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Juice Drinks for the Next Generation



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America is in the throes of a war on obesity, and the latest battleground in its never-ending fight centers squarely on the nation's schoolyards, where enemy No. 1 looks a lot like a soda vending machine. On campuses from California to Connecticut, across Manhattan and Missouri, school boards and administrators have forcibly expelled soft drinks, installing in their stead a regime of less-objectionable options, including milk, sports drinks and plenty of juices and juice-based beverages. The reasoning is elementary: Rather than sanction soda's empty calories, excess sugar and hollow fizz, we owe our students an alternative that encourages healthful consumption consistent with what nutrition research says we should eat and drink.

Like fruits and vegetables: "Fruit in general is getting a lot more attention these days," observes Doug Webster, technical service manager, Tree Top, Inc., Selah, WA. He attributes the focus to the updated USDA Dietary Guidelines for Americans, which, he says, "have increased the recommended servings of fruits and vegetables to nine per day for a 2,000-calorie diet." So if we can't steer Junior to the fruit bowl or salad bar when hot dogs and fries are just a lunch line away, maybe we can at least supplement his nutritionally suspect lunch with potable produce.

But, proving once again that no good deed goes unpunished, even the juices and juice drinks that saved schools from soda now come under scrutiny as parents and professionals, upon actually reading the products' labels, realize that many such drinks are little more than sodas in disguise, packing as much sugar and as scanty nutritional merit as a caffeine-free pop. With the juice content of some not even cracking 5%, many of these purportedly juicy beverages might as well give up, add some bubbles and call themselves sodas.

This places schools, students and anyone else inclined toward sound sipping in a conundrum whose only exit seems to be the drinking fountain. "I think consumers are definitely becoming more aware of what is going on with juice content and are paying more attention to labeling," admits Catherine Hogan, category marketing manager, beverages, International Flavors & Fragrances, Inc., South Brunswick, NJ. Nevertheless, she says, "overall, we do see a lot of beverages with low juice content really showing the most growth, particularly with kid-targeted products." It's no secret why: Who doesn't appreciate the light, fruity sweetness and convenience of juicy beverages, cocktails, "-ades," teas and their like? Despite the recent hand wringing over health, juice's reputation as a virtuous foil to soft drinks is a pillar of public perception that's hard to shake.

The challenge for beverage manufacturers, then, is to align that perception with reality in a new generation of genuinely nourishing juice drinks. The fundamentals are already on our side: No matter how you squeeze it, juice is good food. Now we just have to tweak our formulation strategies and introduce functional benefits that will make these basic beverages — as well as some novel juice categories — even better.

A game of concentration

Whatever the next juicy generation of beverages look like, they owe a debt of gratitude to their common ancestor, good old-fashioned juice — or, as Title 21

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Photo: Pacific Northwest Canned Pear Service



Cost-effective fruit ingredients that remain available year-round and lack major price fluctuations, such as canned pears, often make a great starting point for smoothies and other juice-drink bases.

Section 101 of the Code of Federal Regulations (CFR) says, “the aqueous liquid expressed or extracted from one or more fruits or vegetables, purées of the edible portions of one or more fruits or vegetables, or any concentrate of such liquid or purée.”

Once it’s squeezed, “you can take that juice and do all kinds of treatments to it,” notes Bill Haddad, vice president, technical services, American Fruit Processors, Pacoima, CA. “You can strip off color. You can strip off acid.” You can remove minerals, flavor essences, sugar solids — virtually every characterizing element —

through ion exchange and distillation. What’s left is a sugary solution of “decharacterized” juice that, in FDA’s eyes, no longer even qualifies as juice.

That juice most likely has some of its water evaporated to produce a concentrate. From cold-filled and pasteurized “fresh” juices in the refrigerator case to single-serve Snapples® sitting stably on the shelf, most juice beverages count concentrates as their base ingredients, says Haddad. “It’s the most economical, easiest to transport and most readily available,” he notes.

Concentrates also grant flexibility in the strength and quantity of juice they include — so much so that the government had to pass a law to rein them in. In the early 1990s, FDA established a list of minimum Brix values that would serve as standards of identity for single-strength, 100% juices. The list covers everything from acerola to

youngberry, and any manufacturer who wants to claim “100% juice” on its beverage label has to dilute the chosen concentrate to a Brix level no lower than the listed level.

“Before the NLEA and the restructuring of all the Brix values,” Haddad recalls, “everyone was diluting juice to whatever they wanted based on taste and still declaring 100%. So, if I took apple, pear and cherry and mixed them together as concentrates, no matter how much water I added, the mentality of the industry 10 or 15 years ago had been that it was still 100% juice because I didn’t add anything else.”

Even manufacturers who don’t strive for a 100%-juice claim must be up-front about the dilution, says Haddad. “The law states that if your product purports to be a beverage that contains fruit or vegetable juice, you must declare the juice percentage on it,” he notes. “There’s no way around that.” And the more juices a product uses, the more convoluted the percentage calculation. The arithmetic would be easier if beverage makers worked primarily with single fruits, but more common are juice blends whose respective components’ Brix values differ both in single-strength standards and as concentrates. So how can a product designer ensure that their 100%-juice blend’s discrete components each meet FDA’s Brix minimum? By working backward, Haddad says, “you develop your formula based on each component.”

Consider a 100-gal. blend of four juices in equal quantity: 25 gal. apple juice at a single-strength value of 11.5°Brix, 25 gal. grape juice with a minimum of 16°Brix, 25 gal.

Sodas Get Juiced

It isn't easy being a soft drink these days. Sales are flat, they're getting run out of schools left and right, and — compared to all those jazzy new juice and energy drinks — a can of pop seems so last-millennium. So what's a soda to do when it runs out of fizz?

Get some juice, that's what. The blending of carbonated soft drinks with juice's flavor, color, and healthy halo "has been going on for 20 years, in and out," says John J. "Jack" Schroeder, vice president, director of sales and marketing, Milne Fruit Products, Prosser, WA. "But it seems that people are starting to look at it again, because a soda with empty calories versus a soda that has juice in it may make a mother feel better about giving that soda to a child."

Squeezing even 10% juice into a carbonated soft drink is something of an economic and manufacturing feat. "That's the problem that the soda industry has, because they're used to taking sugar, carbonated water, flavor and acid, adding them together, and making a drink" Schroeder says. "Going to a percentage of juice in their products is a deviation from their usual high-speed manufacturing."

A standard soda also behaves more predictably in response to heat, light and time's abuses than one that contains a natural juice. "Juices are a lot more delicate," notes Eric Johnson, R&D, product development manager, Milne Fruit Products. "And there are a lot more compounds in a juice" — acids, phenols, tannins, proteins and phytochemicals, all anxious to interact. "Sitting on the shelf," he says, "when it comes to when these compounds start to oxidize and combine with other things, what's going to happen? What reaction products are you going to have three months down the road?"

The high-fructose corn syrup, flavors, colors and acids in a typical soft drink fluctuate little from purchase to purchase. Juices aren't always so accommodating. "They can vary a lot depending on growing region and where you buy them from," Johnson explains. "So, say you're adding a raspberry juice to a raspberry soda. There are going to be big variations in acidity and color and flavor from year to year, growing region to growing region." Manufacturers have to ask if they can tolerate such uncertainty.

All is not lost, however. A soda's carbonation, by driving out oxygen and lowering the system's pH, actually helps preserve a perishable juice, Johnson says. And, he adds, "if a customer gives us their specifications — 'We can use it within such-and-such a range' — we know that we can blend or manufacture a more-uniform product to meet that standard."

of pear juice at 12°Brix, and 25 gal. of pineapple at 12.8°Brix. Knowing that you'll need 25 gal. of each at these standard Brix levels, you convert the Brix levels back to sugar solids for each juice and, Haddad continues, "then you actually take each component back to its concentrate. And each one is different in a

concentrate form, so now, even though you need 25 gal. of each juice in single strength, as a concentrate — because apple concentrate is 70°Brix, for example — you may only need about 3 gal. of apple concentrate, 5 gal. of grape and 2.5 gal. of pear. And when you blend those together, you have to dilute it

back to the equivalent of that same 100 gal. at a given Brix based on all those calculations."

For those not quick with numbers, Haddad offers this consolation, "It's all very basic algebra." But, he adds, "you've got to keep all your ducks in a row when you're doing these calculations. When you're doing 1 or 2 or 3 juices or 4, it's pretty easy. But when you get 15 different juices in a blend, you've got to keep track of every ingredient."

What's in a name

Let's say a manufacturer dilutes its 100-gal. juice blend with water. "If I took the same four ingredients for a total of 100 gal., and now I mixed that with 100 gal. of sugar water," Haddad says, "now I have 50% juice. It's the same calculation."

What changes, however, is the product's name. The moment you dilute a juice below its standard 100% Brix value, it's no longer a juice, per se, but rather a juice "drink," "beverage," "cocktail" or some other qualifying term "appropriate to advise the consumer that the product is less than 100% juice," states 21CFR102.33. While the combination of a qualifying term and the presence of a clearly stated juice percentage on the label should leave no question as to the drink's diluted nature, some watchdogs still accuse juice "drinks" of deceiving consumers into thinking that they're getting fresh-squeezed in a 5%- or 10%-juice product.

Partly to immunize themselves against such accusations, manufacturers have taken to designing juice

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beverages that meet their practical processing and price-point needs while still making the 100% cutoff. One tactic is to base the beverage on what the industry calls “filler” juices — white grape, apple and pear. Their advantages are legion: low cost, ample supply, hassle-free sourcing and a relatively inconspicuous sensory profile that allows for easy blending. So for the impossible dream of designing a 100% olallieberry juice, a more-realistic compromise would blend several affordable fillers with “a small amount of the expensive juice and add flavors to make up the difference,” Haddad says.

But don't added flavors dilute the juice from its 100% Brix value? Not if you play your numbers right. The trick is to use a concentrate (or blend thereof) diluted to a Brix value that exceeds the 100% level to begin with. Haddad explains: “Let's say you're working on a 100-gal. basis. You can take 100% juice and add 3 gal. of flavor. Now you have 103 gal. So, theoretically, you should have a 97% juice at this point. But you're allowed to declare this as a 100% juice if you kick up its Brix.” So, by diluting the concentrate to the Brix equivalent of 103%, “when you add the 3 gal. of flavor, you're diluting it back to 100%,” he notes.

While technically you could make a 100% juice out of a 50:50 blend of apple concentrate and other ingredients, Haddad says, “you'd have to make it with a 22°Brix product to say it's 100% juice. And nobody's going to drink it at 22°Brix. So the limit is really based on what the consumer is going to tolerate.”

The sweeter the juice

Experience has shown that consumers welcome juices whose added sweetness, flavor and color come from juice-derived ingredients. Such additives can count toward the percentage-juice declaration if also included in the Brix calculation. What's more, the practicality of using juices as flavoring, sweetening and coloring agents has triggered the development of 100% juices whose organoleptic profiles are far more complex and appealing than something squeezed straight from the fruit.

The substitution of juice concentrates for sugar and corn syrup has allowed beverage manufacturers to sweeten their products for years. Usually, manufacturers chose a blend of filler concentrates to provide sweetness while lulling label-readers with their “all-natural” image. “I like to see sugars sourced 100% from the juice itself,” says Webster, who nonetheless notes that cost-effi-

cient high-fructose corn syrup still exerts a powerful pull.

For the manufacturer who does opt to sweeten juice with juice, Jamie Goodner, Ph.D., product development manager, juice beverage applications, North America, Cargill Foods, Minneapolis, offers this advice. “I start by determining the flavor profile, sweetness level and juice content I want, and then I choose the right concentrate or blend for the job.”

Often, that means white grape. “White grape probably has one of the cleanest flavors that most resembles sugar in taste,” Haddad claims. Its drawback, however, is its 16°Brix finish, which obliges manufacturers “to use a pretty high level of grape, which sometimes could cost more

Beverages that balance juice content with reduced calories appeal to consumers who want natural juice without all the sugar of a 100%-juice drink. High-intensity sweeteners can help remedy any sweetness loss.



Photo: Tate & Lyle

but gives you a better flavor profile,” he says, noting that grape introduces kosher issues. “So the next-best choice behind it might be apple, and then pear. The flavor on pear is kind of marginal, but apple’s a pretty good blending juice if you get one that’s clean enough in flavor.”

It helps to find one clean in color, too. “All juices will be darker than a sugar solution,” Goodner says. They can be prone to browning, too. “It would be tough to go over about 30% juice in the entire drink and have a colorless end product,” she continues.

Suppliers have developed nearly invisible concentrates. Haddad’s company makes a line of reduced-flavor, -acid and -color sweetener concentrates whose blandness owes itself to fruit choice and processing. “We would select very low-acid apples or more-mature apples with a higher Brix,” he explains. “We would reduce the flavor by not returning the essence after concentration. And we may do a carbon treatment to remove the color slightly and make it a little lighter.”

Such steps stop short of ion exchange, which “strips off the acid, strips off all color, all flavor, and pulls out the minerals,” Haddad says. “Then I’m almost left with sugar water.” More specifically, it’s a decharacterized juice. While his company offers such a product for use mainly in bakery and dairy applications, in a juice drink, they don’t add to the juice percentage.

Squeezing out the calories

Most full-calorie juice drinks contain between 10% and 15% sugar solids, “and juices can be used

to provide all the sweetness in place of sugar,” says Goodner. Such a beverage might end up being 120% juice, she notes, and “you can’t really claim more than 100% juice.” But raising a beverage’s juice content above the federal standards sometimes comes in handy.

Too much juice, however, can be a liability, especially when nutritional gadflies have it in for any product that might hasten our decent into obesity. As Haddad observes, “With the whole obesity issue in this nation, everybody wants to switch from sugary drinks to juices, and besides that, they want more low-carb juices. They don’t want sugar.” But a low-calorie drink, he says, “is pretty difficult to achieve with juice because juice does contain a fair amount of natural sugar.”

That makes reducing the calories in an all-natural, 100% juice something of a puzzle. Haddad suggests one roundabout method. The lower that Brix value, the logic goes, the less sugar — and thus the fewer calories — the juice contains. “So, selecting a juice that has a low-Brix standard of identity can give you the lower calories and maintain your 100%-juice declaration,” he says. Take strawberry juice. With an 8°Brix standard of identity, “it’s much, much lower in calories than, say, 100% cherry juice, which has a standard of identity of 20°Brix.”

Most manufacturers, however, are willing to gamble that con-

sumers will accept a lower-percent-age juice “drink” instead of 100% if the deficit in juice begets a slimmer caloric profile. Going below 100% permits manufacturers a much wider berth for dilution, while nonnutritive sweeteners stand in the wings to make up for lost sweetness. Notes Hogan, “What we’ve seen as the trend with lower-juice-content beverages — and they can range from 5% up to 25%, even 50% juice — is

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that they are positioned, for the most part, as lower-calorie and can be blended with different artificial sweeteners.”

That’s why the first question Shawn Sprankle, beverage application scientist, Tate & Lyle, Decatur, IL, asks clients is about calories: “They’ll tell you, for instance, ‘I’m making a 10%-juice drink and I want to make it orange-flavored.’ That gives you a good starting point, but then you come back and say, ‘Well, what calories are you looking for in that 10%-juice drink?’” Knowing the number of calories helps guide his sweetener suggestions. This establishes “a good

benchmark as to whether this is going to be a totally nutritive sweetener,” notes Lori Napier, manager, new technology development, Tate & Lyle, “if it’s going to be totally no-sugar-added or if it’s going to be some combination of nutritive and high-intensity sweetener.”

Increasingly, beverage manufacturers find that the latter option serves both caloric and taste needs

Using functional fortification to pad a juice beverage’s nutritional resume has seized manufacturers’ attention.

best, and ingredient suppliers have responded with tandem sweeteners that pair nutritive options with nonnutritive types. For example, an ingredient that blends liquid fructose and sucralose “allows you to significantly reduce the amount of sugars on your label than if you were to use a normal, full-sugar product,” Sprankle says, noting the potential for reducing calories by up to 75%. “And it still gives you the nice sweetness that you expect when you’re drinking a full-sugar beverage.”

Fructose, Napier says, “can enhance some of the fruit flavors” typical of sweet-tangy juice drinks. “Fructose is found in most fruits

anyway,” she says, “so it gives a very natural sweetness profile.” In the case of beverages, she continues, “it gives you a very upfront, very early sweetness that clears the palate quickly. It doesn’t stay syrupy on the tongue and mute some of those fruit flavors.” The sucralose, whose delayed sweetness onset complements fructose’s immediacy, can cut calories by 75% “while maintaining the right sweetness profile for a variety of fruit-flavored beverages,” she says. “By combining the two, we have, overall, a very balanced sweetness profile more like a full-sugar system.”

While sweetener choice “is really driven by desired calorie count, cost and availability,” says Goodner, “we can make just about any sweetener system work now.” But, she notes that manufacturers relying heavily on high-intensity sweeteners, which don’t provide the bulk of sugar or sweetener syrups, should consider formulating some viscosity back into their beverages with thickening agents like xanthan gum or pectin. And mind the high-temperature treatments: “Heat breaks down aspartame a little bit,” she says, “so you have to consider your use rate when using this sweetener” to make up for what processing might remove.

Juices with a boost

Improving products via calorie reduction is only one side of the

coin. The prospect of using functional fortification to pad a juice beverage’s nutritional resume has seized manufacturers’ attention. “The beverage category is really exploding with all these health-related drivers,” says Ram Chaudhari, senior executive vice president, chief scientific officer, Fortitech, Schenectady, NY. “You see consumers concerned with overall wellness, lifestyle changes and so-forth. They are really pushing this market worldwide, but especially in North America and the United States.” Convenience gives beverages an edge over other foods as wellness delivery vehicles, too, he adds: “Consumers want to have all these nutritional, good-health ingredients and functional aspects in one package. And, with today’s lifestyles, we’re always on the go. Consumers don’t have time to eat properly. They want a simple way of taking in these ingredients.” What can be simpler than “insert straw and sip”?

What’s simple for the sipper, however, can certainly give formulators some serious headaches. A fortified juice beverage is a very dynamic medium, says Chaudhari, and “this is where you run into problems of shelf life, of sedimentation. Sometimes, it’s very hard to stabilize some of these products because of the nature of these nutrients. There are limits to how much you can add. This is where the disciplines of food technology and processing and chemical engineering have to interface. They have to develop together in order to make an acceptable, effective product — look-wise, taste-wise and texture-wise.”

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Chaudhari knows to ask the important questions right from the start. “Customers will come to us with their products, and we will say, ‘OK, if you are going to add all these nutrients and functional-food ingredients — lutein, lycopene, antioxidants, phytochemicals, the B complex — what kind of processing conditions, pH, temperature and shelf life are you aiming for?’ Those things are the foundation of this product because without understanding them, you cannot go any farther in choosing the right ingredients for that particular application.” A ready-to-drink beverage will require more-soluble forms of nutrients in order to avert sedimentation problems, for example. “And you’ll want an emulsified form of, say, vitamin E or A,” he continues. “All of these things have to come into the discussion during the phase when you’re still designing.”

A juice beverage’s pH — which ranges from around 2.5 to 4.5 — can dramatically affect vitamin and, in particular, mineral behavior. Water-soluble vitamins, such as the B complex, usually remain stable in the pH range of juice drinks, Chaudhari says, and “even vitamins D, E and K will go into an emulsified form without any problem.” But, vitamin A, in acidic conditions, assumes a vivid-yellow hue unwelcome in some products. In that case, he suggests the beta-carotene form, which the body prefers anyway. When it comes to minerals, he says, “what happens is most of the minerals are stable in the neutral-pH range, because they are not ionized. But as soon as acidic conditions set in, they

A New Kind of Moo Juice

Two of today’s biggest beverage trends — fortification and blending fruit juice with other beverage categories — come together in the supplementation of juice and juice drinks with dairy-derived whey proteins. Surveying the juice-beverage landscape with its glut of low-juice-content products, Kimberlee “K. J.” Burrington, whey application program coordinator, Wisconsin Center for Dairy Research, University of Wisconsin, Madison, concludes, “to me, the easiest way to add nutrition to those drinks is by adding some protein.”

For instance, “think about how many kids drink milk anymore,” Burrington says. Not many, and we can replace the protein lost by adding it to the beverages they do drink. Research into the relationship between whey proteins and weight loss also suggests a role for them in the battle against obesity. “Some of the nutrition work in the dairy-proteins area has been directed to the study of lean body mass and using whey proteins for the purpose of improving lean body mass,” she says. “I would say that, even for kids, given that there are obesity issues with children, they could also benefit from having whey proteins in their beverages for that purpose.”

A juice’s pH conditions — typically in the high-2 to high-3 range — don’t faze dairy proteins. “When you look at their solubility curve,” Burrington explains, “if you go down to as low as 2.8 and up to maybe 3.5, that is where you have the most charge on the proteins. In other words, they’re all highly positively charged.” At that point, she notes, there’s a lot of repulsion going on because of these positive charges repelling each other. In that pH range, whey proteins are most stable because of the lack of electrostatic interactions. Translation: clarity and stability in solution.

The proteins’ heat sensitivity poses no problems in hot-fill situations, and while higher-temperature treatments such as UHT pasteurization can initiate protein gelling, especially in 5% to 7% protein-fortification range, Burrington suggests several solutions. Addition levels hovering around 5%, which works out to about 10 or 11 grams of protein in an 8-oz. serving, are less likely to gel, and some producers offer hydrolyzed whey proteins whose smaller size better withstands high-heat processing.

Finally, hydrate early and often. A good 20- to 30-minute soak “will help prevent the aggregation that can happen during heating,” says Burrington. “It gives some time for the protein to bind with the water so that the heat won’t agglomerate it.”

A beverage’s individual specs will dictate the amount added and conditions under which whey proteins work best. But consider what they can do for something as simple as a child’s juice box, a “clear, juice-type drink, maybe with 5% or 10% juice, water, and high-fructose corn syrup,” Burrington says: “What better way to add some nutrients than by adding whey proteins, which will still allow the juice to remain clear and thirst-quenching and have similar appeal as a regular juice box?”



Photo: National Honey Board

will be very soluble and ionized. Then all the interactions start.”

Under high-temperature conditions, minerals remain reliably stable. Subjected to UHT, flash-pasteurization, hot-fill and other common beverage-processing treatments, the minerals “don’t go anywhere,” says Chaudhari. “They’ll stay there for years, and nothing will really happen other than they can catalyze reactions,” such as the oxidation vitamin C — which, like vita-

Flavor experts recommend fighting strength with strength in battling fortification’s off-flavors.

mins B₁ (thiamine) and K is heat-labile and oxidation-prone. “Any kind of heat-treatment, especially in the presence of some of the minerals like copper and iron,” he says, puts these vitamins at risk. “So you have to build-in some overages to compensate for that.”

Micropulverized minerals eliminate some of the stability concerns. By breaking the minerals down to their smallest possible particle size, the process “takes advantage of technology so that, in the acidic condition of the stomach, the minerals will be dissolved so you get the bioavailability and nutrient values, but they’re not causing sedimentation, and they’re

not going into interactions in the beverage,” says Chaudhari. The main drawback, though, is that the minerals’ increased surface area presents more contact sites for interaction, particularly in acidic conditions.

The solubility of micropulverized minerals, or any nutrient, for that matter, takes on added weight if a fortified beverage is to make good on its functional claims. “The more soluble a nutrient,” Chaudhari says, “the more bioavailable it will be, because it is going to be absorbed by the cell.” And the more soluble the nutrient, the less the likely it is to fall out of solution in a beverage. However, biological solubility doesn’t always imply solubility in a product. Our bodies can harvest calcium in the citrate,

malate, lactate, gluconate and even carbonate forms, Chaudhari explains, but for the purposes of beverage fortification, we’d disqualify the last choice because of its tendency to appear as sediment under typical pH levels in juices.

All in good taste

As juice beverages enter a new phase, so too does the selection of candidates for fortification. No longer content with vitamins and minerals, consumers privy to the workings of plant sterols, healthful fats, anthocyanins and other “nontraditional” nutrients want to see those extras in their juice drinks, as well.

“We’re seeing soy as a fortification ingredient that’s gaining acceptability,” notes Hogan. “And some of the majors are coming out with heart-healthy ingredients in their juice beverages — even the omega-3 fatty acids.” She mentions the rage in Europe for probiotic ingredients in yogurts and predicts that a similar interest will gain momentum here. “Yogurt is recognized as a healthy product much more in Europe than here in the United States, and some of those probiotic ingredients are starting to come over here. Yogurt naturally contains some of those ingredients, but we’re starting to see it go beyond the yogurt category and into beverages.” Other next-wave beverage supplements of note are fiber and aloe, she adds. “Aloe juice has had a few product introductions over the past year or two, and that’s a trend that started in Asia and also in Europe.”

The upshot of all this fortification is a cocktail whose palate properties can knock your socks off. Overcoming the sulfuric notes of thiamine or calcium’s characteristic chalkiness was hard enough, but soy, sterols, fish oils and the rest only make the job harder. Fortunately, soy-processing technologies have yielded ingredients free of the beany, grassy notes. Plant sterols, depending on the level, “may be a little easier to work with from a flavor standpoint,” notes Joy Merritt, senior food technologist, beverage applications, International Flavors & Fragrances. “The omega-3s are definitely the bigger challenge because they tend to be derived from fish sources, so they have that really fishy character.” Yet algal-source

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omega-3s now promise health benefits without potential sensory offense.

Flavor experts recommend fighting strength with strength in battling fortification's off-flavors. Tropical notes "definitely help" cover up the marine impression left by some omega-3s, says Merritt. "Strong flavor compounds that have a sulfuric character will mask it. And, of course, masking-type flavors that don't have a named flavor per se, but mask off-flavors, help, too."

As a suggestion for combating off-flavors, Merritt says: "Try and pair the flavor choice with what the off-notes are. If you have something that is bitter and astringent, instead of trying to do an orange-cream flavor, do a cranberry-grapefruit. Try to complement the flavor selection to some of the off-notes that are contained in the product."

Adds Jesús Domínguez, beverage technologist, McCormick & Company, Inc., Hunt Valley, MD, "For many years, citrus has been used at very low levels to help minimize some of the flavors from fortification." He attributes their effectiveness to their striking tartness, as well as to their oily properties, which extend their effect on flavor perception. "They last longer," he says, "and they help you cover the aftertaste."

Aside from fortification's organoleptic assaults, their evolution in a beverage over time on the shelf presents yet another variable to consider. With juice beverages being very lively chemical environments — fortified ones even more so — it can make it hard to foresee how supplements and flavor ingredients will

get along down the road. "A lot of products taste very good and have a lot of fortification in the beginning," notes Nancy Farace, marketing manager, U.S. industrial group, McCormick & Company, "but very rapidly go out of consumer acceptance. When the base flavor is changing along with the added flavor because of interactions in that product, we really have to do careful consumer testing for acceptability levels on that product."

If shelf-life problems arise, it's time to alter the formula. "It's at that point where you have to go back and rebalance your juice beverage," says Alan MacFadden, senior scientist, McCormick & Company. "It takes a fair amount of time, from a product-development standpoint, to determine which is the correct tool: Do we add more direct acid? Do we add a juice that has a high acid content versus low? Is it low in colors? The product developer really needs to know his ingredients in order to design a sound product."

Inherently healthy

With all this talk of boosting a beverage's wellness quotient through fortification, it's easy to forget that juices are healthful foods in their own right. Set aside caloric concerns and the public's harrumph over added sweeteners, colors, and flavors, and the liquid that's left is only one degree removed from its parent: produce. Consumers and manufacturers alike see them as responsible beverage alternatives to sugary sodas and other "artificial" options.

"I think, by far, the nutritional value that juices offer is being

emphasized by the companies that we talk to," says John J. "Jack" Schroeder, vice president, director of sales and marketing, Milne Fruit Products, Prosser, WA. "What does a Concord grape juice do for you? What does blueberry juice do for the blend? What does it bring to the mix in the way of healthy benefits for the product?" While most of the buzz-worthy fruits hail from tropical rainforests in South America and Asia, even specimens as prosaic as the blueberry and its cranberry cousin tell compelling health stories.

"Every day we read about the health benefits of blueberry or cranberry," Hogan says. "A lot of these flavors are coming around again to consumers as part of the health-and-wellness positioning of products, so you start to see more blueberry-flavored juice and you see a little bit of blueberry flavor in teas, and particularly in smoothies."

In fact, any dark, antioxidant-rich berry sends positive signals to health-savvy consumers, says Farace. "Even just having that flavor on the label gives you that perceived health benefit that manufacturers are looking for," she notes. "And, of course, we want to help them enhance that image by helping them enhance the actually berry flavor that's in the beverage."

Watermelon is another familiar favorite whose emerging science has received positive notice. Schroeder points out that watermelon contains more lycopene — an antioxidant carotenoid linked to reduced risks for certain cancers, cardiovascular disease and macular degeneration — than do raw tomatoes: 4.9 mg versus 3 mg per 100 grams of water-

Traditional juice flavors, such as orange, peach and strawberry, still please a high percentage of palates. However, new approaches might include adding other flavors or swapping sweeteners to reduce calories.



melon and tomato in the raw fruit, respectively.

The trouble with watermelon juice, however, was that processors always filtered-out the bright-red cloud, which contained the fruit's lycopene. Schroeder's company has developed a process that, he says, "allows us to make a very bright-red watermelon concentrate with no off-flavors" but with the carotenoid-rich cloud left intact.

Among promising fruits found farther afield, smart money is on the garnet-colored Amazonian açai berry to supersede the pomegranate as the next antioxidant "superfruit." "Pomegranate, over the last couple of years, was considered the most nutrient-rich fruit with a wide range

of health benefits," Hogan says, "and, now, açai is supposed to be even better than that."

We'll never find out, though, if we can't make it commercially viable as an ingredient. It just might be too expensive and quantity-limited to sustain beverage production. "If somebody jumped in and needed 100,000 gal. a year," says Schroeder, "I'm not sure if they could find it."

In that case, Farace points out, the next-best bet is to convey its character with flavors. "With the objective being to deliver the best-tasting product with the most-effective cost, flavor is definitely the way

to go," she says. For example, in something like a pomegranate, persimmon or guava juice that uses enough of that juice to put it on the label, but uses a more cost-effective base such as apple or white grape, flavors let designers deliver the profile the customer really wants with just that minimal amount of juice in the actual formula.

The smoothie revolution

"In the health-and-wellness arena," Farace says, "the whole perception of fresh is so important to the consumer that even if they know they're opening a hot-pack beverage

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CONCEPTS

or an aseptic beverage, they still want it to be as fresh-tasting as possible. They don't want it to taste like it'd been cooked in a can." All juices require some form of "cooking," typically a pasteurizing heat treatment, before they reach the consumer, and that can leave them tasting long-since-squeezed if processors aren't careful with their time and temperature.

While new technologies have given us milder processes and fresher-tasting flavors, one of consumers' favorite ways to get fresh-fruit taste is to split the difference between fruit and juice with a smoothie — the most obvious manifestation of the "juice-is-good-food" concept. Whether straight from the blender or RTD in a PET (polyethylene terephthalate) bottle, what began quietly as a juice-bar trend is now a beverage-industry institution. "As with anything that happens in the United States as a fad, something starts and everyone wants to try it," says Al Williams, co-founder and "chief tasting officer," Maui Beverages, Danvers, MA. "And that's what happened with the smoothies. At first, I thought maybe they would have a four-, five-, six-year life. But I really think it's grown into a staple now."

Williams attributes that staying power to the smoothie's versatility. But versatility can be as much of a burden as an asset. With no FDA strictures outlining what a smoothie is or isn't, "the word 'smoothie' can mean 100 different things," he says. Generally, it's come to mean a thick, often slushy, drink made with puréed fruit and ice, but manufacturers and smoothie-shop operators have interpreted the term widely. He considers himself a smoothie purist and his products reflect his ethic: all

fruit, some sweetener (he recently switched from high-fructose corn syrup to cane sugar), acids for flavor, and no green-tea powder, nutraceuticals, soy protein, "energy shots" or ice cream. He doesn't even add gums or stabilizers, although some manufacturers find them necessary to keep solids in suspension. "I look at my customers as the chefs," he says. "They can take my base and add whatever they want or add nothing, depending on their customers needs. Why should I dictate what their customer wants?"

Given their aspirations to fresh, smoothies demand gentle processing. Procedures such as hot-filling — where the beverage is heated to 175°F to 195°F for around 45 seconds, bottled hot and then cooled in the bottle — lack fine controls over heating and cooling. The result, Williams says, is a beverage that's "darker, has a little bit of a burnt color. It's not a fresh-fruit color. It also has a 'jammy' taste to it."

The flash-pasteurization processes that Odwalla Inc., Dinuba, CA, instituted for its smoothie ingredients quickly heats the juices to a temperature high-enough to kill *E. coli* and then cools them down just as rapidly. However, while flash-pasteurization eliminates *E. coli*, it doesn't achieve full sterilization, requiring that the smoothies undergo refrigeration.

Williams' smoothie bases are shelf stable for nine months to a year thanks to aseptic production. The precise heating and cooling leaves "no burnt taste at all," he says, and helps product retain color, flavor and product integrity. As the product tolerance of aseptic technologies improves, it's allowed the smoothies to retain more of the real-fruit substance: the seeds, pips, pulp and par-

ticulates that signal to consumers that they're drinking real food.

Smoothies, a relatively new beverage category, can risk serving as testing ground for novel flavor profiles. They've introduced countless timid palates to wheatgrass and spirulina, and have helped spread the word about "ethnic" fruits. "Because of the population growth, I think more of the influence of ethnic flavors — Latino, Hispanic, Asian — is coming in," Williams says. He suggests mixing smoothie bases with milk to make *licuados*, the blended fruit-and-dairy drinks popular throughout Latin America, "and the Asian influence you see in different fusion flavors like lychee, lemongrass and ginger. Spices are starting to come into different drinks, and we're going to be adding them to smoothies, too."

About a year and a half ago, Williams says, "I introduced passion fruit to my line, and a lot of people at food shows, or wherever I was, asked, 'What is that?' And over the past six months to a year, people are starting to recognize these fruits and they want to try something different. People are adventurous. They get sick of the same old strawberry and banana."

Even so, strawberry is still the No. 1 smoothie flavor — and probably always will be. It just goes to show that the more juices and juice beverages change, the more things stay the same. ■

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