, and in the side compartment of yogurts as offered by several fast food restaurants. "People are always looking for healthy foods, but they also want food that tastes good. That's our focus," Webster said. "You don't want something bland and boring that no one will eat more than once."

In addition, the company produces a variety of drum-dried, low-moisture fruit powders. The drum-dried powders are ideal for producing more cost-effective powders through blending. More expensive fruits such as strawberries are blended with less expensive ones such as apples and then dried to produce powders at lower cost without sacrificing quality or flavor.

Cutting Calories with Coconut Water

On the retail side, Treetop Inc., is taking advantage of what Webster calls "a pretty big fad:" coconut water. The company is using coconut water to naturally reduce the sugar content of 100% fruit juice blends. For example, Treetop now offers grape and apple juices that are blended with coconut water, cutting the sugar content by as much as 25%. The new juice blends appeal to consumers who are looking to drink

more fruit juice without extra calories or with artificial sweeteners added. They're available in grocery stores across the Western United States.

As with any trend or fad, the question that arises about coconut water is how long the popularity will last. Gert van Manen, president of iTi Tropicals Inc. (www.ititropicals.com), Lawrenceville, N.J., a leading provider of coconut water, is cautiously optimistic about the product's future. In a speech addressing a Foodnews Juice Asia 2013 event in Bangkok, Thailand, this spring, he made the case that the product was unique enough to stay around for the long-term in the food and beverage market, especially in juice blends. However, van Manen warned, the future success of coconut water depends on proper labeling of sugar-added products. "There's a big market for sugar-added coconut water, but make sure to label it correctly," he said, alluding to lessons learned from a recent \$10 million lawsuit settled by a company that mislabeled its product.

Fresh That Stays Fresh

With consumers beginning to demand more fresh fruits in their products, demand has also increased for extension of their shelf life. Biocatalysts Ltd., (www.biocatalysts.com), based in South Wales, UK, has recently announced the introduction of *Pectinase 872L*, a fruit-firming enzyme that helps retain the firmness in soft fruits. It works by reducing the breakdown of pectin, needed to maintain the structure and texture of soft fruits such as strawberries, keeping them fresh longer in yogurt and other food applications.

NatureSeal Inc., has also long provided solutions for grocers and restaurant owners to help prevent freshly cut fruits such as pears and apples from browning quickly. The company's proprietary formulation of vitamins and minerals works by both inhibiting respiration and oxidation of the fruits, extending their



Van Drunen Farms has developed low-moisture blackberries that deliver sweetness and help to extend shelf life. Photo © iStockphoto/Thinkstock

shelf life for up to 21 days. Now the company has introduced a special formulation that was developed for the delicate characteristics of avocados. When avocados are dipped or sprayed with the formulation, it helps maintain their color, flavor, and texture—which is expected to make restaurant owners who serve California Rolls and/or guacamole happy.

Fruits as Spices

To go well along with that guac, are salsa and spices that represent yet another way to get a daily dose of polyphenols from fruits such as chili peppers. A company that's tapping into the appeal of Mexican and South American fare is Fuchs North America (www.fuchsna.com), which announced the introduction of a lineup of new flavor bases just last March. These include a fruitful, flavorful chili that's intended for meat rubs (*Aji Amarillo*); an Argentina-inspired flavorful complex combining chili peppers, oregano, chili pepper flakes, and sea salt (*Gauche Rub*); a Brazilian-inspired avocado salsa that is somewhat reminiscent of Mexican guacamole; and a Colombian criollo salsa that blends tomatoes, onions, cumin, garlic, and peppers. The chili varieties range from low heat to spicy, and the company emphasizes quality in its products, providing spices

that offer a unique approach to gaining fruit-derived phytochemicals.

Berry Concentrated Benefits

When it comes to fruits with the most concentration of health-protective polyphenols, it's hard to beat berries. But raw berries are generally only available seasonally, presenting problems for their use in food applications. One option for getting the most berry bang for the buck is through concentrates provided by Proprietary Nutritionals Inc. (PNI), a division of Pharmachem Laboratories Inc., (www.pharmachemlabs.com/divisions/pni), Kearney, N.J., The company specializes in producing patented berry concentrates such as cranberry (*Cran-Max*[®]) and (*Berry-Max*[™]) with clinically shown health benefits. American Ingredients Inc. (www.pharmachemlabs.com/divisions/american-ingredients), Anaheim, Calif., another division of Pharmachem Laboratories, has also recently launched a highly concentrated pomegranate extract that is produced without solvents.

In addition, Van Drunen Farms (www.vandrunenfarms.com), Momence, Ill., has developed a new product for allowing blackberry flavor to be used in foods any time of year. The company's low-moisture blackberries have their water

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content replaced with sugar. The fruit takes on the sweeter flavor, and its shelf life is extended. The low-moisture blackberries are offered for use in baked goods such as muffins, pies, and cakes; breakfast staples like hot cereals, waffles, and pancakes; in dairy products like yogurt and ice cream; in trail mixes, or as stand-alone snacks.

Snack Sensations

Speaking of snacks, Van Drunen has also now expanded its line of products to include freeze-dried mango strips. These strips, like the low-moisture blackberries, are delicious as stand-alone snacks or included as ingredients in cookies, cakes, or breads. The snack market for fruits is proving to be an

expanding one with the opportunity of creating variety for consumers. Take Funky Monkey Snacks (www.funkymonkey-snacks.com), Fishers, Ind., which has recently gained distribution of its 100% real fruit crunchy snack products (*Bananamon*[®] and *Carnaval Mix*[™]) in nearly all Wal-mart supercenters and Wal-mart discount stores in the United States. These dried fruits are advertised as being nutritionally equivalent to their fresh counterparts.

Raisin' Health

While there are relatively few studies that have evaluated the health benefits of dried fruits and fruit-derived ingredients as compared to fresh counterparts, new research on raisins is

promising. Recently, a comprehensive review that included 80 studies was published as a supplement to the June issue of the *Journal of Food Science*, sponsored by the California Marketing Board; the review found that eating raisins regularly could indeed reduce the risk of developing chronic diseases including type 2 diabetes and heart disease, while improving blood sugar control and supporting weight management. The authors of the review also found that raisins could be used for increasing intake of fruit-derived nutrients in children. For example, the researchers found that raisins helped children lower their calorie intake daily. In addition, they suggested somewhat surprisingly that

raisins could reduce the incidence of dental cavities because they are unlikely to stick to teeth and could help remove particles from other foods in teeth.

In an article authored by Rui Hai Lui, Ph.D., as part of the journal supplement, he summarized the recommendations of his report in this way: "The key is to increase the amount up to nine to 13 servings of fruits and vegetables a day in all forms. Fresh, cooked, and processed fruits and vegetables including frozen and canned, 100% fruit juices, 100% vegetable juices, and dried fruits are all considered as servings of fruits and vegetables." **FT**

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