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Mainstreaming Meat Alternatives

Meat alternatives are undeniably having a moment. As state-of-the-art plant-based substitutes like Beyond Meat and the Impossible Burger storm grocers, restaurants, and fast-food chains (so it seems per the media coverage they’ve received), there is still a segment of the population skeptical about these products. Here, we look at some of the positive and negative comments.

One of the biggest attributes of plant-based “meats” is that their production is generally more sustainable compared to conventional meat, producing fewer greenhouse gases and using less land and water. However, one of the criticisms leveled at these newer meat analogues is that, although they use plant inputs, the end products are quite processed and contain a long list of ingredients that runs counter to the move toward cleaner labels, fewer and recognizable ingredients, and transparent production. (Playing devil’s advocate: One could also argue back that some foods consumers perceive as healthy are also processed and fortified to some or great extent.)

Another question is whether these meat analogues are actually healthier than their meat counterparts. Some say no. I caught up with Kantha Shelke, PhD, CFS, principal at Chicago-based food science and research firm Corvus Blue LLC and a senior lecturer at Johns Hopkins University. She says: “The food scientist/nutritionist in me is concerned that the protein quality and quantity and vitamins and minerals of these highly manipulated products do not come close to that of animal-based products. They contain a significant amount of carbohydrate and therefore are more glycemic than the real thing. Their physiological effects do not come close to those of real meat.”

To be fair, neither Beyond Meat nor Impossible Foods necessarily markets its products as healthier than real meat; they primarily promote them as sustainable alternatives. But is the average consumer likely to believe the bat that a plant-based burger is healthier than a meat-based one? Plant-based alternatives do enjoy a “health halo,” said Tom Rees, industry manager of food and nutrition for market researcher Euromonitor, during an October 17’ webcast called “The Future of Meat: Is Consumption Really Decreasing?”

“How long that halo lasts remains another question, he said.

“At the moment, these [alternative] products aren’t under massive scrutiny because they’re sitting under this health halo,” Rees said. “However, as we go forward, this issue will come more sharply into focus. More people will question what’s in them, and differentiation between products based on what’s closer to being clean label, what’s closer to being recognizable, will become stronger. Those who can’t adapt will face losing that health halo.”

Another line of discussion about Beyond Meat and the Impossible Burger is that they are supposed to make it more comfortable for meat-eating consumers to transition to a plant-based diet. Consumers don’t have to drastically change their dining habits; they can have their “meat” and eat it, too. But is that the best approach if the goal is to encourage the world to change its thinking and to truly embrace eating plants?

In an article in The New Republic in June titled, “The Promise and Problem of Fake Meat,” author Emily Atkin writes “[T]he fake-meat products are engineered, specifically, to fool our senses into thinking they’re whole foods—and then marketed, by meat companies, to change our language to reflect the trick. This is nutritionism at its finest, and its success so far reflects the lengths we will go to avoid changing our behavior: We would rather change the entire definition of meat to include something we know isn’t meat, rather than eat less of it to save the planet and ourselves.”

Finally, not everyone will be fans of these products. Shelke says, “For vegetarians and vegans, there is no need for these products to mimic meat foods, because they are perfectly comfortable with consuming high-protein vegetable foods without the extensive manipulation and processing.” And while the trendiest meat analogues continue to capture public fascination, Shelke reminds that there are a great number of other plant-based meat alternatives that have just as much merit. She says: “Some of the textured soy protein products have pretty much delivered on the nutrition and taste/texture of meat foods…and for quite a few years. There is a world of taste and textures waiting from various cultures that are also delicious and healthful, and expanding on that front might be more sustainable and sensible than investing in analogues of meat products.”

The meat analogue market will no doubt be a fascinating one to follow as food science and consumer reception of these products develops. As these alternatives take on the mainstream market, they will be met with some open arms—as well as a helping of beef.

Jennifer Grebow
Editor-in-Chief
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FDA to Help with Nutrition Facts Label Compliance Before Immediately Enforcing

The deadline for companies to comply with FDA’s new Nutrition Facts and Supplement Facts label rules is around the corner. In late October, FDA announced that during the first six months following the first compliance deadline—January 1, 2020—it will focus on helping companies meet the new rules, rather than coming out of the gate to immediately enforce the rules. The agency had received strong requests from numerous leading food and supplement industry associations to provide enforcement flexibility as companies work toward compliance.

Changes to the labeling rules include a new requirement to separately quantify and list added-sugar content, to provide nutrition information reflecting both single- and multiple-serving sizes when applicable, and to adhere to updated Daily Reference Values, among others.

Manufacturers with $10 million or more in annual sales must comply with the deadline of January 1, 2020, while companies with less than $10 million in annual sales have until January 1, 2021, to comply.

In September, associations such as the American Herbal Products Association, the Council for Responsible Nutrition, the American Bakers Association, the Corn Refiners Association, the International Dairy Foods Association, and the National Grocers Association jointly sent a letter urging FDA to “provide flexibility in its enforcement of the new nutrition labeling rules as the January 1, 2020, compliance date approaches.”

On its website, FDA now states that, for the first half of next year, the agency will turn its attention to helping companies with compliance. It says: “The FDA has heard from several manufacturers and groups that more time may be needed to meet all of the requirements. Therefore, during the first six months following the January 1, 2020, compliance date, FDA plans to work cooperatively with manufacturers to meet the new Nutrition Facts label requirements and will not focus on enforcement actions regarding these requirements during that time.”

**FDA, FTC Send Warning Letter to CBD Firm**

On October 22, FDA and FTC sent a joint warning letter to a company selling cannabidiol (CBD) products making unsubstantiated disease claims. The company, Rooted Apothecary LLC (Naples, FL), made claims that its products “treat teething pain and ear aches in infants, autism, attention-deficit/hyperactivity disorder (ADHD), as well as Parkinson’s and Alzheimer’s disease, among other conditions or diseases,” FDA said. The agency called these claims especially worrying because some of them target infants and children.

Both FDA and FTC participated in the joint warning action. Rooted Apothecary not only made claims that the FTC determined were not scientifically substantiated, but the brand also marketed some of its products as dietary supplements despite the fact that FDA has not authorized the legal use of CBD in dietary supplements.

In an FDA statement, FDA Acting Commissioner Ned Sharpless, MD, said: “We’ve sent numerous warning letters that focus on matters of significant public health concern to CBD companies, and these actions should send a message to the broader market about complying with FDA requirements. As we examine potential regulatory pathways for the lawful marketing of cannabis products, protecting and promoting public health through sound, science-based decision-making remains our top priority. We appreciate the FTC joining us on these and other actions to protect consumers from fraudulent CBD products.”

Rooted Apothecary is the seventh CBD company to receive an FDA warning letter in 2019. The company was given 15 working days to respond to the agencies. The company could face the possibility of product seizure and/or injunction.

In its press statement, FDA reiterated its position that CBD is not a legal dietary ingredient and its concern about companies selling unapproved CBD drugs.

However, the agency did add that it continues to “explore potential pathways” for CBD’s use in consumer products. As the agency has previously stated, part of its concern centers on determining the safety of CBD products.

“We recognize that there is significant public interest in cannabis and cannabis-derived compounds; however, we must work together to fill in the knowledge gaps about the science, safety, and quality of many of these products. We are committed to advancing our regulation of these products through an approach that, in line with our mission, prioritizes public health, fosters innovation, and promotes consumer confidence,” said FDA Principal Deputy Commissioner Amy Abernethy, MD, PhD, in the press statement.
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Any Questions?

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*Based on IMS data as of November 6, 2018. Based on 4 total industry magazines. Print only.*
The clean-label movement has dominated the past decade, with survey after survey showing that dietary supplement shoppers and the industry alike are moving toward “cleaner” products. Why? Consumers today aspire to a healthier lifestyle—from the environment they live in to what they put in their body—and, for reasons of their own, they associate cleaner labels with healthier products.

While the term clean label has no official, universally recognized definition, in context it typically refers to products that use all-natural/non-GMO ingredients, transparent supply chains, and inputs that anyone with an eighth-grade education can pronounce. Clean-label products aim to exclude artificial colors, sweeteners, and preservatives, replacing them with natural ingredients that perform the same function.

In its simplest form, clean label asks three integral questions: 1) Can the consumer pronounce the name of the ingredients or excipients? 2) Does the consumer know where the ingredient comes from? And 3) Does the consumer feel better knowing what they’re consuming?” says Steve Pierce, president of ingredient supplier Ribus (St. Louis), which touts itself as “The Original Clean-Label Company.

Clean label sets forth a whole new set of targets for everyone in the supply chain to meet—and often, fulfilling those requirements is a lot harder than it sounds. A clean-label supplement must be, or try to be, clean through and through. This includes both active ingredients and their delivery vehicle. And indeed, more consumers are becoming aware of what goes into making the capsules, powders, and tablets they see on store shelves.

Barri Sigvertsen, global innovation marketing manager for Lonza Consumer Health & Nutrition (Morristown, NJ), points out that clean-label ingredients and delivery systems are “symbiotic.”

“They must work together in order to deliver a truly clean-label solution,” Sigvertsen says. “The delivery system is an integral part of the finished product, and so it makes sense to deliver a clean-label ingredient through a clean-label delivery system. The production requirements and challenges are also typically very much aligned; for both components, it is important to check that the raw material sources, vendors, and practices are clean label–compliant to optimize the output and deliver on consumer demands.”

Verified Portfolios
For delivery system providers, performing to clean-label standards means continually expanding the options for supplement makers. We checked in with a few delivery system providers on their latest developments.

For Lonza, Sigvertsen says, “A major part of delivering clean-label solutions is ensuring that the facilities you operate in also adhere to clean-label requirements. As such,
we have worked closely with our customers and suppliers to discover new raw material sources that address this need, and deliver our own processes that meet clean-label expectations.

One of Lonza’s recent efforts is developing natural, food-based colorants for its Vcaps Plus vegetarian capsules. Says Sigvertsen: “Color has long been an important element of the dietary supplements industry, offering an opportunity for brand owners to differentiate and distinguish their products from the competition. The challenge, however, was that in order to create products with stable, long-lasting color, manufacturers were once left with no other option but to turn to artificial colorants, which did not align with consumer preferences.” Lonza’s naturally sourced colors from foods deliver more robust, stable colors with a more sustained performance than was previously possible, she says.

Capsule supplier ACG (Mumbai, India) has introduced its branded ACGcaps H+, a capsule product line that is made without the use of any gelling agents. “These capsules are manufactured with hydroxypropyl methylcellulose (HPMC) and water,” says Justin Kalafat, scientific business development manager for ACG Capsules. Kalafat says that the clean-label feature adds another benefit claim to the HPMC capsules, which already carried vegetarian/vegan, kosher, halal, and GMO-free claims. Kalafat notes that the clean-label shift is simply the next logical outworking of the GMO-free movement.

Kalafat agrees that dietary supplement companies are actively looking into new options for coloring. White capsules that are free from titanium dioxide are also gaining traction and permit brands to make clean-label claims, he says.

Other companies are also introducing their own clean-label alternatives. Susan Freers, technical service manager for specialty ingredients at Grain Processing Corp. (GPC; Muscatine, IA), says that GPC has been making innovations in its delivery system offerings, including its binders, carriers, and film formers.

“Clean-label ingredients and delivery systems are “symbiotic,” says Lonza’s Barri Sigvertsen.
vitamin oils, omega-3s, or cannabidiol/CBD, for example—and allows oily material to be used in standard capsules, tablets, gummies, or powders. The gummy market, he adds, is now actively cleaning up labels and looking for cleaner ingredients and excipients.

Pullulan, a vegetable-derived, water-soluble polysaccharide used to make capsules, will continue to play an important role in the clean-label movement for years to come. In the U.S., the Organic Trade Association, as well as other industry advocates, have petitioned USDA and the National Organic Program (NOP) to add pullulan to the National List of Allowed and Prohibited Substances—namely, ingredients that are allowed to be used in products labeled as USDA Organic. The effort to add pullulan to the list is significant, considering that there are no other comparable NOP-approved vegetarian alternatives for producing capsules. The National Organic Standards Board has noted that manufacturers would otherwise be forced to use gelatin, which is included on the National List but which does not meet vegetarian, kosher, or halal needs. In 2019, the board voted to add pullulan to the National List. This move is a boon to capsule producers such as Lonza, which makes its Plantcaps vegetarian capsules from pullulan.

Ribus’s Pierce says, “The recent approval of natural pullulan for use in organic capsules—until the organic version [of pullulan] becomes commercialized—is an indicator of the desire to remove synthetics.”

Relying on Certifications
As mentioned, one problem facing brands and formulators is the fact that there is currently no official, universally accepted definition of clean label. While some terms in the dietary supplement and functional foods industry, like USDA Organic, are government regulated, clean label has no such gatekeeper.

Consumers seeking clean-label products will often turn to the vast number of certification schemes in the market for guidance, including USDA Organic, gluten-free, Non-GMO Project Verified, vegan, and others. Navigating so many certifications can be cumbersome—and may lead to consumer confusion and mistrust—which is why organizations like the Clean Label Project are developing independent certifications specifically for the clean-label audience. Clean Label Project has developed its own certification process for sweeteners, dietary supplements, and other products. It says that it uses a transparent screening process to measure the concentration of toxins, pesticides, residual solvents, and plasticizers in food and supplement products, giving its Purity Award to products that pass its tests.

Communication Is Key
ACG’s Kalafat says that delivery system manufacturers have little influence over either the definition of clean label or the consumer’s perception of the term.

“As a capsule manufacturer, the pure definition of clean label is out of our hands,” Kalafat says. “The basic understanding of the term comes from our current and potential customers. They dictate how we must formulate our capsules to be acceptable in their supply chain. But we’re always keeping up with continual shifts in the industry, and we dictate changes our customers might need to stay ahead.”

Kalafat says that clear and accurate marketing messages are essential to brands that want to capitalize on clean-label delivery systems. Brands and contract manufacturers should avoid making assumptions about the end consumer’s awareness level, he says, and also should ensure that all parties involved in the supply chain have the same understanding of what clean label means to the project at hand.

GPC’s Feers says that it’s up to the formulator and the consumer to determine what clean label means to them. She notes, though, that less is often more. “The first thing to be considered when developing a clean-label product is how to create the simplest formula using the fewest possible ingredients,” she says. “Shoppers want to know what they’re consuming, and ingredient labels often determine which products a consumer will purchase.”

Kalafat emphasizes another point: that making a clean-label product can quickly become complicated depending on the number of companies involved in the supply chain.

In the case of a capsule manufacturer selling to a contract manufacturer instead of to a finished-product brand, for instance, all of the parties involved in decision making would need to reach a common agreement on what constitutes a clean-label product. Misunderstandings, Kalafat says, can complicate the plans of finished-product brands that want to make a clean-label claim.

“Finished-product manufacturers desiring clean-label claims might be forced to reformulate their products if they can’t gain clean-label claims for all of the ingredients in a formulation,” he says.

Some suppliers are trying to make it easier for their own customers to find the clean-label solutions they need. An example of this is the Clean Label Alliance, which bands suppliers together to form a “one-stop shop” offering dietary supplement companies guidance and assistance in implementing clean-label practices. Lonza and Ribus were two of the founding members of the alliance.

As consumers increasingly move toward clean-label products, it will become imperative for finished-product brands, contract manufacturers, and delivery system suppliers to communicate on clean-label requirements. Kalafat points to the food and beverage industry as a good example for the supplement industry to follow.

“There are a lot of clean-label products in the food and beverage industry,” he says. “There’s also some crossover, as many products used to make clean-label foods are now being considered for use in dietary supplements. If clean-label food ingredients can replace the standard surfactants and emulsifiers, these could add product value with labeling.”

As demands for clean label get louder alongside growing consumer demand for transparency, brands will be forced to adapt, and the manufacturing supply chain, delivery systems included, will continue adapting with them.
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Remember back when you actually had to swallow a tablet or capsule to get dietary supplementation's nutritional benefits?

Yeah, we can barely remember those days, either. And to the extent that swallowing a vitamin tablet, capsule, or otherwise is now a choice rather than an obligation, we can thank the gummy.

These pudgy, pleasing, and altogether palatable nutrient-delivery vehicles have virtually revolutionized the act of supplementation at the same time that they've broadened the base of supplement users. And few appreciate their contribution better than Doug Brown, Americas director, Sirio Pharma (Shantou, China).

"Gummies continue to be a huge deal for the supplements industry," Brown says. "They've added new fuel to the category's overall growth and clearly signify a strong consumer preference for this fun format."

**Making Nutrition Fun**

So strong is the current consumer preference for vitamin gummies that Brown's company—which has devoted itself to gummy research and development for more than a decade—announced last September the opening of a dedicated new gummy production facility in Maanshan, China, a mere 11 years after opening its previous gummy facility.

As far as Brown is concerned, these are wise investments, given the numbers. He cites data from Transparency Market Research predicting 5.2% compound annual growth for gummy vitamins between 2017 and 2025, sending the sector to an estimated value of $4.17 billion.¹
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“The real value of the gummy format,” he says, “is that it provides consumers with a more pleasant choice to address their daily nutritional needs.”

Initially, their appeal aimed mainly at children, who might have been more reluctant—or simply unable—to tolerate more traditional supplement formats. And indeed, Brown says, gummies now account for more than half the children’s vitamin, mineral, and supplement segment’s sales.

“But as it turns out,” he continues, “parents and grandparents soon discovered their ‘inner child’ and have driven strong growth of gummies across the category.” Adults now form the core of gummies’ target audience, he says, and adult-directed supplements are responsible for upwards of 65% of the market.

Matters of Taste
But gummy supplements don’t just grow on trees. Nor do they come from a candy store—although Brown notes that nutritional gummy manufacturing evolved from the confectionery process.

Fact is, gummy supplements are more difficult to produce and have to clear several formulation and manufacturing hurdles vis-à-vis taste, texture, and structural stability.

Consider taste. “Consumer preferences tend toward pleasant fruity flavors with a juicy quality,” Brown observes. Alas, few nutritional ingredients exhibit such profiles. Fortunately for consumers, the fruity, juicy flavors they prize also effectively mask the off flavors of most nutritional ingredients, Brown says. “For the more challenging ingredients, such as B vitamins, minerals, and omega-3s, we’re able to solve issues with our R&D team.” He says his company has built a database of ingredients, flavors, colors, and sweeteners—as well as an inventory of their interactions during manufacturing—to get better leverage over the flavor and formulation challenges.

Getting a Feel for Things
Texture is another important—and potentially vexing—consideration in gummy formulation. As Brown explains, gummy texture comes
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mainly from the colloidal base, but in the case of gelatin gummies in particular, some ingredients can compromise the base structure.

Consider calcium, which reduces the gelatin base’s water content. Switching to a plant base, Brown says, resolves the issue. “To prevent crosslinking from impacting gummy stability and texture,” he continues, “more gelling agent is used to maintain the bond’s strength.”

And opting for micro-ionized forms of some nutritional ingredients, when available, can head off any grittiness in the mouthfeel while at the same time help to address possible flavor and nutrient-loading issues.

**Protective Medium**

What about those nutritionals themselves? How well does the gummy matrix protect and preserve vulnerable or highly labile nutrients?

“Gummies are an excellent protective medium for most nutritional ingredients,” Brown says. “Absorption is similar to other delivery systems.”

Nevertheless, gummy production involves complex temperature, humidity, and pH conditions that Brown says “require careful stewardship of ingredients.”

Probiotics can suffer especially “as most strains don’t hold up to this type of process,” Brown says. In response, Sirio developed a proprietary probiotic process that ensures probiotic survival and potency in the finished gummy. They’ve even devoted an entire facility to the process, he says.

Finally, manufacturers can’t get into the gummy game without taking clean labeling into account. “Consumers have expressed a clear preference for uncompromising clean, natural ingredients with full transparency,” Brown says.

Thus, his company offers plant-based, low-sugar, and no-sugar versions of its gummies with comparable taste to traditional offerings. “We readily choose natural materials for all aspects of production, so clean label is part of our DNA,” he says.

In fact, he thinks going clean makes gummy production less complicated. Given the dynamic state of the gummy supplement market, that’s good news for all involved.

Kimberly J. Decker writes for the food and nutrition industries from her base in the San Francisco area, where she enjoys eating food as much as she does writing about it.

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If proteins could talk, whey might have the loudest voice in the room.

And that’s not entirely without reason. As a nutritionally complete protein, it boasts a full complement of essential amino acids, including the key branched-chain amino acids leucine, isoleucine, and valine. Extensive research supports whey protein’s role in muscle growth and recovery, weight management, healthy aging, and overall wellness. And it doesn’t taste nearly as funky as some of those plant proteins out there.

But listen more closely and you’ll hear the stirrings of a quieter, yet just as compelling, protein voice. Who’s doing the talking? A group of bioactive whey protein fractions that only within the past couple decades have begun to attract attention from researchers, health professionals, wellness brands—even some curious consumers.

The stories they tell have yet to fully play out. But the more we learn, the more powerful the narrative will get. As Terri Rexroat, vice president of global ingredient marketing, U.S. Dairy Export Council (USDEC; Arlington, VA), says, “While whey protein fractions aren’t necessarily a new discovery, the ways in which they’re being used and their known benefits are both expanding.”

Whey Down

Whey is so ubiquitous that it’s easy to gloss over what, exactly, it is—and what, exactly, we get from it.

As the watery liquid left over after milk solids coagulate, whey is a cornucopia of proteins, peptides, and carbohydrates, many of which are bioactive—or, in other words, can have an effect on health and nutrition based on dose,” explains Brent Petersen, senior director, ingredient/bioactives R&D, Glanbia Nutritional (Chicago).

Bioactive whey protein fractions, Rexroat adds, are unique peptides that “exist in different proportions within whey protein, are made of different peptides, and can benefit health in different ways.”

Beta-lactoglobulin accounts for about 50%—the largest share—of the protein in whey, she notes, while alpha-lactalbumin comes in second at about 25%. Smaller shares of glycomacropeptide (GMP), immunoglobulins, serum albumin, lactoferrin, lactoperoxidase, and more make up the remainder.

Here to Help

These whey fractions show considerable promise in delivering “bioactivities” beyond those of whey protein writ large, and their benefits can span the lifecycle.

“For example,” Rexroat says, “alpha-lactalbumin is abundant in mothers’ milk, and its addition to infant formula allows for closer matching to breastmilk.” In adults, the same fraction enhances sleep quality and restfulness, “particularly for athletes, as it contains...”
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the high-quality amino acid composition expected from whey, with a higher level of tryptophan.”

Immunoglobulins appear to support the immune system, while other whey fractions may exert anti-inflammatory, muscle-repair, and cardio-protective effects. “In more clinical settings,” Rexroat says, “glycomacropeptide can provide an unrivaled source of protein to those with phenylketonuria.” Phenylketonurics have difficulty metabolizing the amino acid phenylalanine, and glycomacropeptide doesn’t contain phenylalanine.

Petersen notes that lactoferrin appears not only in breastmilk, but in tears, saliva, and nasal secretions, as well, and provides “antibacterial, antifungal, antiviral, and anti-parasitic benefits, directly supporting dental, ophthalmic, and skin health.” His company has even demonstrated an active role for the fraction in binding and transporting iron, “an area of interest for athletes across the sports-nutrition and endurance segments,” he says.

**Building the Market**

Closely associated with bioactive whey peptides are whey protein hydrolysates, which Rexroat says “are gaining popularity from both health and application perspectives.” Their advantage: “They have a reasonable level of consumer understanding and can be beneficial for a number of different consumers and in different applications.”

Whey components rich in the phospholipids found naturally in milk—compounds like milk fat globule membrane (MFGM)—are also gaining notice for their potential to promote cognitive health in adults and gut health in infants, Rexroat adds.

This has already produced some healthy market moves. “The whey protein hydrolysate sector was valued at more than $302 million in 2018, and the powder-based milk protein hydrolysate market is projected to grow around 6% by 2025,” Rexroat notes. And products rich in MFGM as well as in the bioactive peptides alpha-lactalbumin, lactoferrin, immunoglobulin, and more are now available to consumers—albeit to varying degrees. “So the benefits are definitely being recognized.”

**Learning Curve**

That said, hurdles to the category’s development remain, including the need to “build out the science,” Rexroat says, “particularly in human studies, better to educate consumers about how these natural ingredients can help support health and wellbeing.” Continuing up the learning curve of research is important.

“Research is going into all aspects of these fractions, from building the science behind known health benefits and demonstrating new ones to trialing them in different applications and developing new analytical methods to test levels in products—even to mapping the bioactive peptides,” Rexroat notes.

Petersen also sees the need for continued research. “It’s certainly grown over the past 15 years,” he says, “but with the exception of lactoferrin, which has extensive research behind it, many of the other fractions still don’t have a robust body of studies.”

**Critical Mass**

“Of course, much of the scientific work is being done in academia,” Petersen goes on. “However, there’s research being executed in the dairy industry as more brands and consumers realize the benefits of dairy fractions.”

Alas, fully realizing those benefits will take time, as another hurdle hampering whey fractions’ commercial development is supply. As Petersen says, “Many fractions in whey are present in very small quantities, so you need access to a large amount of whey to enrich or isolate them.”


Consider lactoferrin. Although not uncommon in products like infant formula, “you’d have to produce an enormous amount of milk to extract a small fraction of lactoferrin,” she says. “This is part of the reason lactoferrin is so expensive, which makes it difficult to formulate with.”

Along with other suppliers, FrieslandCampina is trying to increase production efficiency better to harvest whey fractions. “We’re also working with top-ranked universities to test and validate new benefits of whey protein fractions,” she adds. “We’re definitely gaining more knowledge the more we use and explore different applications.”

**Looking Ahead**

As for further challenges, Matthew Pikosky, PhD, RD, vice president, nutrition science and partnerships, National Dairy Council (Rosemont, IL), notes that “most of the benefits attributed to whey protein fractions or to the peptides generated by whey protein digestion or hydrolysis have been found in vitro and animal models—so it’s important to conduct more research to evaluate and corroborate those effects in humans.”

And supply will continue to be a tough nut to crack. But, says Rexroat, exciting times are ahead: “More research will help expand our understanding of the role of some whey protein fractions for new age groups, conditions, and different applications.”

Here’s a look at what we can look forward to in the world of whey protein fractions.
Only within the past couple decades have whey protein fractions begun to attract attention from researchers, health professionals, wellness brands—even some curious consumers.

**Alpha-Lactalbumin**

This whey fraction has a lot of health potential. According to Moises Torres-Gonzalez, PhD, director of nutrition research at the National Dairy Council, “The most frequently studied uses for alpha-lactalbumin are as a component of infant formulas designed to be more similar to breastmilk.”

Why? Alpha-lactalbumin’s levels of tryptophan and cysteine approach the levels found in breastmilk, making infant formulas supplemented with the peptide closer to that nutritional ideal.

“Research shows that infants provided alpha-lac-enriched formulas compared to other formulas are more likely to have growth patterns similar to those observed with breastfed infants,” Torres-Gonzalez says. Further studies suggest that including alpha-lactalbumin in infant formulas may improve intestinal health and immune response, while also possibly increasing absorption of trace elements like iron and zinc—“which, again, could provide benefits closer to those provided by breastmilk.”

In adults, alpha-lactalbumin’s high tryptophan content could support both sleep and neurological function through its influence on serotonin and melatonin synthesis. “Findings in humans have been mixed to date, and additional work needs to be done to clearly support these benefits,” Torres-Gonzalez notes.

Finally, says Pikosky, ‘Alpha-lactalbumin chelates heavy metals—reducing oxidative stress—and when orally administered protects against ethanol- and stress-induced gastric mucosal injury in rats, suggesting it may have utility as an agent to prevent ulcers.”

**Beta-Lactoglobulin**

At almost half the protein found in cow’s milk, beta-lactoglobulin is rife with binding sites for minerals, fat-soluble vitamins, and lipids, Pikosky says. And it can serve as a direct carrier of lipophilic compounds such as tocopherols and vitamin A in low-fat product matrices.

**Beta-Lactoglobulin** is great at binding water.

**Milk Immunoglobulins**

The milk immunoglobulins IgG1, IgG2, IgA, and IgM have antimicrobial activity and may also help neutralize toxins and viruses, according to the American Dairy Products Institute (ADPI).1

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1. Only within the past couple decades have whey protein fractions begun to attract attention from researchers, health professionals, wellness brands—even some curious consumers.

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Per Torres-Gonzalez, the peptides’ ability to stimulate growth of *Lactobacillus bifidus* might assist in averting infections in the gastrointestinal and respiratory tracts.

And considerable research is looking into milk immunoglobulins’ potential application in preventing and even treating microbial diseases and conditions in humans, according to ADPI.¹

### Lactoferrin

“Lactoferrin has a lot of benefits,” Friesland-Campina’s Arnaly notes, and enhancing iron absorption (it’s the main iron-binding protein in human milk) is just the start.

Pikosky notes that lactoferrin may help regulate myelopoiesis—the generation of bone marrow and its cellular products—while also acting on systemic immune response.

Together with alpha-lactalbumin, he adds, lactoferrin has shown in animal studies “to improve energy balance and metabolism, and to decrease adiposity.”

And according to ADPI, lactoferrin’s antimicrobial and antiviral properties may inhibit everything from yeast, bacteria, fungi, parasitic protozoa, and *E. coli* to HIV, herpes, and hepatitis C. “Preliminary research appears to show that it stimulates growth of beneficial bacteria in the intestinal tract,” the organization adds. And animal studies suggest it may moderate bone breakdown, better sustaining bone density.¹

### Lactoperoxidase

Actually a secretory enzyme, lactoperoxidase acts as a natural preservative, Arnaly says, and “can also have anti-inflammatory effects and promote intestinal flora.”

While it exhibits no inherent antibacterial activity of its own, “along with H₂O₂ and thioscyanate, it forms a potent antibacterial system that people may know as the LP system,” she explains.

In fact, LP shows up in dental products, antidiarrheal medications, dermatology, ophthalmology, and even milk, cheese, meat, and functional products, where it can stanch bacterial proliferation and extend shelf life.

### Glycomacropeptide

ADPI describes glycomacropeptide (GMP) as a casein-derived peptide found in cheese whey that has antimicrobial capacity.

Its lack of the amino acid phenylalanine makes it a viable protein source for those with phenylketonuria, but evidence also suggests that it promotes satiety and thus weight loss, prevents dental caries as well as gout, and may benefit infant development.¹

Reference


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How do you know when a food trend is worth taking seriously? When McDonald’s picks it up.

And by that measure, plant-based meat alternatives are some serious business. In late September, the fast-food chain that put burgers on the map began a 12-week Canadian test run of the P.L.T.—a.k.a. “Plant”—a meatless patty that Beyond Meat, the Los Angeles–based purveyor of plant-protein products, developed expressly for McDonald’s.¹

This came less than half a year after Beyond Meat raised almost a quarter of a billion dollars in a high-profile initial public offering.² And it came within a week of the September retail debut of the Impossible Burger, the contribution of Impossible Foods (Oakland, CA)—now joining competitor Beyond Meat in the grocery store aisle—to the burgeoning meatless-burger bonanza.²

Yet these are just the most conspicuous examples of how plant-based innovators are disrupting the very definition of what we call “meat.” And as far as Steven Gumeny, regional product manager, North America, Beneo (Morris Plains, NJ), is concerned, the best is yet to come.

“The recent IPO from Beyond Meat and the growth of the Impossible Burger were certainly breakthroughs showing just how strong demand for plant-based meat alternatives is,” he says. “It’s exciting to see two startups become clear market leaders almost overnight. And now major food brands are buying in, trying to innovate quickly to catch up.”

Their innovation wouldn’t be feasible, though, were it not for an emerging class of plant-based ingredients that approach the taste, texture, appearance—even the nutritional value—of “real” meat. In so doing, they’re leaving the bean burgers and tofu patties of the past in the past.

Impossible Foods Inc. is one of the key players forging new ground in the cutting-edge meat alternatives market.

Meeting the Meat-Free Need

You needn’t be a vegetarian—let alone a vegan—to appreciate the latest generation of cheat meats. In fact, the 2019 International Food Information Council Foundation’s Food Health Survey found that one-third of consumers eat plant-based protein daily, with three quarters viewing protein from plant sources as healthy.⁴

Cargill (Minneapolis) conducted its own survey of consumers’ protein perceptions and found that of the 1,900 U.S. grocery shoppers polled, nearly half agree to feeling better about eating plant protein, and almost as many actively try to eat more protein from plants,⁵ notes Pam Stauffer, Cargill’s global marketing programs manager.

Plant-based ingredients transform the meat-analogue category.

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Protein

And though consumers across the age range are curious about plant-based meat alternatives, the real oomph comes from the younger crowd. ADMs (Chicago) Outside-Voice Primary Research Study, completed in May 2019, found that younger consumers "drive the plant protein agenda," says Kurt Long, ADM’s commercial director of protein specialties and flexitarian solutions, "motivated by health and wellness, taste, ethics and beliefs, and cost and convenience.”

If It Tastes Like Chicken…
Young or old, plant-curious consumers have triggered an explosion in product development. “New launches have grown significantly,” Stauffeder says, “and with these innovations we’ve seen dramatic improvements in product flavor and texture. Those who may have been turned off by early versions of meat and dairy alternatives are coming to them today and finding a different, very satisfying experience.”

For that they can thank novel plant-protein ingredients that are closing in on the organoleptic qualities of “real” meat. While past iterations of meat analogues mainly replicated ground proteins—think burgers, patties, sausage crumbles, and franks—current products can aim much higher.

As Melissa Machen, senior technical services specialist in plant protein at Cargill, explains, “Burgers were always a forgiving format for meat analogues, as they’re usually served on a bun with condiments and other toppings that add flavor, texture, and juiciness.”

But with new ingredients surfacing, “We’re seeing other product formats that closely mimic traditional meat in color, texture, and bite, including meatless nuggets, analogue tuna, and plant-based meat alternatives in frozen and convenience foods,” she continues. “It’s clear that some brands are striving to create products that are indistinguishable from meat—a goal they’re making significant progress toward accomplishing.”

Long adds that by altering inbound ingredients and extrusion methods, his team “can yield a variety of different shapes, sizes, and textures depending on the target application.” Even pulled pork is possible, he claims.

“Some products, like fish analogues, may require a completely different ingredient set and processing method.” Long continues. “But by having a deep understanding of the science behind the ingredients that go into these products, we can design natural flavors and maskers to make these products emulate meat even better.”

Go-To Ingredients
As for which plant proteins create the best meat analogues, “function, cost, sustainability, availability, flavor, and nutritional characteristics are all qualities we consider,” Long says. “There’s no one protein that’ll check every box for every consumer, but in combination, you can complement nutritional and taste profiles.”

Soy still dominates, “and for good reasons,” says Mark Cornthwaite, industry and marketing manager, DuPont Nutrition & Biosciences (New Century, KS). “Soy is the most nutritious, functional, and highly available protein on the market—although that supply is highly constrained. More than 40 years of science are behind it, from the early days of a highly flavored basic protein to today’s highly palatable protein that can bind, hold moisture for juiciness, and reduce dehydration.”

Hot on soy’s heels—and getting hotter—is pea protein. In both powdered and textured form, “Pea protein delivers quality protein and functional performance similar to soy,” Machen says. “Our Puris textured pea protein delivers a neutral flavor profile and high protein content for an array of meat-alternative applications.” Cargill began a joint venture with pea protein, pea starch, and pea fiber supplier Puris (Minneapolis) last year. Most recently, Cargill invested an additional $75 million to help Puris more than double its pea protein production.

Looking beyond pea and soy, ADM’s Long points to chickpeas, pulses, seeds, and ancient grains as “a few more of the ingredients we’re currently working with in formulation.” His team is even exploring options like lupin, algae, and mycoprotein.

“We also expect new sources in the future like sunflower, linseed, and rapeseed, and are keeping a very close eye on their development,” Beneo’s Gumeny adds.

Beyond Pure Protein
But as Cargill’s Machen cautions, “Plant proteins alone will only take you so far. To replicate some of meat’s textural properties, formulators have to turn to ingredients like hydrocolloids.”

Methylcellulose, for example, has “unique properties” that Machen claims generate...
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Carrageenan also appears in meat alternatives; handy in binding and texturizing, it contributes a firm, sliceable structure and bite. Finally, starches and fibers in binder systems "create the optimal balance between a firm bite and juiciness," Machen says, adding that such ingredients also help manage moisture. Cargill offers functional native starches that bind water to yield a firm and meaty texture while still looking clean on a label.

Gumeny notes that Beneo’s rice starches improve meat analogue texture and freeze/thaw stability. Meanwhile, chicory root fiber—or inulin—can replace fat, replicate its texture, and supply valuable prebiotic fiber, all at the same time. "And our proteins from wheat and rice not only add a protein source; they also improve texture."

Stacking Up Nutritionally

But recreating meat’s sensory properties with plant-based ingredients is only half the battle. "Another challenge is creating a product with a complete protein profile," Machen says.

Jing Zhou, PhD, business scientist, global plant-based proteins R&D, Ingredion Inc. (Westchester, IL), notes that a product with a protein content of up to 30%—accompanied by a low fat level—

A new competitor in the grocery aisle: In September, Impossible Foods made its supermarket retail launch at select grocers nationwide.

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fits agreed-upon criteria for “a good alternative to meat from a nutritional perspective.” And given that most current meat analogues are made with plant-protein concentrates or isolates, sheer quantity of protein is rarely a question.

“However,” Zhou continues, “plant proteins usually have a lower protein quality than animal proteins.” Soy, with a protein digestibility-corrected amino acid score (PDCAAS) approaching the benchmark of 1.0, is the exception. But plant proteins that fall short, like rice, many legumes, and grains, can team with each other in blends whose complementary amino acid profiles add up to nutritional completion—pea with ancient grains, say, or with seeds and nuts.

“It’s also worth noting that most meat-eating consumers have an overconsumption of protein anyway,” Zhou adds. “So in the case of partial replacement of meat in a diet with meat analogues, the requirements aren’t so strict.”

Plant-based nutrition isn’t all about the protein, though. “From a nutritional standpoint, today’s meat analogues might be missing an opportunity to address other health trends like clean label and digestive wellness,” Beneo’s Gumeny says. “There’s room to evolve this space by adding healthy ingredients like prebiotic fibers, and prioritizing clean labels with easy-to-recognize ingredients like rice starch or flour.”

Long agrees. “Desire for protein with functional health and wellness benefits has led to a rise in the development of protein-enriched ‘protein-plus’ products high in protein but with added benefits like fiber, omega-3s, iron, and antioxidants,” he says. He says ADM has created formulations along these lines using ingredients like legumes and ancient grains, which not only have whole-food credibility but the well-rounded nutrition, textures, and flavors that consumers gravitate toward.

And in the end, the experts agree: That’s the winning formula. “Taste is, and will remain, the number-one repurchase decision factor,” Gumeny says. “Only great-tasting products with good texture will make consumers forget about meat. And a product with good nutritional benefits will be a popular choice for feeding families. As acceptance grows, consumers will demand these plant-based products because of their great taste and health benefits—not just as a substitute for meat.”

In August, KFC became the first U.S. fast-food restaurant to offer plant-based chicken. Dubbed Beyond Fried Chicken and made with Beyond Meat, the item was introduced at one of the chain’s Atlanta locations and sold out in less than five hours.

Kimberly J. Decker writes for the food and nutrition industries from her base in the San Francisco area, where she enjoys eating food as much as she does writing about it.
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Cardiovascular disease remains the leading cause of death in the United States. Nearly half of all American adults currently have some form of the disease, according to the American Heart Association (AHA). These include coronary heart disease, heart failure, stroke, and high blood pressure.

When these facts are combined with an American public that is growing ever more eager for information about nutrition and exercise and more aware of product labeling and terminology, the result is a consumer base seeking out and researching dietary supplements for improved cardiovascular health.

Members of the scientific and medical communities, however, have yet to reach consensus on the role of dietary supplements in restoring or maintaining cardiovascular health. The reason for this depends on whom you ask; and, by nature, science, medicine, and nutrition are all dynamic areas of study full of complexity. One recent meta-analysis of supplements for cardiovascular health, “Effects of nutritional supplements and dietary interventions on cardiovascular outcomes: an umbrella review and evidence map,” and an associated editorial, “Dispense with supplements for improving heart outcomes,” both published in the August 2019 issue of the Annals of Internal Medicine, garnered quite a bit of attention and reaction from various cardiovascular-health stakeholders. The conclusions of the meta-analysis were that reduced salt intake, the use of omega-3 long-chain polyunsaturated fatty acids, and supplementation with folate could reduce the risk of some cardiovascular outcomes in adults. Additionally, “combined calcium plus vitamin D might increase the risk of stroke,” the authors wrote. Limitations of the analysis were “suboptimal quality and certainty of evidence,” they added.

“The piece published in Annals had some positive findings,” says Andrea Wong, PhD, senior vice president, scientific and regulatory affairs, Council for Responsible Nutrition.
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(CRN; Washington, DC). "It showed omega-3 fatty acids can decrease the risk of heart attack and coronary heart disease. Folic acid can decrease the risk of stroke. But these findings were overshadowed by the accompanying editorial, 'Dispense with supplements for improving heart outcomes,' which made very broad and unfounded statements on the whole category of supplements and their effect on heart health. And that really does a disservice to consumers as well as to healthcare providers who are advising their patients."

Wong goes on to make the point that "heart disease is very complex, and many factors can contribute to its development." She says it is "unrealistic to expect that making one change, like consuming a dietary supplement, will have a dramatic effect on heart health outcomes." Supplements can "play a role in cardiovascular health, she explains, but consumers also need to practice other healthy habits. She adds that supplements can’t be compared to prescription drugs, and that they are "not meant to replace prescription drugs or dialogue with one’s healthcare provider, so it’s unfortunate that the author of the editorial and others are repeating the same [anti-supplements] message and trying to influence public policy in this area."

His is a blanket statement against supplements in general," she says. "We can’t apply the drug-research paradigm to nutrition research and expect to have the same type of outcome."

Michael Roberts, PhD, chief scientific officer at ChromaDex (Los Angeles), which supplies the nicotinamide riboside ingredient Niagen for heart health, including in its own Tru Niagen supplement, shares Wong’s assertion. "Many attacks on supplements are based on a flawed notion that supplements should be studied like drugs. While supplements are a great tool for supporting and promoting health, they are fundamentally different from drugs and should not be seen as a replacement for them."

He continues, "Drugs are designed to treat diseases—they function in the body to actively improve a condition and/or reverse symptoms of a disease. Supplements, on the other hand, are exactly that: supplements. They supplement the diet to ensure we are giving our bodies the best nutritional support possible. Through nutrition and healthy habits like exercise and good sleep hygiene, we can support the body’s natural ability to function optimally and stay resilient to stress.”

**Spotlight on Omega-3s**

Omega-3 fatty acids seem to have secured their position among heart-health supplements as one of the leaders. Chris Gearheart, director, member communications and engagement, Global Organization for EPA and DHA Omega-3 (GOED; Salt Lake City), points to three large-scale studies published in the past year—REDUCE-IT®, VITAL, and ASCEND—which have “doubled the number of human subjects studied in the literature on omega-3s and cardiovascular outcomes,” he says. And while not all of those studies met their primary research endpoints, he says, they did all show "statistically significant risk reductions in areas like myocardial infarction and coronary heart disease.”

Gearheart explains that there are multiple reasons why some studies show a clear cardiovascular benefit of omega-3s while others do not, including, he says, "the inclusion/exclusion criteria for studies, which are chosen by the authors; the fact that the subjects may be on cardiovascular drugs that are effective, lessening the chance of omega-3s having an additional effect; and, lastly, the lack of baseline level measurement in some studies. If the subjects already have high omega-3 consumption, he says, "additional omega-3 intake is not as likely to have an impact.”

Gearheart adds that GOED is preparing to submit a paper on EPA/DHA and cardiovascular dose response that summarizes the state of the literature in light of this new data, "which we hope to have published this year,” he says.

CRN’s Wong cites a piece published this past September in the *Journal of the American Heart Association,* "Marine omega-3 supplementation and cardiovascular disease: an updated meta-analysis of 13 randomized controlled trials involving 127,477 participants,” which, she says, further confirms the supplement’s cardio-friendly attributes. The meta-analysis concluded that marine omega-3 supplementation "lowers risk for myocardial infarction, coronary heart disease death, total coronary heart disease, cardiovascular disease death, and total cardiovascular disease, even after exclusion of REDUCE-IT. Risk reductions appeared to be linearly related to marine omega-3 dose," according to the paper’s authors.

**Other Heart-Friendly Supplements**

While omega-3s’ cardiovascular benefits are largely (if perhaps grudgingly, by some) accepted in the medical community, the variety and volume of other ingredients and supplements with potential for cardiovascular benefits is vast, and study of them is ongoing. What follows is an update on and round-up of some of the most interesting.

**Nicotinamide Riboside**

Although scientists first published studies about the molecule nicotinamide riboside (NR) in the 1940s, says ChromaDex’s Roberts, “its potential to support human health wasn’t uncovered until recently.” And last year, he points out, a study from the University of Colorado Boulder, published in *Nature Communications,* showed the potential for NR to decrease blood pressure and arterial stiffness.

“This needs to be replicated,” he says, “but the authors of the study now have two ongoing follow-up clinical trials looking at these cardiovascular endpoints in larger groups of people.” Roberts predicts “lots of exciting research on the horizon” for this ingredient.

**Glucosamine**

A study published in May of this year in *BMJ* concluded that glucosamine supplementation in those with osteoarthritis might also be related to lower risk of cardiovascular-disease events. In other words, cardiovascular benefits might be a happy side effect.

Jacob Teitelbaum, MD, founder of the *Cures A-Z* app and author of various popular health titles, says that this finding “should not come as a surprise to those who follow the research. Two other large studies with a total of over 330,000 subjects showed similar findings for glucosamine,” he asserts. Teitelbaum is a champion of promoting herbal and other non-pharmaceutical remedies for osteoarthritis pain over the use of NSAIDS, which he says increase the risk of both cardiovascular death and bleeding ulcers. He condones the use of glucosamine and other supplements to treat osteoarthritis pain and laments that marketers of glucosamine...
can’t cite research findings in support of glucosamine for heart health on their package labels.

D-Ribose

“By introducing D-ribose pre- and post-operation in heart surgery, the extensive damage implicated as reperfusion injury—tissue damage caused when blood supply returns to tissue following a lack of oxygen—‘can be reduced or avoided altogether,’” says Michael Crabtree, director of scientific affairs, Bioenergy Life Science Inc. (Minneapolis), which markets the Bioenergy Ribose brand of D-ribose. Supplementation with D-ribose is demonstrated to assist in the maintenance and recovery of the elasticity of left-ventricular function, he adds, preserving stroke-volume—the quantity of blood delivered to tissue with each cycle—by maintaining normal energy charge in cardiac cells.

An “important new discovery” on this front, Crabtree says, is that D-ribose helps untrained individuals to adapt to physical exercise.9 “We have also found that D-ribose combined with caffeine increased energy substance and endurance in fatigued mice, as well as in humans.”10

Indian Gooseberry (Amla) Extract

A study published in January of this year in BMC Complementary and Alternative Medicine indicates a positive effect of Arjuna Natural’s (Kerala, India) Tri-Low full-spectrum botanical amla extract (Phyllanthus emblica) on dyslipidemia, a contributor to atherosclerosis.11 The extract, from a fruit widely used in Ayurvedic medicine, has shown “significant potential in reducing total cholesterol and triglyceride levels and stimulating a more favorable balance of lipid ratios,” according to company literature. The company also states that the extract “is the first of its kind standardized with diglycerides of alpha-linolenic acid and polyphenols.”

Aronia Berry

Harvested from a largely ornamental shrub native to Eastern North America, the aronia berry is rich in polyphenols and is being studied for its potential benefits to cardiovascular health and the microbiome. Eve Landen, media manager, flavor division at Naturex (Avignon, France), part of Givauden (Vernier, Switzerland), points to a recent study published in the American Journal of Clinical Nutrition that suggests that consumption of both aronia whole-fruit powder and extract of aronia berry (Naturex’s Aronox product) improves endothelial function and modulates the composition of gut microbiota, thereby helping to maintain cardiovascular health.12 Aronox comprises Aronia melanocarpa and Aronia mitrullii.

“Improving endothelial function leads to improvements in blood flow,” Landen says. “A 1% improvement in endothelial function has
been shown to correlate with an 8%-12% reduction in CVD risk, according to two recent meta-analyses.”

Part of the Toolbox
Supplements aren’t magic bullets or miracle cures, but they are likely to be one of many useful, valuable tools which consumers can call for optimal cardiovascular health, along with proper nutrition, exercise, adequate sleep, and high-quality medical care. Rather than “dispensing with” supplements altogether because the science is still in development, the public and the medical establishment alike might perhaps be wise to keep an open mind, and view supplements the way ChromaDex’s Roberts does: as support for the body’s natural ability to function optimally and stay resilient to stress. “Our toolboxes can include supplements, the type and selection of which will depend on one’s health needs and objectives,” he says.

“Heart disease continues to be the leading cause of death of Americans according to the CDC,” adds CRN’s Wong, “and the prevalence is increasing. It’s a huge burden on quality of life, and on individual and family finances. For these reasons, people seem to be taking a more proactive approach to their health. They may not be waiting for a diagnosis, so there’s a lot of interest among consumers in a nutritional way to maintain their heart health.” Along with other healthy lifestyle habits, supplements—thoughtfully selected and appropriately dosed—may be just the thing.

Maureen Kingsley is a freelance writer, editor, and proofreader based in Los Angeles. She covers a variety of industries, including medical technology, food-ingredient manufacturing, and cinematography.

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Inflammation, C-reactive protein (hsCRP), levels of uric acid, and lipoprotein(a) are all indices to consider. In clinical studies, Gugulipid® was shown to significantly benefit the combination of all these factors. Antioxidant rich foods such as healthful berries, red wine, and an Ayurvedic medicinal preparation for cardiovascular wellness, Drakshasava, contain stilbenol compounds such as resveratrol (concentrated in Resvenox®) and pterostilbene (the biomarker in Silbinol®), that target inflammation, sugar and lipid metabolism.*

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Children’s Health

**EARLY ESSENTIALS**

Omega-3 fatty acids are critical nutrients for healthy mental and physical development.

**BY IRFAN QURESHI, ND**

Omega-3 fatty acids are critical nutrients for the developing fetus and the growing child. Published studies attest to the benefits of increasing omega-3 intake levels through dietary practices as well as dietary supplements, especially in pregnant women and early childhood development. Why? Omega-3 long-chain polyunsaturated fats (PUFA) play major roles in embryonic development that span the gamut of human physiology.

Docosahexaenoic acid (DHA), in particular, is one of the most critical omega-3 fatty acids for fetal development. This is illustrated by the fact that, while concentrations of all fatty acids in maternal blood increase during pregnancy, the concentration of DHA specifically decreases, indicating the growing fetus’s need for DHA. In addition, DHA is one of the few fatty acids that is preferentially transferred to the placenta through the mother’s cord blood.¹

DHA and other omega-3 fatty acids, including eicosapentaenoic acid (EPA), remain of critical importance after birth, in early childhood and through adolescence. Unfortunately, the majority of DHA and EPA intake comes from the diet, and it has been shown that dietary intake of these essential omega-3s by both young and old remains woefully inadequate. According to National Institutes of Health data, children and teens average about a 40-mg total daily DHA + EPA intake from dietary sources, while adults average about 90 mg.² This is substantially lower than the 500 mg/day that the Global Organization for EPA and DHA Omega-3 (GOED; Salt Lake City) recommends for health maintenance,³ and does little to fulfill potential daily requirements for these key nutritional factors.

This is concerning, given that ongoing research continues to point to the great need for omega-3 fatty acids for healthy development. Ahead, we highlight some recent studies in the areas of fetal development, childhood growth, and brain development.

**Preterm Birth and Fetal Growth**

Omega-3 fatty acids, in particular DHA, support several aspects of fetal growth. Several, but not all, recent studies indicate that higher intake of omega-3 fatty acids during pregnancy may reduce the incidence of preterm birth and help reduce the likelihood of children being born with low or very low birth weight. Additional research points to the
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benefits of DHA intake for addressing other areas of fetal development.

A recent analysis at the University of Kansas Medical Center took data from two clinical studies conducted earlier which assessed other pregnancy-related outcomes in women supplementing with DHA. The researchers performed a secondary analysis on this data looking specifically at the relationship between DHA supplement dosage and the incidence of preterm birth and birth weight in 345 pregnant women.4 In the original studies, healthy pregnant women with singleton pregnancies (no twins, etc.) were assigned to supplement with 600 mg/day of DHA or a corn-and-soybean-oil placebo beginning between week 12 and 20 of gestation until delivery.

Because supplementation compliance was pointed out as an issue of concern in the original studies, the authors looked at the relationship between compliance and the relevant endpoints of preterm delivery and birth weight. They found that the incidence of low and very low birth weight, as well as preterm deliveries, decreased significantly with increased compliance (and therefore greater DHA intake). Upon assessing the data, they determined that a rate of about 50% compliance (or an average intake of 285 mg of DHA/day) reduced preterm birth and reduced low- and very-low-birth-weight rates by nearly half. Increasing the dose of DHA even further (up to 600 mg/day) led to additional declines in preterm birth as well as very-low-birth-weight deliveries.

In another investigation, researchers from Brigham and Women’s Hospital led a secondary analysis of data from the Maternal-Fetal Medicine Units Network randomized controlled trial assessing whether supplementation with 2 g of omega-3 fatty acids daily (as 800 mg DHA and 1200 mg EPA) during pregnancy (beginning between weeks 16 and 22) prevented recurrent preterm birth.5 While the primary study did not show a benefit of omega-3 supplementation in preventing preterm birth6, this secondary analysis looked at whether the ratio of pro-inflammatory-to-inflammatory fatty acids (omega-6:omega-3 ratio) measured between week 25 and 28 of pregnancy impacted fetal growth parameters. Furthermore, the participants were divided into two subgroups based on their body mass index (BMI) and classified as lean (18.5-24.9 kg/m²) or overweight/obese (>25 kg/m²). The analysis included 440 pregnant women with a prior history of preterm delivery.

While the primary study did not show a benefit of omega-3 supplementation in preventing preterm birth, this secondary analysis looked at whether the ratio of pro-inflammatory-to-inflammatory fatty acids (omega-6:omega-3 ratio) measured between week 25 and 28 of pregnancy impacted fetal growth parameters. Furthermore, the participants were divided into two subgroups based on their body mass index (BMI) and classified as lean (18.5-24.9 kg/m²) or overweight/obese (>25 kg/m²). The analysis included 440 pregnant women with a prior history of preterm delivery.

Of the women taking omega-3 supplements during pregnancy, the researchers found that those classified as obese/overweight with higher omega-6:omega-3 ratios showed impaired fetal growth and shorter gestational length. The babies of these mothers also had a higher incidence of respiratory distress after birth as well as increased hospital stays. These results indicate that higher maternal inflammation (as

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measured by omega-6:omega-3 ratios during pregnancy) may be a marker of adverse fetal growth outcomes, especially in overweight and obese pregnant women. Because supplementation with omega-3 fatty acids can modify maternal inflammation, it may have a protective effect on fetal growth parameters.

A more recent, large, double-blind, multi-center study performed in Australia followed 5,544 pregnancies in which women were asked to supplement with 900 mg of omega-3 fatty acids or placebo daily beginning before 20 weeks of gestation to the end of pregnancy. The primary outcome of this study was early preterm delivery. The results showed that early preterm delivery occurred in 2.0% of the women taking the placebo, while it occurred in 2.2% of those taking omega-3; however, the differences were not statistically significant. On the other hand, a significantly higher percentage of infants born to women taking omega-3 were very large for gestational age at the time of birth. Given these results, the impact of omega-3 supplementation on preterm birth remains unclear and requires further analysis.

Childhood Growth and Healthy Body Composition

Omega-3 intake at a young age and during development has been found to confer significant benefits on several aspects of childhood growth. Research has shown that omega-3s, whether consumed by the mother in pregnancy or by the child during his or her early years, are likely to positively influence body composition and overall growth.

In a trial at the University of Copenhagen, researchers studying fish oil supplementation during pregnancy and its effects on childhood growth found significant benefits for bone health as well as lean and fat mass.

Brain Development

PUFA, and particularly DHA, are known to be important building blocks for brain
development. Several studies suggest that supplementation of omega-3 fatty acids either by the mother during pregnancy or by children in their early years may have lasting benefits for brain function and cognition.

University of Kansas Medical Center researchers conducted a study to evaluate the effect of consuming long-chain-PUFA–fortified infant formula (containing arachidonic acid/ARA and DHA) during the first year of life on brain development at age nine. In the study, 42 children who consumed formula without long-chain PUFA, or with 0.64% ARA plus three different concentrations of DHA (0.32%, 0.64%, or 0.96%), were then evaluated using various magnetic resonance imaging (MRI) techniques to assess effects on brain structure, function, and metabolism. Following functional MRI analysis, researchers found that children who had consumed long-chain-PUFA–fortified formula during the first year of life had greater brain activation in the anterior cingulate cortex and parietal regions when undergoing the Flanker task (a measure of the brain’s ability to inhibit responses that are inappropriate in a given context), indicating greater inhibition.

Furthermore, resting-state MRI analysis of each of the groups found that those consuming the formula fortified with 0.64% DHA showed greater connectivity between the prefrontal and parietal regions of the brain compared to all other groups. Brain white matter volume in the prefrontal and anterior cingulate cortex also increased in the 0.32%– and 0.64%-DHA groups. These results suggest that fortification of formula-fed infants with DHA during their first year of life can have significant, lasting benefits for neurological development.

Another study looked at the effect on infant brain volumes of a DHA-enriched supplement given to pregnant mothers. Here, 300 pregnant women consumed two capsules of the DHA supplement (containing 300 mg DHA, 42 mg EPA, and 8.4 mg ARA per capsule) or a placebo until delivery. At study’s end, 86 infants underwent brain MRI scans at an average gestational age of 43 weeks. In female infants, no significant differences in brain volume were noted in the supplement group versus placebo; however, in male infants in the supplement group, DHA led to increased birth length and head circumference as well as increased total brain, cortex, corpus callosum, and whole gray matter volume compared to placebo.

study findings indicate a gender-specific effect of DHA and highlights the need for ensuring optimal DHA status in pregnant women for supporting healthy infant brain development.

**Crucial for Kids**
The research on omega-3 fats and their ability to positively impact the developing fetus and growing children is clear. Nutritional interventions incorporating these essential and healthy fats can yield significant benefits for childhood growth and development.

Although researchers must continue to tease out issues around dosing as well as identifying population groups that are likely to benefit the most, adding DHA and other
omega-3 fatty acids to a child or expecting mother’s daily routine may be a prudent step in ensuring individuals are meeting their need for these critical nutritional factors.

Irfan Qureshi, ND, is vice president, product development and quality assurance, for Healthy Directions.

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Turmeric is the shining star of today’s botanical market. Mounting research is not only validating turmeric’s traditional health benefits but also revealing new, previously unexplored potential therapeutic uses of this curry staple. Given turmeric’s powerful anti-inflammatory and antioxidant benefits, it’s not difficult to see why the herb’s popularity is increasing annually. According to the HerbalGram Herb Market Report for 2018 published this fall, turmeric was the number-two bestselling herbal supplement in the natural channel, with over $51 million in 2018 sales. It held the third spot in mainstream channel sales, with over $93 million—a figure 30.5% higher than in 2017.

Positive study outcomes for “The Golden Spice” are leading to higher levels of acceptance of the well-renowned traditional benefits of the herb—to the point where associations seen in several initial epidemiological studies years ago are translating to tangible health benefits in intervention-based human clinical trials. A big reason for this seems to be that the current extracts of turmeric, namely curcumin, possess higher bioavailability than the pure spice itself. Curcumin supplementation leads to higher blood levels of the active curcuminoids, resulting in positive outcomes in several health conditions.

As turmeric’s notable bioavailability challenges are increasingly overcome through further technological advancements, it’s reasonable to expect that scientists will discover additional uses for the golden spice in the years ahead, fueling added consumer interest as well as sales of this beneficial spice.

Liver Function
One of turmeric’s traditional uses is supporting liver health. A recent double-blind, placebo-controlled trial led by Naveen Krishnareddy of Life Care Hospital in Bangalore, India, investigated the effect of curcumin supplementation on liver function in chronic alcoholics.

A novel curcumin complex with galactomannoside providing enhanced delivery and improved bioavailability of free curcuminoids was used in the study. The ingredient is the CurQfen branded ingredient, 39.1% curcuminoids, from supplier Akay Flavours & Aromatics Pvt. Ltd. (Cochin, India). Healthy male subjects between the ages of 30 to 50 consuming six servings or more of alcohol per week (fitting the National Institute on Alcohol Abuse and Alcoholism (NIAAA) criteria for chronic...
alcoholism) were asked to supplement with 500 mg of CurQfen or placebo daily for eight weeks. All individuals had elevated liver enzymes, including serum transaminases and gamma-glutamyl transferase.

Liver function markers in the placebo group increased by around 9.5% after eight weeks. The curcumin-supplemented group saw significant improvements, however, including serum transaminases reduced by 31% from baseline and gamma-glutamyl transferase reduced by 29% from baseline. Furthermore, measures of endogenous antioxidant activity increased, while measures of inflammation significantly decreased in those taking the curcumin complex. The study results show that curcumin may significantly improve liver health and function in chronic alcoholics.

**Memory and Attention in Aging Adults**

Recently, scientists from the University of California, Los Angeles (Los Angeles, CA), investigated the effects of curcumin supplementation on memory and attention in adults without dementia.

In the double-blind placebo-controlled study conducted by Gary Small and colleagues, 40 adults aged 51 to 84 were divided into groups taking a bioavailable form of curcumin—as Theracurmin from Theravals (Tokyo, Japan) containing 90 mg of curcumin twice daily—or placebo for 18 months. In addition to assessing verbal and visual memory and attention, brain amyloid and tau protein accumulation were also assessed. These were assessed because hallmarks of Alzheimer’s disease include beta-amyloid protein accumulating in senile plaques and tau protein accumulating in neurofibrillary tangles. These begin accumulating decades before dementia symptoms are apparent.

In the study, curcumin supplementation led to significant improvements in verbal and visual memory as well as attention compared to placebo treatment. Furthermore, PET scan imaging data found that amyloid and tau accumulation was significantly decreased in the amygdala in the curcumin group compared to placebo. In the hypothalamus, protein accumulation was unchanged with curcumin supplementation but increased with placebo, indicating that curcumin may decrease amyloid and tau protein accumulation in brain areas associated with mood and memory.

**Cholesterol and Blood Lipid Support**

Researchers from the University of Newcastle (Callaghan, Australia) led by Jessica Ferguson aimed to evaluate the effect of curcumin supplementation as a potentiator of the benefits of phytosterols for controlling high cholesterol levels.

In the double-blind, placebo-controlled trial, for four weeks, 70 participants with average total cholesterol levels of 6.57 mmol/L received either 1) placebo, 2) phytosterols (2 g/day), 3) curcumin (200 mg/day, derived from Meriva, a curcumin phospholipid from Indena in Milan, Italy), or 4) phytosterols (2 g/day) plus curcumin (200 mg/day).

At the end of the study, significant decreases from baseline values were seen in both the phytosterol group and the combination phytosterol + curcumin group in the following measures: total cholesterol, LDL cholesterol, and the total cholesterol:HDL cholesterol.

_Turmeric’s popularity is increasing annually, given its powerful anti-inflammatory and antioxidant benefits._

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ratio. In the phytosterol group, reductions in total cholesterol averaged 4.8% and in LDL cholesterol were 8.1%. In the combination group, adding curcumin to phytosterols resulted in a total cholesterol reduction of 11% on average, while LDL cholesterol decreased by 14.4% with the combination.

These reductions were significantly greater than with placebo or with curcumin alone. The results indicate that the addition of curcumin in a phospholipid form can potentiate the cholesterol-lowering effects of phytosterols.

Enhanced Sperm Quality
Infertility is a common issue, with 25% of couples seeking medical help with infertility at some point during their relationship. Male infertility accounts for the issue in at least 50% of cases. Sperm are highly susceptible to reactive oxygen species and the effects of free radicals. Given curcumin’s strong antioxidant and anti-inflammatory potential, researchers led by Fatemeh Alizadeh from Qazvin University of Medical Science (Qazvin, Iran) decided to study the impact of curcumin supplementation in men with infertility.

In the double-blind, placebo-controlled study, 60 infertile men were randomized to supplement with 80 mg of curcumin in a novel nanomicellar formulation daily or a placebo for 10 weeks. Semen analysis and measures of antioxidant function as well as inflammatory measures were assessed at baseline and the end of the study.

Curcumin supplementation led to a statistically significant improvement in total sperm count, sperm concentration, and sperm motility compared to placebo. Curcumin also led to statistically significant improvements versus placebo in total antioxidant capacity and malondialdehyde (measures of antioxidant function), as well as reductions in C-reactive protein and tumor necrosis factor (measures of inflammation). Given the results of this study, supplementation with curcumin may be an effective treatment option for improving sperm quality in infertile men. 

References


Irfan Qureshi, ND, is vice president, product development and quality assurance, for Healthy Directions.
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The push for clean label is changing the way products are colored.

BY SEBASTIAN KRAWIEC

The color of a food or drink makes a big impression when consumers are making a purchasing decision. Artificial colors have long been an important tool for food formulators, but with the push for clean-label products, artificial colors continue to fall out of favor. Natural colors, sourced from food, are growing in popularity, but they still pose some challenges to formulators making clean-label products.

Interplay of Color and Flavor
"The main challenges switching to natural colors include stability and cost, and it is not as simple as a 1:1 replacement for artificial," explains Brian Stuart, color chemist for Gold Coast Ingredients (Commerce, CA). "When using natural colors, the pH, any heat being added, if the product is being exposed to light—all of this has to be taken into account when using natural. Then the cost of natural colors is usually more expensive than artificial colors."

Because natural colors are sourced from food, their taste may not be neutral and will therefore contribute to the end product. Turmeric and paprika are good examples of ingredients that produce vibrant, natural colors but that also impart flavor. When formulating a product from scratch, this must be taken into account and either intentionally become part of the product’s flavor profile, or else formulators must compensate for the taste.

“This is not often an issue due to the low usage of coloring agents,” says Stuart. “However, if the usage of the coloring agent is high, then it might become necessary to mask any undesired flavor the color gives the product. Masking agents are a great ingredient to mask any off notes put off by natural colorants, which tend to carry an ‘earthy,’ ‘dirt,’ or possibly bitter taste.”

Replacing traditionally used colors with natural colors requires creativity to ensure that the overall flavor profile remains the same. For example, because of Prop 65 regulations in California, many manufacturers are trying to find an alternative to caramel coloring. This is why Sensient (Chicago, IL) recently launched Sienna Colors, a portfolio of brown shades from natural sources that are free from furfuryl alcohol and 4-MEI. Sienna Colors are heat and light stable across a wide pH range.

“If you think about it, caramel may or may not have contributed taste to the product, and if you’re adding different colors, it could affect your taste profile. That’s why the colors and flavors [we offer] are a unique, added-value proposition we have for our customers,” explains Aret Meyer, general manager of savory flavors for Sensient.

Mixing the Right Shade
If you’ve ever bought paint at a hardware store, you know that the color you choose is actually a blend of many different colors at a specific ratio. Coloring foods can be similar.

“The intensity of the color is dependent on the molecule that acts as the coloring constituent,” explains Stuart. “For example, red beet is a red color, and that specific red color comes from a molecule called betanin. The intensity of the red beet color is determined by the concentration of betanin content. Variation in hue stems from the formulation of blends by adding a variety of natural colors to achieve a new hue, and even small amounts of different additions of colors can make a large difference in terms of a variation of that color—for example, transitioning a light green color to a lime green color.”

The way a color looks may also depend on the source material is a powder or liquid. Powders, for instance, can vary in color. “Powders tend to have good-to-okay consistency in terms of shade and hue, but can vary more than liquids due to the fact that it is a natural color. Since the source of the color has several variables, these factors can cause, for example, a blue color to be darker or lighter, but when put into solution would remain consistent in terms of the same color from different batches,” explains Stuart. By contrast, he says, “Liquid colors tend to be consistent in terms of shade and hue since the color is dispersed into a liquid media, which allows for a different color expression than that of powder.”

Using a powder or liquid has different advantages and disadvantages. Powders, for example, can be used in most applications and have a longer shelf life and stability in storage, but liquids tend to be more versatile and easier to work with for measuring out and handling the material. Liquid colors can be more challenging to use in oil-based applications, however.

Considering that these differences are pretty small, powder and liquid forms are mostly interchangeable, says Stuart, and depend on the customer’s preference.

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- Flexibility (45.5% increase; P = 0.005)

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Pain Scale Reduction Chart Recorded During Trial

* Clinical Trial conducted by Morton Scientific Group, Cambridge, Ontario, Canada.
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