



Food technology and **innovation**

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Food and beverage CPGs need to constantly revamp their products to cater to shifting consumer preferences. For the most part, these shifts are happening more rapidly than the typical product development cycle, contributing to the failure of some 80% to 85% of new products post-launch. **Thomas Hayes** highlights the emerging digital tools, like artificial intelligence (AI), that are presenting a unique opportunity to help meet this challenge.

7 Disruption in the food space

Technology innovation is a channel that companies can connect to and use to innovate and drive change and growth in the food and beverage industry. Several cutting-edge companies are leveraging food technology to disrupt the industry. **Joana Maricato** identifies real-world examples of where food technology has been leveraged to meet consumer health demands.

11 Phenolic antioxidants in a tech frame

With consumers increasingly demanding more healthful products, it is essential that food and beverages on the market that claim this, such as those with antioxidants, are truly healthful. **Dr Vincent Candrawinata** discusses phenolic antioxidants and how to benefit from them properly.

16 Takeaways



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Future of food

Technology plays such an integral role in our daily lives – often more so than we’d care to admit. Advances in technology have changed the way we communicate, travel, bank, shop and – especially – what and how we eat. It’s a thrilling time for the food space as developers continually look to technology to accelerate product development and tackle issues surrounding food safety and security, health profiles, sustainability and waste.

Artificial intelligence (AI), automation and CRM systems are all examples of technology that have been refined for the industry, and especially for the supply chain’s understanding of consumer needs and demands. As disruption continues to shake the industry, innovative solutions are emerging and suppliers connect more closely to consumers.

Quickly shifting customer preferences makes it increasingly difficult for finished product businesses to keep up, and there’s rising interest in how technology like AI can be used as a tool to overcome these challenges. Thomas Hayes outlines AI as a digital tool for the food space and the role it plays in product development for food and beverage CPG brands on [page 4](#).

Although there’s a preoccupation to deliver on consumer expectations, they don’t buy into the technology and innovation behind the product they decide pick off the shelf – or ‘add to cart,’ I should say. Consumers buy into products that meet their health-conscious needs, and the commercial opportunity for businesses is certainly worth considering as mindsets have changed to prioritise health benefits over price tags. With that in mind, technology should simply be viewed as a catalyst to motivate a customer’s final purchasing decision. On [page 7](#), Joanna Maricato highlights case studies of brands that have successfully used technology to innovate food categories and finished product offerings.

Finally, we shift from big-picture thinking and take a closer look at how technological advances have impacted an isolated area. Antioxidant products are common to a variety of markets within the nutraceutical industry – especially healthy ageing, nutricosmetic and skincare categories. In a deep dive into phenolic antioxidants ([page 11](#)), Dr Vincent Candrawinata walks us through new technology for extraction and delivery.

Health and nutrition trends coupled with new technology is paving the way for product development and testing. It’s an exciting time for the nutraceutical and greater food industries as disruption continues to drive change and bridge the gap between suppliers and consumers.



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Future forward

Artificial intelligence for new product development

By Thomas Hayes

Food and beverage CPGs need to constantly revamp their products to cater to shifting consumer preferences. More often than not, these shifts in consumer preferences are happening more rapidly than the typical product development cycle, contributing to the failure of some 80% to 85%¹ of new products post-launch. Thankfully, emerging digital tools are presenting a unique opportunity to help meet this challenge.

How digital tools will revolutionise food and beverage development

The rise of big data analytics and artificial intelligence (AI) have garnered hundreds of billions of dollars in funding since 2014. While other industries have already generated significant momentum in adopting AI-fueled analytics to accelerate product development, the CPG industry is in its early days of doing so. Two prime examples of increased adoption elsewhere are AI for drug discovery and materials informatics, within the pharma and materials industries, respectively. The first real-world example of leveraging AI to support food and beverage development can be traced back to 2014 with IBM's now-retired Chef Watson, but it wasn't until around 2018 that an uptick in market development showed early signs of legitimate adoption by the CPG industry.

This uptick in market development (e.g., funding, partnership announcements, product roll-outs) is coalescing into its own technology space comprised of two types of players: 'brand owners' (those using AI-based data analytics to create their own or co-developed products) and 'service providers' (those offering AI-based data analytics as a software service to CPGs). Regardless of type, there are only a dozen or so companies operating in this space and all are start-ups except for IBM. Although most of the start-ups fit the 'service provider' profile, two of the three falling into the 'brand owner' classification have garnered the vast majority of funding: Nuritas and NotCo. These companies have received at least \$61 million and \$30 million in funding, respectively. Of the service providers, Analytical Flavor Systems has raised the most funding, largely from a \$4 million Series A round in November 2018.

Artificial intelligence for new product development

While funding helps indicate momentum into the space, proving a return on investment (ROI) through such approaches will be the most vital indicator of future success. In select instances, companies have proved ROI in terms of accelerated product development cycles. This has been highlighted by recent work from IBM and Nuritas.

IBM

IBM made headlines in 2019 by creating and deploying AI-based solutions for McCormick and Cerealto Siro Foods. IBM took different approaches in each instance. For McCormick, IBM Research developed an interactive tool for flavorists that recommended new seasoning formulas, drawing on McCormick's wealth of existing proprietary data. For Cerealto Siro Foods, IBM Services provided a trendspotting resource for new product inspiration that relied on publicly available information like social media. In both cases, IBM departed from the approach used with its since-retired Chef Watson project that built on the flavor pairing hypothesis.

In the case of McCormick, its chief science officer has stated that through the tool delivered by IBM, it can speed up the product development cycle by up to 70%². Moreover, the company conceptualised a line of seasonings using IBM's AI platform, dubbed "ONE," which it released in the U.S. around mid-2019. With regard to Cerealto Siro, it has yet to make any explicit remarks about reduction in product development timelines, but the company has already launched new products in the U.K. inspired by IBM's tools.



Nuritas

In January 2017, BASF announced a partnership with Irish startup Nuritas, which employs artificial intelligence to identify novel bioactive peptides. BASF leveraged Nuritas' expertise in combining genomics and evolutionary algorithms for effective data mining and modeling of bioactive peptides from plant proteins, making the identification faster and easier.

Thanks to this partnership, BASF was able to launch a novel rice protein-based bioactive ingredient "PeptAlde" in November 2018, within two years of the original partnership announcement. The ingredient is currently available in the U.S., and the company hopes to commercialise it in Asia-Pacific and Europe by the end of 2019.

Looking forward: A shift in spotlight to Asia Pacific

While development activity to date has largely resided within North America and Europe, this will expand into Asia-Pacific given the evolving needs of the region. Around 90% of the global middle-class growth by 2030 will be from three regions within Asia: India (380 million), China (350 million), and Southeast Asia (210 million)³. This will undoubtedly lead to an increased consumption of packaged foods and beverages, creating an opportunity for CPGs, but within a uniquely vast and heterogenous market.

Start-ups Analytical Flavor Systems (AFF) and AI Palette are both service providers and have been early movers to recognise this regional opportunity. Although headquartered in the U.S., more than 50% of AFF's current customer base is from Asia. The company possesses an AI-based sensory intelligence software platform, called Gastrograph AI, to predict the perception of food and beverage products by different demographics of consumers. By focusing on demographic-driven product design, it caters well to the heterogenous nature of Asia and hence has gained traction there. AI Palette, headquartered in Singapore, focuses on demographic-driven product design too, but through a different approach. It is focusing much more on the conceptualisation stage of product development through consumer intelligence insights, rather than the prototyping stage where sensory intelligence from the likes of AFF comes into the equation. The company's main differentiator is its use of language-agnostic natural language processing capabilities to derive insight from public sources of information, such as social media and restaurant reviews, once again catering well to the heterogenous nature of Asia.

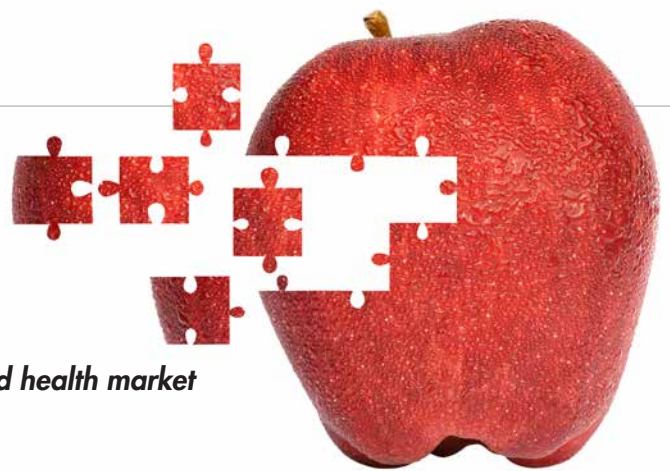
In Asia and abroad, there's a clear need to take a more agile, data-driven approach to reformulating as well as developing new foods and beverages. Although it is still an emerging space with only a handful of players, CPGs should view this approach as an efficient strategy to rapidly accelerate the development timeline for new product launches, thus enabling companies to address challenges around changing consumer preferences. As digitally driven technologies move faster than physical product innovation, now is the time to engage. ●

Thomas Hayes is an analyst at Lux Research, with a specialised focus on the global health and nutrition market insights and big data.

Sources

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Stirring the pot

How technology innovation disrupts the food and health market

By Joana Maricato

MTechnology has shaped the way we eat and has also dramatically changed the way we buy, preserve, and consume foods. Refrigeration is an example of a process that has changed the way we eat, while processes like canning, pasteurisation and freeze-drying have allowed us to preserve food life. These are examples of how technology disrupted the food space to create some of the ordinary and everyday solutions we know today. Some technologies keep reinventing themselves and driving new categories within the food and beverage space. Fermentation is the process behind products like cheese, yogurt, bread and wine. But interestingly, fermentation is going through a '2.0' phase – not in that the process or the technology is changing, but rather connecting to a new generation of products that consumers perceive as being healthier than previously fermented products – like kombucha, kefir and kimchi. As one of the several examples of areas that are reinventing themselves, new generation fermentation introduces variety and presents exciting new commercial opportunities for the fermented foods space.

Technology innovation is indeed a channel that companies can connect to and use to innovate and drive change and growth in the food and beverage industry. Several cutting-edge companies are leveraging food technology to disrupt the industry.

Fairlife

Fairlife is a brand within the dairy industry from Coca-Cola. Using ultra-filtration technology, Fairlife has produced a finished product milk that is lactose-free, higher in protein and lower in sugar milk. Launched in 2015, FairLife ultra-filtered milk achieved €267 million in sales despite selling at a 50% premium to regular milk. This buying power reflects the uncompromising willingness of consumers to spend if a product connects to their key needs and concerns – like sufficient protein content, low sugar and digestive comfort, in this case.

The technology itself is not a motivator for purchase, but more so the fulfilment of health needs. Consumers want healthy products, but often not at the cost of good taste. Beyond the health benefits it delivers, milk processed through ultra-filtration delivers creamier taste and texture. As this technology becomes more commonplace in the dairy industry, it will become increasingly challenging for developers to create a point of differentiation based on the process alone.



A2 Milk

Staying with the dairy industry, the Australian-born company A2 Milk is gaining traction in Europe and the U.S. Essentially, A2 Milk is milk that only contains A2 protein, which is said to be easier to digest due to the absence of A1 protein. A2 Milk is currently the fastest growing dairy milk company in the world, with a 68% sales jump to €547 million in 2018, and 10% share of Australia's milk market. In China, the brand has grown to have a 5.1% value share of the infant formula market.

The core messaging of this brand is its association with the easy-to-digest properties of the A2 milk, evident in both adults and children.

The assurance of A2 milk has been made possible through innovation in genomic tests. Over the years, the test has become easily assessible and currently allows farmers to test the tissue or the finished milk of dairy cows. Various companies offer A2 genetic testing as an add-on to a full genomic test, while others offer testing for A2 on its own at little cost. Most farmers' approach is to limit their sire selection to bulls classified and confirmed as A2A2. The science behind A2 milk is still considered in its early stage, and there are arguments that testing is not as straightforward as experts would like it to be. Despite these views, the company continues to grow and it evidently has an impact on consumers and their willingness to buy.

Coconut water

The global rise in sales of coconut water is considered a reflection of packaging innovation. The category development has Tetra Prisma Aseptic packaging to thank for its growth. The coconut water market is currently valued at €978 million in the U.S. and €314 in Europe. Introduced in 2007, aseptic packaging allows the coconut water to maintain its nutritional value and natural taste, whilst also providing longer storage/shelf life.

Alternative meat

Enjoying high growth and getting plenty of attention from vegan, vegetarian, flexitarian or simply health-

conscious consumers is the plant-based meat market. The Impossible Burger, which has been in the global spotlight, has produced a plant-based, meat-lookalike, great-tasting burger. The Impossible Burger includes an ingredient present in soybeans – leghemoglobin – a protein that is chemically bound a non-protein molecule (called heme) which gives leghemoglobin its blood-red colour. The ingredient is produced using a genetically modified yeast grown through fermentation. The soy leghemoglobin (containing heme) is then isolated from the yeast and added to the Impossible Burger patty mix where it combines with other micronutrients.

The genetic engineering technology has been successful in producing a healthy and plant-based alternative which also satisfies consumers' taste and texture palate.





NotCo

A Chilean company, NotCo started with an initial investment of €222 million in 2015 to develop a software capable of formulating food products, based in plant ingredients, that imitate the taste and texture of the foods. The software, named Giuseppe, uses an artificial intelligence algorithm that searches for patterns, like molecular structure, in traditional foods and searches for the plant-based ingredients in which the pattern, or structure, can be replicated. NotCo recently received a further €27 million investment from Jeff Bezos.

NotCo's flagship product, NotMayo, is available in Chile, Brazil and other Latin American markets with a plan to enter the U.S. in 2020. In Chile, NotMayo maintains more than 10% share of the mayonnaise market.

Shopping habits

Beyond food technology, innovation has also disrupted the way we discover, shop, buy and consume the foods and beverages we eat. Ecommerce has played a pivotal role in sales growth for established businesses and start-ups, and online B2C is now a major channel for food and beverage companies across the world.

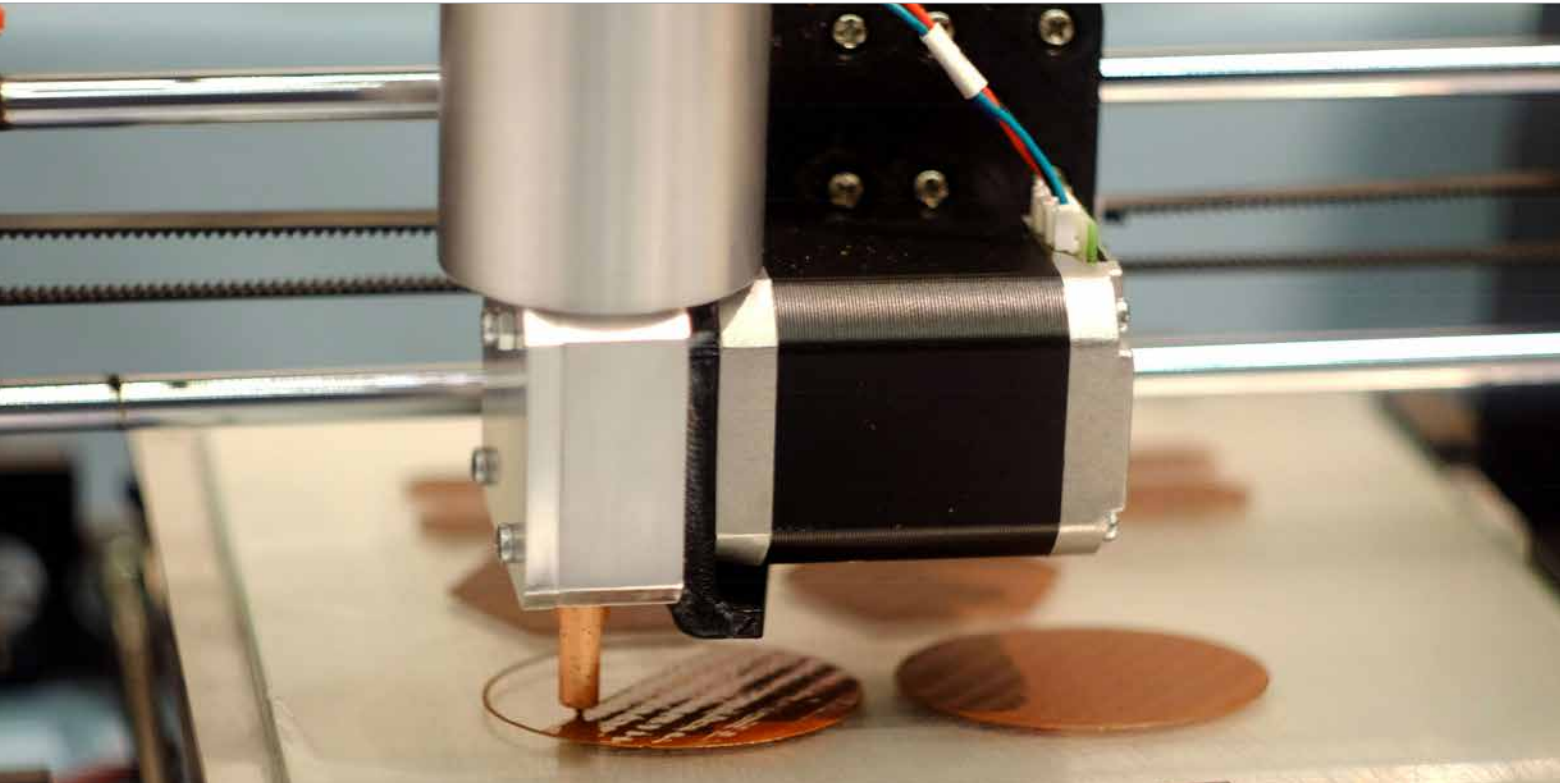
In the U.S., Amazon's ecommerce market share is 33.7% and sales of Amazon Fresh's food sales increased significantly with the acquisition of Whole Foods. Top grocery items bought from Amazon Fresh are currently listed as: cold beverages coffee, snack foods, breakfast foods, and candy. Amazon UK sales are currently worth €51.4 million. Following strategic partnerships with Monoprix and Morrison's, Amazon Fresh launched same-day grocery delivery in 2016.

China has the highest rate of retail sales in the world, with its online retail sales exceeding those in the U.S. – totalling €1.1 trillion in 2018 (an increase of 23.095). 35.3% of China's retail sales occur online, and China's fresh food ecommerce market is reported to include 37.88 million users.

Mimica Touch

Although not considered to be disrupting the industry yet, Mimica Touch's labelling technology is forecasted to innovate the future market. Mimica Touch is a patented label that indicates to consumers exactly when food spoils. It is calibrated to degrade at the same rate as the food. The technology creates a freshness indicator for all types of perishable products – ranging from foods to pharmaceuticals. Consumers are able to apply the label to the exterior of food packaging. When a person pushes the label and feels ridges or bumps beneath the surface of the label, the food is no longer suitable for consumption. After three years of lab development, Mimica Touch will be launching in 2019 starting in the dairy and juice industries, and partnering with companies like Arla Foods.





3D printing

Finally, and although also not considered to be disrupting the industry yet, 3D food printing aims to find its place on consumer kitchen counters. Foodini is one such company looking to perfect a 3D printing device for consumers. Foodini is a system that pushes food down a capsule, through the nozzle, and prints it. A precision control system moves the capsule accurately, creating shapes which then can be stacked layer upon layer to become 3D printed food. 'Prints' can be served or plated directly, baked in the oven, frozen or dehydrated. The estimated price tag of such a device is €3,600.

Takeaways

Consumers don't buy into the technology and food innovation; they buy into health needs that are met in a finished product. A key consideration for developers is connecting food technology to the trends and benefits that consumers demand. Taste and texture are still part of food enjoyment and very few consumers are willing to compromise on these two factors. Disruption takes time. The abovementioned examples are reaping the rewards now, but this is on the back of at least four years of establishment, disrupting respective categories, and stamping a place in the overall market. ●

Figures and statistics: New Nutrition Business 2019

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Phenolic antioxidant effects

Extraction and delivery done right

By *Vincent Candrawinata*

With consumers increasingly demanding more healthful products, it is essential that food and beverages on the market that claim this, such as those with antioxidants, are truly healthful.

Free radicals

Phenolics are highly regarded for their potency. Technically, phenolics are a group of phytochemicals that demonstrate antioxidant activity as well as anti-histamine and anti-inflammatory activity. Antioxidant activity is the ability of compounds to protect against oxidative agents, such as free radicals.

Free radicals are unstable molecules constantly seeking to 'steal' electrons to gain stability. In the human body, the source of those stolen electrons are our cells. The devastating effect of free radicals does not only affect one cell but it initiates a chain reaction that affects multiple cells at one time, much like a domino effect.

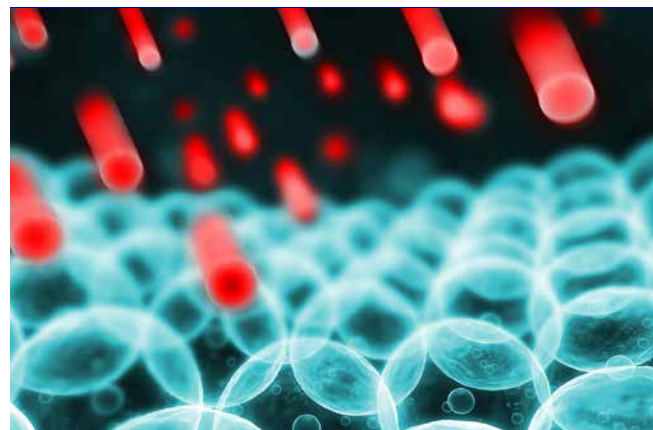
Free radicals are produced in our body as by-products of natural bodily functions, such as respiration, and externally from the environment. The human body is excellent at fending off free radicals and keeping the negative effects of oxidation under control. However, environmental pollution, prevalence of processed foods and fast-paced contemporary lifestyles are exposing us to the highest ever levels of free radicals.

Phenolic antioxidants are being studied intensively because of their potentially significantly increased benefits for human health.

Free radicals & pro-oxidation

Studies show that phenolic antioxidant compounds have the ability to reduce cellular damage, and may be effective at protecting against a plethora of conditions linked to oxidative events, such as cardiovascular and respiratory disorders, cancers and diabetes.

Phenolics are powerful free radical 'scavengers' because of the numbers of hydroxyl groups in their chemical structures. The number of hydroxyl groups correspond to a compound's ability to neutralise free



Phenolic antioxidant effects



radicals. The hydroxyl groups are essentially the electrons which are donated to free radical molecules to stop them stealing electrons from human body's cells.

More importantly, the number of hydroxyl groups contribute to the stability of the phenolic antioxidants so that they do not become unsafe in the human body, even after neutralising free radicals. Other antioxidants, for example vitamin C, have fewer hydroxyl groups and after collecting a free radical, can become unstable; this is known as pro-oxidation and can do more harm than good.

Pro-oxidation, as the name suggests, is the polar opposite of the functions of antioxidant. Pro-oxidation happens because when an antioxidant molecule gives up its electron to neutralise a free radical molecule, it becomes a free radical itself. Therefore, although it neutralises one free radical molecule, it is now starting an oxidation chain reaction of its own.



“**Supplements** have been created one of two ways—synthetically in a laboratory or extracted from natural foods using chemicals, both of which are very difficult for the body to break down and absorb.

Over the last few decades, antioxidants in food and supplements have emerged as a focus for maintaining and improving human health. Some research and healthy-eating commentators have attacked antioxidant supplements, as we know them, due to the pro-oxidation risk.

This criticism is substantiated by trials. One such trial, which started in 1994, found that daily doses of the antioxidant beta-carotene significantly elevated the risk of lung cancer in male smokers by 18%. In a 2011 trial involving more than 35,500 men over 50 found that large doses of another common antioxidant—vitamin E—increased the risk of prostate cancer by 17%.

Phenolic antioxidants

Phenolic antioxidants, by not being prone to pro-oxidation, resolve the risks borne out in the studies. However, until recently, phenolic antioxidant compounds were not available with sufficient levels of bioavailability in the body.

Phenolic antioxidant effects

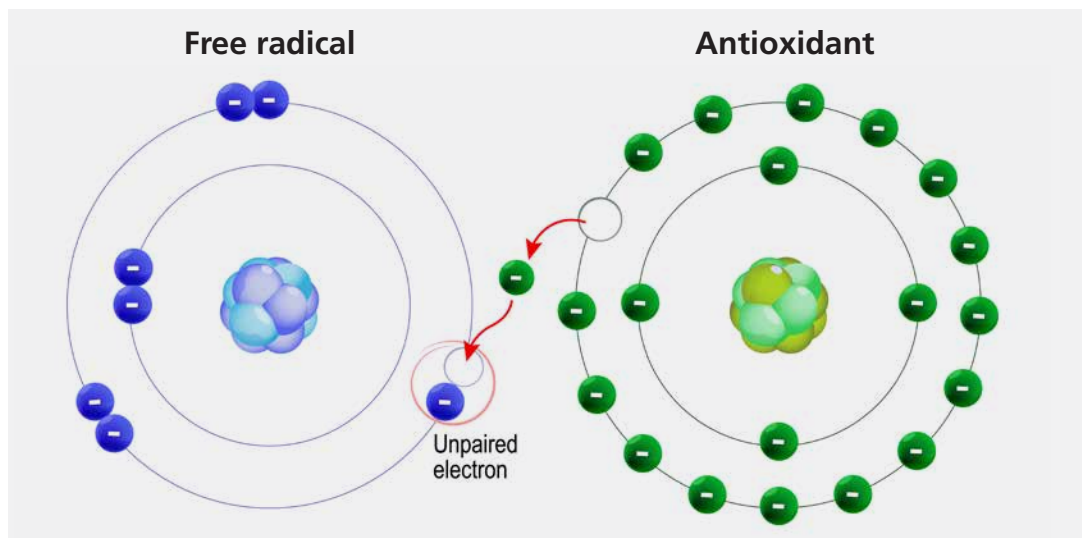
Traditionally, supplements have been created one of two ways—synthetically in a laboratory or extracted from natural foods using chemicals, both of which are very difficult for the body to break down and absorb.

Antioxidants made synthetically or extracted from natural food using chemicals such as methanol, acetone or ethanol require these same chemicals to break them down; however the human body does not produce those chemicals, hindering human biological system to process, absorb and utilise them.

These unabsorbed and unused antioxidants are not only useless in the body, they could cause harm to the body's system. High concentration of these unusable compounds adds to the workload of kidney and liver, which over a long period could have detrimental effects to the organs.

A simple example is that when someone consumes too many blueberries or drinks beetroot or carrot juice, they would notice changes in their urine colour or sometimes experience diarrhoea. This is because the body can only absorb a tiny fraction of the phenolics at once and has to flush out the unused portion.

Saturating the body with a cocktail of antioxidants could also negatively impact the body's indigenous antioxidant system, which could significantly increase the risk of exposure towards free radical damage.



In 2012, the United States Department of Agriculture (USDA) discontinued the use oxygen radical absorbance capacity (ORAC) assay to measure antioxidant level in food and supplements because this method was false, inaccurate, not factual and non-representative of the antioxidant activity, capacity and availability in human body.

Nevertheless, ORAC assay is still widely used by companies selling antioxidant products, because this method gives their chemically extracted and/or synthesised product a seemingly high antioxidant level, which is very attractive as a marketing tool.

These high numbers mean nothing because they are all generated by measuring the antioxidant level in a laboratory environment which bears no similarity with human's body. On the contrary, the higher the number, the higher the risk it could possess in

terms of overloading the work of kidney and liver to eliminate them from the body. The European Food Safety Authority (EFSA) went as far as to making it illegal for companies to claim that products with high ORAC values possess any health benefits.

Safe-guarding phenolics

A new breed of all-natural dietary phenolics are emerging, accessed with a breakthrough technology that just uses water to extract and activate the phenolic antioxidants.

This technology gives the phenolic antioxidants the synergy, absorbability and bioavailability that are the keys in achieving therapeutic effects in a biological system—something common antioxidants cannot offer.

The unprecedented potency of the antioxidant is achieved through new natural extraction technology which involves no chemical solvent at any stage of the process. This is achieved by manipulating the behaviour of water molecules to extract and activate the phenolic antioxidants, resulting in a highly water-soluble antioxidant, which is 100% natural and entirely compatible with the human body.

This technology also allows for the creation of a single-source broad spectrum antioxidant, instead of having to mix a number of different antioxidant sources, some of those are very much incompatible with human's digestion system, such as tree barks which throughout the evolution process, had never been a food or nutrient source for humans.

Phenolic antioxidants, when extracted in the right way and from the right sources, deliver a true broad spectrum of antioxidants. And being extracted from a single source, it offers not just any broad spectrum, but importantly, antioxidants that all work in synergy with each other as well as with the human body's indigenous antioxidant system.

It is time for commentators to update their understanding of antioxidants. It is time to acknowledge that common antioxidant supplements are made either synthetically in a laboratory or extracted from natural foods using chemicals (methanol, acetone or ethanol), making them very difficult to break down and absorb and could potentially cause more harm than good.

It is time to understand that phenolic antioxidants, when properly sourced, extracted and activated, do work synergistically with the body to deliver real results. ●

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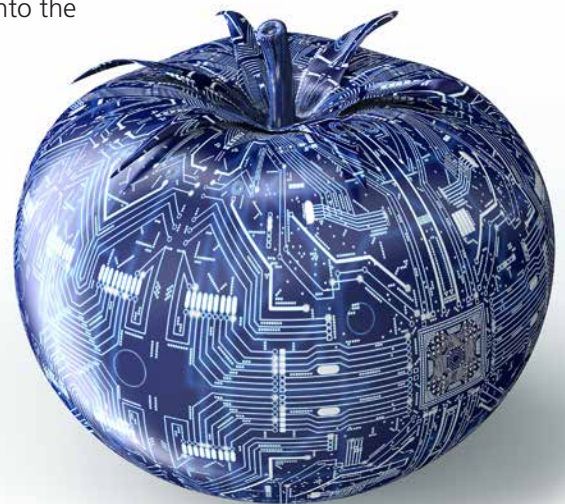
Takeaways for your business

Disruption within the food industry is driving growth within individual categories – like dairy and plant-based – and also shaping reinvention for established processes – like fermentation. Food technology has driven the innovation behind new generation ingredients and products – ultimately connecting to modern consumer needs and demands. Millions of dollars and euros spent on refining new technology reflects a global investment in foods that meet health preferences and reform food sustainability.

Beyond the technology that certainly goes a long way in stimulating interest among supply chain players, end consumers are only really concerned with how a finished product ticks their health needs. CPG brands are challenged with keeping up with consumer preferences and the latest direction of purchase. Radical shifts in expectation mean that some products are already considered outdated by the time they go through the development cycle and finally launch. However, big data analytics and emerging digital tools present businesses with intelligent solutions to overcome these hurdles.

Artificial intelligence (AI), in particular, has amassed hundreds of billions of dollars in funding since it took off in 2014. Numerous other industries have demonstrated the success of AI in bridging the gap between suppliers and consumers, as well as accelerating product process and development. Although relatively new to the health and nutrition space, AI has already been implemented for drug discovery and materials informatics. Real-world examples through companies like IBM and Nuritas provide valuable learnings for established and new businesses. While funding helps direct momentum into the space, return on investment will ultimately be the most vital indicator of future success.

Development activity to date has largely resided within North America and Europe, but this will expand into Asia-Pacific given the evolving needs of the region. An estimated 90% of global middle-class growth by 2030 will originate from three Asian regions: India (380 million), China (350 million), and Southeast Asia (210 million). This will undoubtedly lead to an increased consumption of packaged foods and beverages, creating an opportunity for CPGs, but within a uniquely vast and competitive market. ●



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