

bone and joint health

The power of polyphenols and what you need to know to stay ahead of the competition

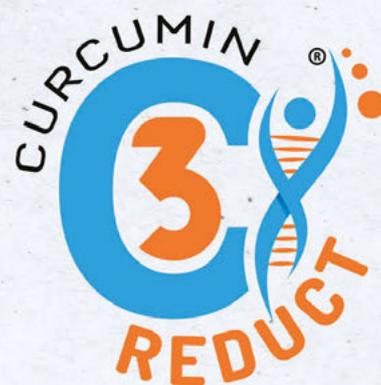
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ISSN 2055-1835

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Printed by Stephens & George
Print Group, UK

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ALL YOU NEED TO KNOW TO STAND OUT IN THE BONE AND JOINT HEALTH SPACE

With consumers taking a more proactive approach to mobility, the bone and joint supplement market is poised for new growth opportunities. Dr Kevin Robinson sat down with Jane Durga, Scientific Affairs and Advocacy at Balchem, who unveiled three top tips to help brands stay at the forefront of innovation

Valued at approximately \$13.6 billion in 2023, the bone and joint health supplement market is set to grow at a CAGR of 7.5% from 2024 to 2032.¹ Driven by an increasing life expectancy and associated age-related issues, this rise also correlates with the trend for younger generations to take a more preventive approach to health.² According to FMCG Gurus research, 61% of global consumers are “likely” or “very likely” to be interested in products that promote bone and joint health.³ So, how can brands break new ground in this evolving space?

BIOAVAILABILITY MUST BE A TOP PRIORITY

“Although we’re seeing a shift in the profile of today’s bone and joint health consumers, one thing remains the same: quality is still a top priority. People are searching for solutions that offer the best value for money — with research indicating that 46% of global consumers are willing to pay a premium for products that improve bone and joint health.”³ “For brands looking to enter this market, formulating with nutrients that can be absorbed and utilised in the body effectively is key. But this is easier said than done,” explains Jane. “Take calcium, for example, which can be challenging for supplement manufacturers as the most commonly used forms — such as calcium carbonate — have relatively low bioavailability, which can negatively affect efficacy.⁴

Another key factor to consider is the presence of the so-called antinutrients in our diets. Common plant-based foods — such as whole grains, nuts, seeds and legumes — contain

Multiple studies have shown that chelation can improve the bioavailability of minerals





phytates and oxalates that can decrease calcium absorption. And the impact can be remarkable; just 10 mg of phytates can inhibit iron absorption by roughly 60%.⁵ Fortunately, there are alternative solutions available, such as chelated minerals. Multiple studies have shown that chelation can improve the bioavailability of minerals, which means they can be easily absorbed into the human body.^{6,7}

“At Balchem, we can support manufacturers with our Albion Minerals range, a complete portfolio of organic mineral amino acid chelates that includes calcium bisglycinate chelate — an essential ingredient when it comes to maintaining healthy bones. Studies suggest that bisglycinate compounds may reduce the binding of antinutrients, allowing for superior absorption even in the presence of phytates and oxalates.”⁸

To raise awareness of these common challenges and the importance of choosing the right ingredients, Balchem is also collaborating with the International Life Sciences Institute (ILSI) US and Canada on new research that sheds light on how to improve the prediction of calcium bioavailability for different food matrices.

UNLOCK MULTIPLE HEALTH BENEFITS WITH HOLISTIC SOLUTIONS

With holistic wellness dominating health trends, consumers are looking for convenient solutions that target multiple health areas at once — such as a product that supports overall mobility by combining popular ingredients for joints, tendons, bones and muscles. According to Jane, the key to unlocking innovation opportunities is to master the art of blended formulations without compromising on absorbability, bioavailability and effectiveness.

“One ingredient to watch in this space is vitamin K2 — a go-to nutrient for healthy bones. Vitamin K2 regulates calcium metabolism in the body, thereby increasing the yield of calcium that reaches the bones from the food you eat. This in turn supports increased bone mineral density (BMD) and strength. However, not all K2 is created equal and some forms can lose stability when combined with minerals such as calcium. Balchem’s K2VITAL DELTA is the first vitamin K2 to be microencapsulated in special double-coated beadlets, ensuring complete stability in most environments. This allows brands to use it in tandem with Albion Minerals’ highly bioavailable chelates without compromising on results — something we’re currently investigating further.”

And bone health is just one piece of the puzzle when it comes to mobility and staying active for longer. Adjacent to this category lies joint health. For brands looking to venture

down the route of multi-ingredient solutions, there's another key nutrient they can include in their formulation: methylsulfonylmethane (MSM). MSM plays a critical role in the maintenance of joint tissue and supporting glutathione's function in the defence against free radicals.^{9,10} Supplementation with Balchem's OptiMSM provides essential nutritional support for joints and connective tissues; plus, it can be combined with glucosamine and chondroitin to support markers of joint health and boost its effectiveness.¹¹

CONVENIENCE IS KING: EXPLORE NEW APPLICATION FORMATS

"When we talk about convenience, we're not only referring to delivering multiple health benefits at once; it's also about practical on-the-go solutions that can easily fit into our daily routines," explains Jane. "Although fortified foods and beverages are growing in popularity, their appeal ultimately hinges on taste, meaning that manufacturers need to offer consumers a pleasant experience. So, it's important to consider taste, texture and odour too."

And this is no mean feat. When formulating appealing bone health solutions with calcium carbonate, for example, brands can face several challenges in terms of taste and texture. As it is relatively insoluble, formulating with calcium carbonate can result in sediment, a gritty texture, a soapy flavour and a chalky mouthfeel.¹² Albion Minerals' calcium citrate malate (CCM) represents a good alternative by providing high solubility, excellent compatibility with multiple applications and improved absorption in the body.¹³ Thanks to these important features, CCM has been used successfully to create fortified juice beverages, plant-based and bovine milk, as well as fitness waters.¹⁴

Offering versatility to brands exploring new formats, another ingredient that can deliver in terms of both palatability and nutritional quality is K2VITAL DELTA. Suitable for dry powder, water-based liquid formulations and gummies, in recent years new studies have confirmed K2VITAL DELTA's excellent stability in final product applications — such as UHT, dairy and plant-based drinks, cereal bars and fortified dry powders — enabling manufacturers to tap into a variety of consumer preferences." Jane concludes: "At Balchem, we can help brands to identify the right ingredients and overcome formulation challenges, elevating their bone and joint health offering to tap into consumer needs and desires." 

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EXPLORING ROBUVIT'S MECHANISMS OF ACTION: PART I

Whether used to build shelters, craft boats or produce barrels, oak trees have long been cherished for their wood. Recently, scientists have discovered that these majestic trees also contain valuable molecules that benefit human health, reports Franziska Weichmann, Manager of Scientific Communications and Product Development at Horphag Research

Robuvit French oak wood extract has demonstrated impressive efficacy in human clinical studies in four key areas. First, it boosts energy levels, providing a natural way to enhance vitality. Second, it supports detoxification and liver function, aiding the body's natural cleansing processes. Third, Robuvit significantly helps with recovery, reduces fatigue and alleviates stress, making it an excellent supplement for overall well-being. Lastly, it promotes muscle mass and improves sports performance, helping athletes to achieve better results and maintain their physical fitness. These benefits make Robuvit a valuable addition to health and wellness regimens.

Robuvit's underlying mechanisms of action have been widely studied in both *in vitro* and *in vivo* trials, as well as in gene expression studies. Clinical results highlight Robuvit's powerful antioxidant properties, which protect cells from oxidative stress and contribute to overall health. Additionally, Robuvit's effects on mitochondrial rejuvenation and the associated respiratory chain optimise ATP generation (the cellular source of energy). Increased ribosome genesis, induced by Robuvit intake, is tightly connected to enhanced protein production and leads to improved cellular functionality. Urolithins, the gut metabolites of ellagitannins



found in Robuvit, show beneficial effects on muscle tissue synthesis, energy levels and liver function. Further clinical and mechanistic studies are under way to continuously expand the knowledge surrounding Robuvit.

INCREASED ENERGY, REDUCED FATIGUE AND STRESS

Robuvit polyphenols, specifically ellagitannins, undergo metabolism by gut microbiota when ingested, resulting in the generation of urolithins A, B and C, and subsequent absorption into the bloodstream.^{1,2} These metabolites have demonstrated impressive effects on different body functions and their levels in the blood have been shown to increase after the oral intake of Robuvit.^{1,2}

One of these metabolites, urolithin A, has been observed to promote enhanced energy production through a process called mitophagy.³ Mitophagy is a biological mechanism in which inefficient mitochondria are degraded and replaced with new and more efficient ones.⁴

Mitochondria are known as the powerhouses of cells and are responsible for producing cellular energy in the form of ATP molecules. The process of mitophagy thus ensures optimal energy generation from consumed food and healthy functioning cells.⁴

In addition, Robuvit supplementation has been shown to increase the expression of mitochondrial protein NADH dehydrogenase, which plays a direct role in the cellular respiratory chain to further enhance ATP generation and energy production.¹ As the intake of Robuvit leads to improved energy output, several clinical studies have been performed to investigate its effects on people with different energy deficiency issues. These studies have shown that Robuvit can reduce fatigue and enhance sleep quality in individuals with chronic fatigue syndrome, insomnia or after chemotherapy.⁵⁻⁹

**Robuvit's
underlying
mechanisms of
action have been
widely studied in
both *in vitro* and
in vivo trials**

In addition, Robuvit led to faster recovery from conditions such as liver damage, kidney dysfunction, mononucleosis, mild heart failure or PTSD and post-surgery recovery.^{2,10-18} Moreover, clinical studies showed that Robuvit alleviates symptoms related to burnout/work-related stress and boosts overall energy levels in healthy subjects.¹⁹⁻²³ The earliest study attributing energising properties to Robuvit supplementation was done with 20 healthy volunteers aged 45–65 years.²¹ Fatigue and energy were assessed with the Activation-Deactivation Adjective Check List (AD ACL). The questionnaire assessed each participant's energy level based on four categories: energy, calmness, tiredness and tension. Four weeks of supplementation with Robuvit significantly improved the energy and calm state of subjects and notably reduced the fatigue and stress score of the study participants.²¹

A double-blind placebo-controlled study investigated the effects of Robuvit on patients, recovering from hysterectomy.¹⁸ The participating women started the supplementation 3 days after surgery. After 4 weeks, general and mental health were significantly better in the Robuvit group compared with the placebo controls by 18% and 12%, respectively. The energy levels in the Robuvit group increased by 3%, whereas the placebo group experienced a 10% decrease. The investigators suggested that Robuvit can be used to relieve both general and mental post-operative symptoms.

A 6-week study investigated the effects of Robuvit on post-chemotherapy recovery after colon cancer.⁷ Robuvit supplementation significantly improved each patient's quality of life, mood, hand grip strength and treadmill fitness test score compared with controls. In addition, their fatigue score after 6 weeks was significantly reduced by 70% with Robuvit (compared with controls).

In another study, Robuvit was given to people suffering from burnout syndrome owing to particularly stressful circumstances.¹⁹ The study comprised surgeons in training as well as senior professionals and managers. Their burnout symptoms were assessed by a questionnaire, including satisfaction at work, level of intolerance, emotional drainage and fatigue. After 4 weeks of daily Robuvit intake, the burnout symptoms were significantly relieved compared with the control participants (Figure 1).

MUSCLE MASS AND ENHANCED SPORTS PERFORMANCE

Urolithin B, another metabolite found in blood following Robuvit intake, has been shown to have stimulating effects on skeletal muscle mass.²⁴ It acts as a regulator by inducing muscle growth and increasing protein synthesis. An

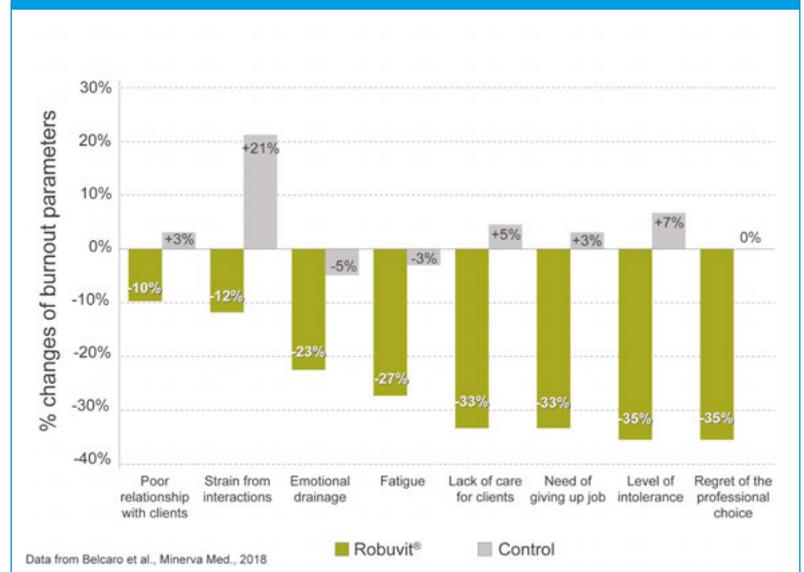
increase in muscle mass contributes to enhanced metabolism and increased energy expenditure. Research studies have shown that urolithin B promotes the growth and differentiation of muscle cells by increasing protein synthesis and repressing protein degradation.²⁴ In vivo experiments confirmed the ability of urolithin B to induce muscle growth and reduce muscle tissue decrease after sciatic nerve section.²⁴ 

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Figure 1: Robuvit improves burnout symptoms in senior professionals in 4 weeks





POLYPHENOL POWER: HOW OLIVES CAN BENEFIT POSTMENOPAUSAL WOMEN

Clinical studies have demonstrated the positive effects of Bonolive on bone health and formation, cholesterol levels and lipid balance

Menopause alters the functionality of the human body in many ways; negative symptoms such as hot flashes, bone deterioration and mood swings are all too common for a significant proportion of those women going through it. Hormone replacement therapy (HRT) is the most advised treatment for menopausal symptoms, although many women are moving away from this option owing to the increased risk of breast, ovarian and endometrial cancers.

With a noticeable gap in the market for non-hormonal alternatives, BioActor — a Solabia company — set about developing an ingredient that could bolster the health of menopausal women in a variety of ways. From this, they created Bonolive, a proprietary olive polyphenol derived from the leaves of *Olea europaea*. This novel dry extract has been clinically proven to enhance bone health and regeneration capabilities, blood lipid profiles and cholesterol levels in women aged 45 and older. Annabel Kartal-Allen spoke to Hans van der Saag, CEO of BioActor, to find out more.

SUPPORTING WOMEN'S HEALTH

A key driver behind BioActor's initiative to develop Bonolive came from the realisation of an unmet need: "We are a strong believer in the necessity of developing women's health ingredients. Right now, there's a lack of products that safely and effectively target women of this demographic; we believe that there needs to be considerably more focus on expanding this area of nutraceuticals. Women continue to be the most predominant consumer group in the supplement industry, so there's a huge untapped market waiting to be served."

"Developers have traditionally tested their products on mixed populations with little

Women continue to be the most predominant consumer group in the supplement industry

interest placed on postmenopausal individuals. We wanted to address this unmet need head on and create a product that could benefit these women.”

A MULTIFUNCTIONAL APPROACH TO TREATMENT

Bonolive can influence women’s health in a plethora of ways, according to Hans: “The benefits of this phytonutrient are multifaceted. We see them in terms of supporting bone health and formation, which is a considerable issue during and after menopause. Our standpoint, however, is that menopause is more than bone health and hot flushes; it affects several health areas.”

“Therefore, we were pleased to see additional benefits with respect to blood lipid concentrations. Typically, postmenopausal cholesterol levels will be unbalanced or at risk of becoming so. The ability of this ingredient to manage cholesterol levels would be highly useful for our target demographic.”

“We can see that Bonolive also has a positive impact on joint health — another factor that often deteriorates in the menopause — by the clinical data we’ve gathered.” As well as the information derived from studies, BioActor has

also conducted consumer research to determine the impacts of Bonolive: “Data from a recent consumer study saw benefits in reducing menopause symptoms such as hot flushes, sleep disturbances and mood swings.”

A UNIQUE INGREDIENT

Although there are a range of nutraceuticals available for postmenopausal women, van der Saag believes that Bonolive sets itself apart from the rest: “A standout feature of this product is the raw material it’s made from. This is the only olive-based ingredient on the market that’s clinically proven to give all these benefits. We are the first in the world to have an olive polyphenol product — backed by clinical research — that benefits postmenopausal women.”

“The data are also rather unique as you can observe benefits for several issues that menopausal women may face, including bone and joint health, cholesterol levels and hot flushes.” Another unique facet of this ingredient is that it’s oestrogen free. Almost all products targeted at menopausal women — in any stage — rely heavily on utilising hormones for their positive effects. For the women that



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don't want to consume these hormones, Bonolive offers another efficacious option, which is important."

WHO IS BIOACTOR?

BioActor is a global company specialising in the research and development of active nutraceutical ingredients. The organisation currently has eight active products in its portfolio, with more than 20 clinical studies backing their efficacy and safety.

THE STUDY

When van der Saag started the company almost 15 years ago, he began a research collaboration with a French Group of scientists to explore the benefits of olive polyphenols: "In early animal studies, the effects of olive polyphenols on bone metabolism were confirmed. From there, we took this information to the clinic, running a 12-month study in postmenopausal women to see the effects on both bone health and blood lipids."

"This was the first clinical study in postmenopausal women using olive polyphenols and we saw very strong results. There was a 30% increase in osteocalcin, which is the chemical the body uses as a scaffold for new bone. The ingredient seems to attract calcium ions, facilitating the formation of calcified tissue and, thus, bone fortification."

"We additionally saw that any lipid imbalance was positively restored in the postmenopausal women involved in the study. There was an increase in HDL (high density lipoproteins) and a decrease in LDL (low density lipoproteins) with the ratio significantly improving in this study."

"Benefits were also observed in blood lipid levels, which were backed up by the results of a second study. Within this iteration, we looked at a population of postmenopausal women as well as men older than 50 who were overweight. As a result of consuming olive polyphenols, we saw an improvement in the blood lipid profile of the participants."

A third study to determine the efficacy of Bonolive endeavoured to prove the ingredient's bioavailability in postmenopausal women: "We assessed two groups — young female students and postmenopausal women — to ensure the ingredient was able to reach the target tissues within our desired demographic."

Not only was the product being absorbed into the bloodstream of the older women, but the results were better than for the student cohort. We don't currently have an explanation for this but it gives us the reassurance that our ingredient is efficacious and can easily be transported in the bloodstream to reach the target tissues." In addition to a positive bioavailability profile, the study revealed Bonolive's ability to reduce oxidative stress in



participants. "Further to this, in collaboration with Nestlé, we ran a large study on joint care that focused on pain and mobility. Within this group, a significant proportion of participants were suffering with more severe pain; yet the study showed significant improvement. The study was both in men and women, but all of them were postmenopausal or older than 55 years of age.

CONTINUING RESEARCH: A FUTURE PERSPECTIVE

Although BioActor has found multiple benefits associated with its proprietary ingredient, the company wants to further enhance its know-how regarding the functionality and efficacy of Bonolive: "We are currently running another clinical study in postmenopausal women to assess a range of aspects; we want to prove that the benefits of our ingredient are multifaceted. We're looking forward to seeing the outcome of this clinical study and, once that's done, we want to put a focus on the effects that Bonolive has on skin and body composition." 🏠

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The benefits of this phytonutrient are multifaceted

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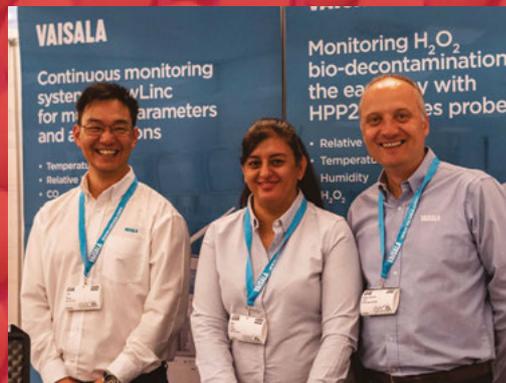
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HOW SUPPLEMENT BRANDS CAN STAND OUT WITH ADVANCED DOSAGE FORM TECHNOLOGIES

The landscape of dietary supplement dosage forms and the technologies behind them have undergone significant changes in recent years



Several innovations and consumer trends have transformed the nutraceutical space, including the growing demand for botanical supplements and the thriving probiotic market. However, the right dosage form is still an important criterion for consumers; 70% of US purchasers say that dosage forms matter to them when selecting their supplements or medicines.¹

With numerous consumer standpoints and preferences to navigate and a vast array of dosage form solutions to choose from, it's becoming increasingly important for brands to create products that stand out from the crowd. Meeting the increasingly complex needs of supplement consumers is, of course, essential — not only in terms of their health goals but also their product expectations, including

- efficacy
 - a natural or clean label positioning
 - the overall consumption experience.
- However, the challenge remains: how can companies create a great consumer experience while also making sure that their product stands out on the shelf? Here are the key factors that brands should consider when innovating their next product, including how advancements in dosage form technologies can help to differentiate them from the competition.

DISTINCTLY DIFFERENT: THE IMPORTANCE OF DIFFERENTIATION

The supplements market is expected to grow at a CAGR of 8.9% from 2022 to 2030, which means that competition is fierce and brands must continue to evolve with consumer demand ... or risk being left behind.² Thinking beyond a product's ingredients to also include

Producers can leverage the ever-expanding choice of advanced capsule technologies to truly make their mark

the right dosage form enables true differentiation. And research shows that, despite the range of new and unique dosage forms entering the market, capsules still reign supreme for 44% of consumers globally.³

As a highly versatile dosage form, capsules can help brands to meet consumer demand and deliver the convenience, swallowability and efficacy that ensures customer satisfaction and enables products to stand out. Many of the latest capsule innovations on the market also come with vegetarian, vegan or plant-based positionings, making them ideal for companies looking to win over today's environmentally and ethically conscious consumers.

Standing out isn't the only challenge that supplement producers must overcome; the more complex the functionality of the end-product is, the more likely it is that there will be a variety of challenges to overcome during formulation or manufacturing. So, how can capsules help?

NAVIGATING TECHNICAL CHALLENGES

A range of formulation challenges can add layers of complication during production. For example, some ingredients — particularly plant-based or botanical ones — have unpleasant tastes and odours that must be masked to avoid an off-putting experience for consumers.

At the same time, ensuring effective delivery is equally important when creating a supplement solution that will attract consumer attention and make them repeat purchasers. For example, acid-sensitive ingredients such as probiotics need the right protection so that they can pass through the low-pH stomach

environment and reach the small intestine where they are most effective.

More advanced dosage form technologies can be used to ensure that the end product delivers in terms of consumer expectation, while also enabling brands to diversify their portfolio. Today, producers can leverage the ever-expanding choice of advanced capsule technologies to truly make their mark.

Capsule-in-capsule technology is one such solution; it offers endless innovation and differentiation opportunities by enabling combination products to be developed in a single dosage form.

Here, brands can utilise liquids or powders in a smaller prefilled capsule inside a larger filled one, opening up a range of formulation opportunities for brand differentiation. Modified release capsule technology with acid-resilient properties is another dosage form solution that can protect sensitive ingredients — such as increasingly popular probiotics — as they pass through the acidic stomach to maximise efficacy.

Innovative capsule sealing technologies provide solutions for liquid ingredients. Ensuring optimal product efficacy, liquid-filled capsule technology combines patented, specially designed hard capsules with proprietary fusion technology; this helps brands to achieve a leak- and clump-resistant dosage form for a better consumer experience.

For further differentiation, lipid multiparticulate (LMP) technology — which encapsulates ingredients in a lipid-based microsphere — can expand application versatility both within and beyond capsules, such as in premium nutraceutical beverages. In addition, new flavour and aroma capsule coating technologies can be used to create a distinct sensory experience and increase consumer appeal.

For brands looking to diversify their product even further, colour is a simple addition that can create a unique, visually appealing supplement. White-tinted supplements are favoured by 30% of consumers who are likely to purchase products with colouring. This whiteness has historically been created using titanium dioxide (TiO₂), which the European Food Safety Authority (EFSA) recently classified as an unsafe food additive.^{4,5} TiO₂-free opaque and semi-opaque capsules now offer brands the opportunity to create the bright white colour they need to capture consumer attention without the addition of harmful additives.

Supplement producers can also utilise natural colourings in their capsules to create a standout product that doesn't compromise on consumer values. Plant-based capsules can be tinted with natural ingredients such as purple carrot and blue spirulina to create a visually appealing, high-performance solution that

meets consumer expectations while also standing out from competitors.

EXPLORING VEGAN DOSAGE FORMS

Plant-based lifestyles continue to gain popularity with consumers worldwide. Indeed, vegan attributes are now a key consideration for shoppers: 40% of supplement users cite the importance of “vegan” as a purchasing factor ... and we've seen a 25% growth in supplement users who state that “plant-based” is important to them when making a purchase. This presents a huge opportunity for brands to differentiate with plant-based supplements that don't compromise the consumption experience. Thanks to advances in capsule polymers, many vegan capsules are now available to help brands and manufacturers ensure ingredient efficacy and maximise consumer appeal.

Pullulan, a polysaccharide polymer that is water-soluble and made from fermented tapioca is one such material that can be used to create vegan capsules. Offering a range of benefits including a high oxygen barrier to help prevent degradation, its taste and odour masking capabilities are also beneficial for plant-based supplement formulations. Another capsule polymer that is well-suited for plant-based supplements is hydroxypropyl methylcellulose or HPMC. This low-moisture vegetarian material protects moisture-sensitive or hygroscopic ingredients while offering sustained flexibility and mechanical robustness when exposed to dry conditions.

CREATING STANDOUT SUPPLEMENTS

With the demand for supplements on the rise and competition fierce, it is more crucial than ever for companies to stand out from the crowd. Fortunately, advanced capsule technologies offer a diversified, next-generation solution to help brands differentiate their products without compromising on consumer needs. Lonza offers innovative capsule technologies, science-backed ingredients and industry led global manufacturing expertise to help manufacturers overcome product challenges and stand out in the marketplace. 

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ADDRESSING THE CRITICAL FACTORS OF WEIGHT LOSS WITH CHROMIUM PICOLINATE

Nutrition21, an Everwell Health company, has been investigating the importance of healthy balanced weight management, including preserving muscle mass and both managing and regulating appetite



With a large percentage of Americans being overweight or obese, many are now pursuing weight management programmes — some with the help of ever-popular GLP-1 medications. The rise of drugs such as Ozempic has reinvigorated discussions about weight loss in the US and shone a spotlight on the importance of both taking a holistic approach and maintaining proper body composition — such as preserving muscle mass — which can suffer with the use of GLP-1 medications.

GLP-1 drugs continue to grow in popularity as users see results, causing both brands and consumers to consider dietary supplements that can help to manage their side-effects or as an alternative solution to managing weight. It's forecasted that, by 2035, more than four billion people — more than half the global population — will be obese.¹

Obesity is a growing problem, so medications such as GLP-1 drugs that show promise in terms of supporting significant weight loss are here to stay. In fact, research predicts that by 2030 there will be 30 million American GLP-1 users — approximately 9% of the country's total population.²

Maintaining an ideal body composition and retaining muscle mass is important throughout all weight loss journeys, which is being highlighted by the results obtained with GLP-1 drugs. For example, in a 69-week clinical trial of semaglutide, the active ingredient in Ozempic and Wegovy, participants lost approximately 15 pounds of lean muscle and 23 pounds of fat.³ This loss of muscle mass impacts more than appearance as it results in increased frailty and reduced mobility, increasing the risk of injury and bone fractures.

Although these medications show promising effects (reductions in body weight), they come with a range of challenges — such as cost, availability, limited long-term safety profiles and side effects — so they're not a fit for all consumers. Nevertheless, a proper approach to long-term weight management requires several approaches, often in combination, for optimal success. Whereas medications work for some, they don't for others. And, regardless of the use of medications, all weight loss programmes should include a focus on exercise and nutrition — including the use of dietary supplements — to support and improve overall health.

Research predicts that by 2030 there will be 30 million American GLP-1 users

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“Dieting should not just focus on weight lost ... but on the overall health of a person,” said Jordan Miller, Vice President, Marketing, Nutrition21. “Weight loss programmes without a focus on holistic health run the risk of impacting overall wellness by, for example, diminishing muscle mass. It’s critical for consumers to find solutions that allow them to lose weight while maintaining lean muscle mass for long-term success and continued health. Weight loss programmes that only focus on calorie reduction often leave gaps in nutrition, which can be filled by supplements.”

Medications such as Ozempic and Wegovy are not single-step solutions to healthy weight loss. As has been advised by medical experts for decades, healthy diet and exercise are crucial to maintaining a healthy weight ... and this rings true even when taking GLP-1 medications. But maintaining good nutrition and proper body composition can be a challenge, particularly when cutting calories.

Incorporating a dietary supplement with science-backed ingredients can also play a part in a weight loss programme. When used together with a healthy approach to diet and exercise, Chromax by Nutrition21 has been shown to help users maintain lean muscle mass, support healthy carbohydrate and glucose metabolism while also helping to manage cravings and appetite.

Incorporating Chromax into metabolic health and weight management supplements is an attractive option to help users lose fat, not muscle. It has been extensively studied and is supported by more than a dozen clinical studies, making it the most clinically tested form of chromium picolinate on the market. It is safe and effective with GRAS status and is proven to offer superior bioavailability compared with other forms of chromium.⁴

“As many Americans pursue multiple efforts to lose weight, the need for additional supplements to fill a variety of nutritional and wellness gaps is coming into the spotlight, such as protein for satiety and muscle support, herbs and botanicals to support the stress response and promote a healthy insulin response, and often overlooked nutrients such as chromium that can help to support metabolism and muscle retention during weight loss,” said Miller.

“Yet, when consumers think of weight loss supplements, they often picture fat burning fads and diet pills, which are often ineffective and sometimes dangerous. We strive to reframe the mindset when it comes to supplements that contain ingredients such as Chromax to position them as a way to fill gaps and support a successful weight loss journey for consumers.”

Chromax has been clinically tested and proven to provide multiple metabolic health benefits. Brands seeking to develop new

THE OG CP

Chromax is the original chromium picolinate ingredient solution brought to market by Nutrition21 and has been shown to be safe and effective through a range of studies that have been conducted during its 30 years of sales.

Among them are two of the largest body composition studies ever conducted, with one including DEXA for body composition. These studies, done using the gold-standard randomised, double-blind placebo-controlled design, demonstrated that Chromax — when used daily as part of a healthy diet and exercise plan — could help to promote healthy body composition, specifically supporting the retention of muscle mass while losing weight.

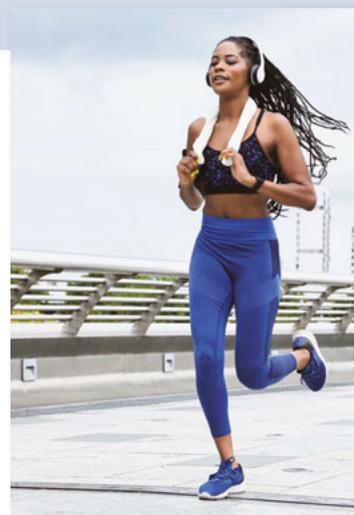
supplement options to support weight management efforts, whether using medications or not, can utilise this ingredient to formulate dietary supplements with substantiated claims, including the following:

- helps to maintain muscle mass while you lose weight⁵
- helps to improve body composition as you lose weight⁶
- can support healthy blood sugar levels (by promoting healthy insulin function)^{7,8}
- helps to manage carb cravings and appetite.^{9,10}

“Chromax is clinically backed and shown to provide multiple benefits,” said Miller. “Working together with diet and exercise, it can help consumers as they work towards their health and wellness goals in a safe and effective way.” This most clinically tested form of chromium picolinate is USP-grade and easily incorporated into a variety of dietary supplement and functional food/beverage applications, including nutritional bars, ready-to-drink (RTD) beverages, powders, tablets, capsules, gummies and gels. 🍌

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Incorporating a dietary supplement with science-backed ingredients can also play a part in a weight loss programme

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NUTRACEUTICALS FOR HAIR LOSS: THE BEST INGREDIENTS FOR LUSCIOUS LOCKS

Functional ingredients such as omega-3s, vitamins and zinc could offer a cost-effective and beneficial solution to this common problem

Alopecia is a widespread condition that affects millions of people worldwide. Although it's often associated with ageing, hair loss can occur at any time and can be triggered by a plethora of factors. These can include genetics, hormonal changes, medical conditions and lifestyle choices.

Understanding the underlying causes of hair loss and exploring effective treatments is essential to manage this condition. Nutraceuticals can benefit consumers by preventing and treating hair loss, explains Rizvan Faruk Batha, Pharmacist and Director of Operations at Specialist Pharmacy.

HOW DOES HAIR LOSS HAPPEN?

To effectively treat hair loss, it is important to understand the primary causes of its main subtypes. Androgenetic alopecia, also known as pattern baldness, is caused by genetic and hormonal factors. It generally results in a receding hairline and thinning hair on the crown in men and diffuse thinning on the top of the scalp in women.

Telogen effluvium, by contrast, is a temporary form of hair loss that occurs when a significant proportion of hair follicles simultaneously enter the resting phase. This is generally caused by physical or emotional

hardship, illness or hormonal changes. Alopecia areata is an autoimmune disorder that results in the body's immune system attacking hair follicles, thus resulting in patchy hair loss.

Although there are a considerable number of ways in which hair loss can occur, some of them are easily preventable — such as traction alopecia. This form of hair loss is generally triggered by repeated tension and hair “pulling,” which is often associated with tight hairstyles. Another example of this is nutritional deficiency; the inadequate intake of essential dietary elements can weaken hair and lead to its loss. Key nutrients for healthy hair include vitamins A, B, C, D and E, as well as iron, zinc and omega-3 fatty acids.

THE ROLE OF NUTRACEUTICALS IN PREVENTING HAIR LOSS

Dietary supplements derived from botanicals and other natural sources can offer benefits in several health areas — with the prevention and treatment of hair loss being no different. They can do this by providing essential nutrients that naturally impact a consumer's quality of hair, with some being better at this than others. Some examples of effective functional ingredients for hair loss prevention include the following:

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The inadequate intake of essential dietary elements can weaken hair and lead to its loss

Vitamins

Vitamin B7: Biotin is a water-soluble B vitamin that is essential for healthy hair, skin and nails. It supports the production of keratin, a crucial protein implicated in the hair structure and — when deficient — can cause hair brittleness and shedding. Studies have observed the benefits of biotin supplementation on hair growth in individuals with a deficiency.¹

Vitamin D: This vitamin is heavily involved in the hair growth cycle; it helps to create new hair follicles and prevents hair from becoming thin or brittle. A vitamin D deficiency has been linked to hair loss conditions such as alopecia areata.²

Vitamin E is an antioxidant that can protect hair follicles from oxidative stress. It can also improve blood circulation to the scalp to promote hair growth. A study supporting this mode of action found that those who supplemented with vitamin E products experienced a significant increase in hair growth.³

Vitamin C: Another antioxidant that helps to protect hair follicles from damage caused by free radicals is vitamin C. It also aids in the production of collagen — a protein that strengthens the hair and improves its quality. Vitamin C can also enhance iron absorption, which is essential for healthy hair growth.⁴

Minerals

Iron: This mineral is essential for producing haemoglobin, a protein associated with the transport of oxygen to the hair follicles. Iron deficiency — particularly in women — can lead to hair loss.⁵ Supplementing with iron can help to restore hair growth in individuals with iron-deficient anaemia.

Zinc: Not only is zinc vital for hair tissue growth and repair, it also assists with the maintenance of oil glands around the hair follicle. A zinc deficiency can lead to hair loss and a dry, flaky scalp, so supplementing with zinc can enhance hair health and prevent its loss.⁶

Selenium: This mineral is involved in the production of selenoproteins, which have antioxidant properties and help to protect cells from damage. It also contributes to thyroid hormone metabolism, which is important as thyroid imbalances can result in hair loss.⁷ It's important to note that this functional ingredient should come from natural sources as high levels can encourage hair shedding.

Proteins and fats

Omega-3s: These essential fatty acids promote hair growth by providing nourishment to hair follicles and reducing inflammation while also keeping the scalp hydrated. Studies have shown that omega-3 supplementation can improve hair density and reduce hair loss.⁸

Collagen: Collagen is a peptide that provides structure to the hair, skin and nails, with a

number of amino acids contained in its structure that are essential for hair growth and repair. Collagen supplementation can help to strengthen the hair and reduce breakage.⁹

Botanical and herbal extracts

Saw palmetto: This natural extract from the fruit of the *Serenoa repens* plant is believed to block 5-alpha-reductase activity, which converts testosterone to DHT — a hormone linked to androgenetic alopecia. Some studies have highlighted that saw palmetto supplementation can reduce hair loss and improve hair density.¹⁰

Ginseng: This herb is often called upon for its anti-inflammatory/antioxidant properties and is believed to stimulate hair follicles and promote hair growth by improving blood circulation to the scalp. Studies have highlighted the role of ginseng in terms of reducing hair loss while also boosting hair density.¹¹

TWO (OR MORE) HEADS ARE BETTER THAN ONE

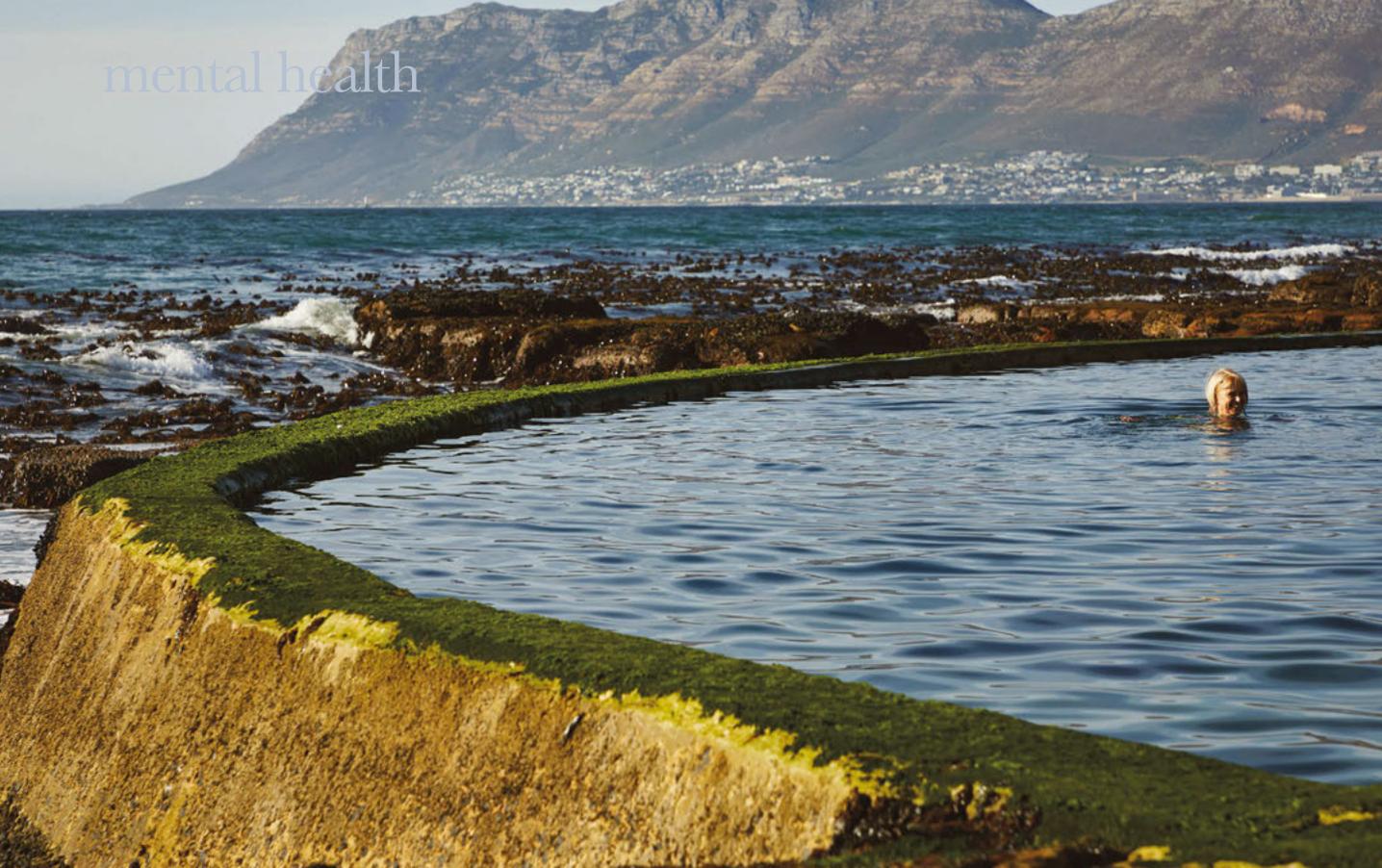
Although individual functional ingredients can be effective in preventing and treating hair loss, combining multiple supplements may enable consumers to achieve better results. To create a comprehensive nutraceutical regimen, the public should be advised to consult a healthcare professional prior to taking supplements to ensure that they're safe and appropriate for their individual needs.

Nutraceutical providers should also look to better educate consumers regarding suitable dosages to achieve the beneficial effects they're searching for, which may require further study by the company if not widely available. This is also crucial as over-exposure to certain functional ingredients can have adverse effects. As well as this, the necessity of treatment consistency should be stressed as supplementation will not show instant results.

Nutraceuticals offer a promising approach to support hair health by providing essential nutrients that promote its growth and prevent its loss. By combining supplements with a balanced diet, healthy lifestyle choices and professional guidance, individuals can take proactive steps to maintain healthy, vibrant hair. ✚

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MICROALGAE: A SMALL INGREDIENT WITH GREAT POTENTIAL TO BOOST COGNITION

A novel study has elucidated the benefits of fucoxanthin supplementation on cognition and oxidative stress in murine models

Cognition is an area of development in the nutraceutical industry that has timeless potential; consumers continue to search for the best tools to help them get through the slog of the 9 to 5, study for that impossible exam or just to feel refreshed and “switched on” during the day. Thousands of products exist on the market from a plethora of natural and synthetic sources, which is why so many companies are looking into uncharted territory to find the next big thing; MicroPhyt believes that microalgae could be the answer.

As the presence of ingredients from algal sources begins to increase in the nutraceutical industry, a stream of clinical studies has highlighted the benefits of supplementation with these water-loving protists. Regularly fortifying the diet with microalgae has been proven to benefit users in multiple ways, including cognition, muscle endurance and overall mood.

MicroPhyt believes in the power of microalgae and, because of this, wanted to test

how *Phaeodactylum tricornutum* (PT) can influence cognition and overall brain health when taken daily. To find out more about the study and its implications for the industry, Annabel Kartal-Allen spoke to Dr Rémi Pradelles, Chief Scientific Officer of MicroPhyt.

THE STUDY

This investigation was part of a series of seven preclinical trials conducted by MicroPhyt that aimed to determine PT’s efficacy in various contexts. Dr Pradelles comments: “We wanted to determine if BrainPhyt is beneficial in terms of supporting cognitive health, while also ascertaining the mechanisms of action that led to these positive impacts. A primary focus in this study was establishing if PT supplementation could help people experiencing symptoms of ageing ... and therefore whether the ingredient could be useful for an older demographic. BrainPhyt is a PT extract standardised to 2% fucoxanthin, a carotenoid and potent antioxidant.”

“In our study, published in *Marine Drugs*, researchers employed a validated mouse model to study the effects of BrainPhyt on the ageing brain. The parameters measured were cognitive function, oxidative stress and inflammation. D-galactose exposure was used to accelerate ageing in the mouse brain by inducing oxidative stress, inflammation and neurochemical changes.”

The 51-day study randomised 72 mice into three groups: a control, a negative control and four BrainPhyt groups, each receiving different human equivalent doses. The control group was injected with saline and the other mice received D-galactose injections 5 days per week.

The mice were put through a series of tests to evaluate their spatial cognitive function, short and long-term memory, as well as long-term

learning after supplementation, with impairments induced in some groups via chronic D-galactose exposure.

Spatial cognitive function was evaluated using the Y-maze test. By quantifying spontaneous alternation behaviour (the natural tendency of rodents to alternate between maze arms), researchers can assess spatial memory and cognitive flexibility. This provides insights into the impact of D-galactose intoxication on spatial cognition and memory processes.

To determine long-term learning and memory function, a 5-day Morris water maze test was done. Mice placed in a water maze must swim to find a platform that allows them to exit. As the test is repeated, the mice learn the location of the platform using visual cues. Researchers measure how long it takes the animals to find the platform during training sessions (swim latency) and how accurately they remember it in future sessions.

Short-term learning and memory function was measured with a passive avoidance test. Mice are placed in a box with two compartments: one brightly lit and the other dark. When the animal crosses over to the dark compartment, it receives a mildly negative stimulus (such as a loud noise). Repeating the test enables scientists to measure the time it takes for the mice to enter the dark compartment, which indicates better memory retention.

WHO IS MICROPHYT?

MicroPhyt is an ingredients developer that focuses on harnessing the natural power of microalgae, a somewhat untapped market in the health and nutraceutical industry. The company places a significant weight on sustainability in its processes and wishes to create ingredients that are great for both users and the planet.

THE RESULTS

Dr Pradelles elaborates on the findings of the trial: “These tests consistently demonstrated that BrainPhyt provided significant protection against memory decline and the behavioural issues caused by D-galactose. Higher doses of BrainPhyt not only mitigated but completely reversed the D-galactose-induced cognitive decline, with the response being dose dependent.”¹

“Biochemical analyses further supported the study results. The BrainPhyt groups had significantly reduced inflammatory markers, including TNF- α and IL-6. In addition, positive effects were observed on markers of oxidative stress, including brain and plasma levels of lipid peroxidation.”¹

“BrainPhyt demonstrated positive effects on several aspects of cognitive function, including spatial working memory and both long and

Regularly fortifying the diet with microalgae has been proven to benefit users in multiple ways

short-term memory compared with the untreated group following exposure to brain age-accelerating D-galactose.”¹

The neuroprotective properties of BrainPhyt are underscored by significant reductions in both oxidative stress and inflammation.² Fucoxanthin is a remarkable antioxidant and has the advantage — compared with similar molecules — of being able to cross the blood-brain barrier. In vitro studies demonstrate that fucoxanthin promotes neurite outgrowth activity, highlighting its potential to foster neural growth.² These neuroprotective benefits play an important role in maintaining brain health and cognitive function.

WHAT ELSE CAN IT DO?

As well as its most recent cognitive study, MicroPhyt has explored other areas in which PT supplementation can benefit consumer health. For example, another proprietary extract owned by MicroPhyt, PhaeOptim, supports metabolic wellness.

Dr Pradelles explains: “Microalgae can also help to support an active lifestyle, which is a vital element of healthy weight management. A double-blinded, placebo-controlled and randomised clinical study showed that women following a supervised exercise and diet plan and taking 220 mg/day of PhaeOptim burned more fat during and after exercise whilst also enhancing their aerobic capacity by 250% and reducing their resting heart rate.”³

“PT also contains other nutrients, including omega-3 fatty acids, which are linked to brain health and function, so multiple components will likely be exhibiting the positive effects we’ve seen in clinical trials.”

AN INGREDIENT FOR EVERYBODY?

With the benefits of microalgae supplementation being demonstrated across a variety of demographics in a range of contexts, this ingredient type could significantly impact the industry by offering solutions for most age groups and health applications. Going into the future, MicroPhyt hopes to continue the pursuit of knowledge in this field: “Another clinical study with BrainPhyt is currently pending publication. From there, we plan to continue our research into the benefits of PT, as well as other microalgal strains, for human health and wellness,” Dr Pradelles concludes. 

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YOUR BRAIN MATTERS: HERE'S HOW NATURE CAN KEEP IT SHARP FOR LIFE

Your brain is your most valuable asset. From breathing to problem solving, it controls everything you do and even shapes your emotions and personality. Just like any other part of your body, though, it needs care and attention to function at its best

According to the World Health Organization (WHO), brain health is “the state of brain functioning across cognitive, sensory, socio-emotional, behavioural and motor domains, allowing a person to realise their full potential during the life course.”¹ Maintaining good brain health throughout your whole life is crucial for several reasons:

- **it reduces the risk of cognitive decline, which is a growing concern:** although there's no guaranteed prevention, a healthy lifestyle can significantly reduce the risks
- **it improves mental well-being:** a healthy brain is better equipped to manage stress, regulate emotions and maintain a positive outlook
- **it boosts productivity and creativity:** when your brain is functioning optimally, you're able to think clearly, focus better and come up with innovative solutions
- **it enhances overall quality of life:** good brain health contributes to a fulfilling and independent life, allowing you to enjoy hobbies, relationships and daily activities to the fullest.

LIFESTYLE CHOICES FOR A HEALTHIER BRAIN
Luckily, by adhering to certain evidence-based strategies that target cognitive functions, people

Ginkgo biloba has been used in traditional Chinese medicine for centuries to improve mental functions



can take control of their brain health by adopting the following practices:

- **stay physically active:** regular exercise benefits not just your body but also your brain
- **nourish your brain with a balanced diet:** focus on fruits, vegetables, whole grains, lean protein and healthy fats, limiting processed foods, sugary drinks and saturated and trans fats
- **challenge your mind:** keep your brain active by engaging in mentally stimulating activities such as puzzles, reading, learning a new language or playing a musical instrument
- **prioritise sleep:** aim for 7–8 hours of quality sleep each night; it's crucial for memory consolidation and brain detoxification
- **manage stress effectively:** chronic stress can have detrimental effects on the brain; find healthy ways to cope, such as exercise, meditation or spending time in nature
- **stay socially connected:** strong social connections are vital for brain health; try to maintain relationships with friends and family and engage in social activities
- **protect your head:** head injuries can have serious consequences for brain health; wear a helmet when engaging in activities that put you at risk.

Taking care of our brain is a lifelong endeavour. Yet, by adopting these healthy habits, you can support cognitive function, enhance mental well-being and enjoy a fulfilling life for years to come.

HOW CAN NATURE BOOST YOUR BRAIN AND MENTAL HEALTH?

Stress, personal worries, anxiety, adverse global events, diet, physical discomforts, social jetlag and the use of artificial light and/or electronic devices: these are all sources of unhealthy mental and emotional conditions. The main outcomes may be lack of sleep, poor focus, memory loss, low impulse control and an inability to respond well to stressors.

Moreover, it is proven that similar conditions are often linked to microcirculation issues — the bloodflow through prearterioles, arterioles and capillaries that facilitate the exchange of gases, nutrients, hormones and other molecules. Based on this concept, Indena has developed several high quality next-generation extracts.

Virtiva™ Plus is a proprietary synergistic formulation of a standardised alcoholic extract (approx. 25%) of *Ginkgo biloba* L and sunflower-derived lecithin (approx. 75%) — comprising 20% phosphatidylserine. It's standardised to contain ≥5% ginkgo flavonglycosides, ≥0.5% ginkgo terpenes and ≥12% phosphatidylserine by HPLC. *Ginkgo biloba* is a plant that's been used in traditional Chinese medicine for centuries to improve mental functions and its bioactives are known to deliver vascular health benefits.

Clinical evidence shows that a single dose of Virtiva Plus (480 mg) has a significant effect on mental and memory performance in young subjects, particularly regarding the consolidation of working memory and processing speed. No such benefits have been recorded for either standardised extracts of *Ginkgo biloba* leaves (GBE) or in combination with phosphatidylcholine, thus confirming the synergistic interaction between GBE and phosphatidylserine.² As a result, Virtiva Plus effectively supports memory, learning, vocabulary skills and concentration ... and can play an important — natural — role when the brain needs a boost of energy.

Mirtoselect® is an innovative standardised bilberry extract comprising more than 36% anthocyanins. It's characterised by a very specific and consistent HPLC profile that represents the "fingerprint" of the extract and retains the anthocyanin pattern of natural bilberry fruit. The proven benefits of these ingredients on microcirculation, vascular and eye health led to in-progress research that aims to show the effects of these extracts on memory, concentration and visual acuity.³ Mirtoselect works to maintain brain health in the medium and long-term.

Enovita® is the result of Indena's 40 years of experience in grape seed extract production. It's an OPC-rich extract made exclusively with grape seeds from white wine production that also

boasts environmentally friendly production. Enovita contains a low amount (5.0–15.0%) of flavane monomers (catechin and epicatechin) and a high concentration of oligomeric proanthocyanidins: it's standardised to contain >95% proanthocyanidins (spectrophotometry) and 5–15% catechin/epicatechin (HPLC).

Indena's grape seed extract offers cardiovascular and mental health benefits thanks to a proven double effect on endothelial function and mood: recent clinical evidence suggests that Enovita effectively reduces perceived stress.⁴

Talking about brain health also means considering our emotional well-being. That's why Indena's portfolio of brain health products also includes Relissa™. This health food ingredient, based on a formulation of *Melissa officinalis* with phospholipids (Melissa Indena Phytosome™), optimises both dispersion in gastrointestinal fluids and biological performance.

Melissa leaves are a traditional sleep aid but their biological activity is mostly derived from hydroxycinnamic/rosmarinic acids and their derivatives. In a market populated with lemon balm extracts that lack standardisation or proof of efficacy, have unclear dosages and are of poor quality, Indena's researchers have achieved the perfect formulation. Relissa is a standardised, reliable, effective and melatonin-free supplement that supports deep, long-lasting sleep and counteracts daily stress. Recent clinical evidence shows that this product offers clear support for sleep, mood, emotional balance, mental health and quality of life.^{5,6}

Moreover, the ingredient recently won the NutraIngredients Award in the Cognitive Function category at Vitafoods 2024.⁷ The award celebrates the finest achievements in the nutrition and dietary supplements industry and Relissa was recognised as an innovative product amongst stiff competition that's backed by the right data to provide consumers with confidence.

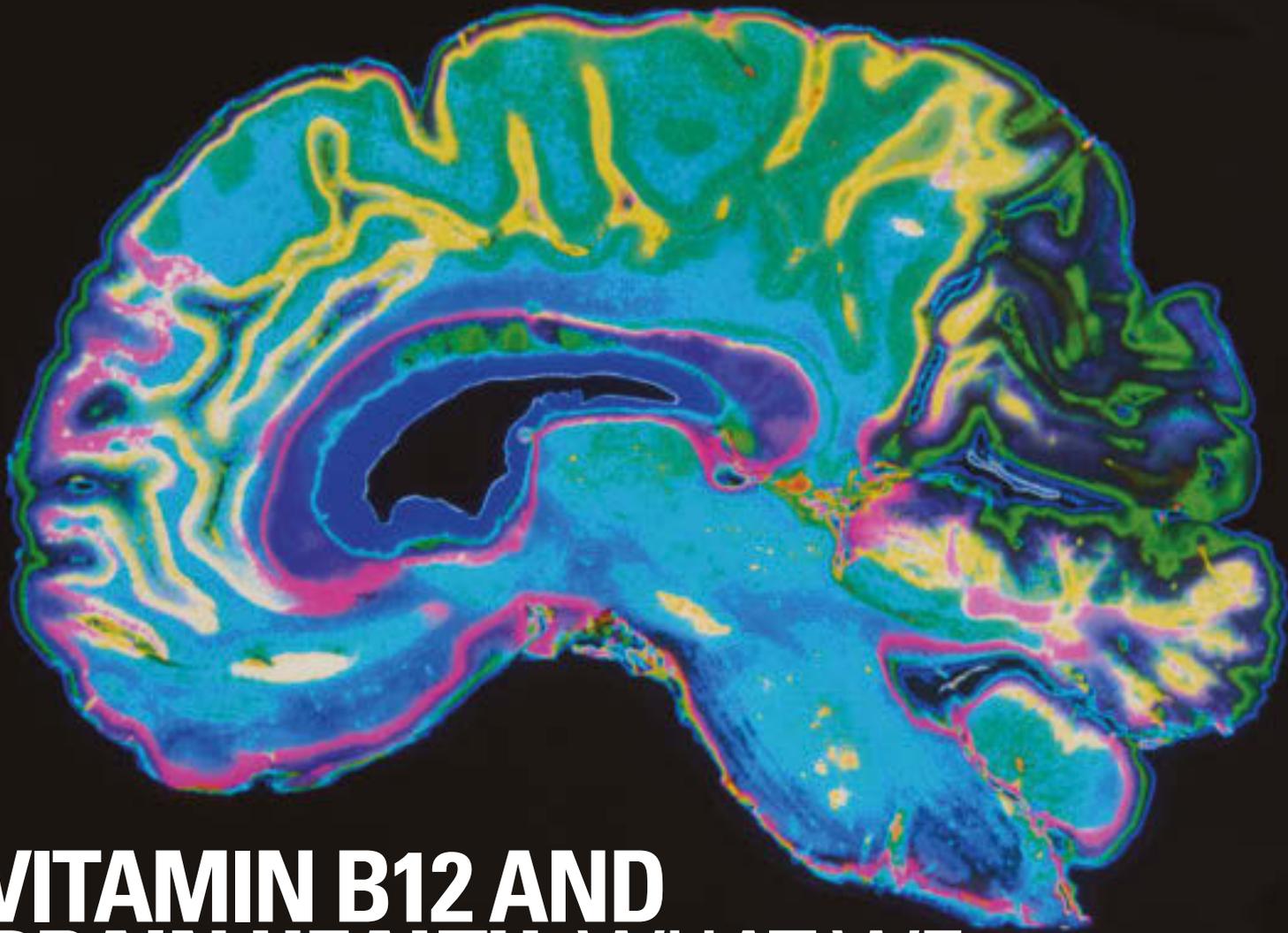
Indena knows how important it is to tackle one of the most common concerns for people of all ages: brain health. The young need to maintain focus and concentration in an age of distractions; the adult population must deal with the hectic rhythms of a performance-oriented life and seniors want to prevent age-related cognitive decline. What's the answer? The fabulous four: Virtiva Plus, Mirtoselect, Enovita and Relissa. All from Indena, all with quality, safety and efficacy based on science.

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VITAMIN B12 AND BRAIN HEALTH: WHAT WE KNOW ABOUT ITS IMPACT ON COGNITION (PART I)

Vitamin B12 has been associated with both memory retention and stroke recovery, while also reducing neuroinflammation and symptoms of mild cognitive impairment (MCI)

Vitamin B12's role in the body's healthy functioning has long been discussed, with numerous studies linking it to metabolic function, homeostasis and the mitigation of oxidative stress, as well as cardiovascular health, red blood cell formation and DNA synthesis. As the public becomes increasingly aware of the importance of cognitive health, the industry has seen a sharp rise in engagement and sales — with a market forecast suggesting it will grow by \$4.7 billion during the next 4 years.¹ Simultaneously, an ever-growing number of consumers are looking for solutions to help them improve their daily cognitive performance and brain health, with

many turning to natural ingredients to achieve this. Therefore, functional ingredient formulators must compete to develop and provide the industry's best nutraceuticals to maintain a viable market share.

With a wide array of clinical studies pointing to the benefits of healthy vitamin B12 levels in the blood, there has been a surge in interest regarding its capabilities to boost brain health and cognition through supplementation. Several trials have aimed to delve into this topic and this article will highlight the key findings in the areas of memory retention, mild cognitive impairment (MCI), neuroinflammation and stroke recovery.

VITAMIN B12'S ROLE IN MEMORY

Memory is a highly relevant area of cognition for many who purchase supplements as they look for ways to ace their exams, maintain memory capacity in old age or just enhance their day-to-day ability to retain information. Researchers also appear to have piqued a fascination with the topic as they look to understand how and what encourages the effective formation of memories and how we can positively modulate this for cognitive enhancement.

Vitamin B12 has shown promise in this area, with a study evaluating the impacts of adequate B12 intake demonstrating a 33.3% reduction in the likelihood of low cognitive performance (LCP) in elderly adults. This was established when performing Consortium to Establish a Registry for Alzheimer's disease (CERAD) word learning and recall modules, the animal fluency test (AF) and the digit symbol substitution test (DSST).²

Another study by Mishra and Thakur (2024) supports this discovery, finding that the collaborative supplementation of B12 and folate could positively alter the metabolic properties of neuronal cells through the mitochondria, mitigating neurodegeneration and supporting spatial memory and recognition in an ageing animal model.³

Most of the studies involving vitamin B12 focus on elderly populations, although there is also evidence to suggest that B12 supplementation can be beneficial for a much younger population too. Akbari et al. (2023) explored how B12 administration could benefit adolescents with alcohol-induced learning and memory impairment, finding that it had significant mitigative impacts on alcohol-induced reductions in cognition via the regulation of the brain's oxidant to antioxidant balance. This was seen specifically by the enhancement of brain growth factor BDNF and the reduction of GFAP.⁴

Going back even further on the ageing timeline, clinical studies have suggested that maternal B12 levels in pregnancy can impact a child's subsequent cognitive development postnatally. The 2023 ECLIPSES study determined that maternal B12 levels in the first trimester were positively linked to a child's performance in working memory and cognitive performance tests at 4 years old.⁵ The children whose mothers had high blood vitamin B12 levels in pregnancy also had better Wechsler Preschool and Primary Scale of Intelligence (WPPSI-IV) and Neuropsychological Assessment of Development (NEPSY-II) scores, indicating the vitamin's benefits in cognition throughout the human lifespan.⁵

Although this study indicates the benefits of adequate-to-high maternal B12 levels during pregnancy, a recent literature review

determined that the impacts of the vitamin were inconclusive from the currently available data, underlining the need for further studies to determine the true influence it has on foetal and infant development.⁶

MITIGATING NEUROINFLAMMATION WITH B12

As vitamin B12 has an impact on a significant portion of the body's homeostatic functions, researchers have been further investigating the role of B12 in terms of alleviating neuroinflammation. As this phenomenon is intimately connected to the natural ageing process, finding ways to assuage it could stave off symptoms and allow for better cognitive processing and functionality in older adults.⁷

A research paper by Yousaf et al. from 2023 found that vitamin B12 significantly reduced cadmium-associated neurotoxicity, oxidative stress and inflammation in adult mice. It also improved the Morris Water Maze (MWM) and Y-Maze (YM) test results of the models, suggesting the knock-on effect of reduced inflammation was an improvement in memory retention.⁸

Another supportive study by Mehrdad et al. (2021) found that scopolamine-injected rats were protected from the inflammatory and apoptotic effects of the drug when exposed to supplemental vitamin B12.⁹ Researchers observed a significant reduction in the presence of inflammatory markers in the hippocampus — the region of the brain responsible for learning and memory.

A further trial implicating vitamin B12 in the modulation of the hippocampus is a 2023 study from Cassiano et al., which investigated its ability to reduce the impact of pneumococcal meningitis — a severe brain infection characterised by neuroinflammation — through the reduction of microglial activation and the diminished presence of proinflammatory markers.¹⁰

The vitamin has also been found to have some neuroregenerative capabilities in those who have suffered a recent ischaemic stroke. Ge et al. (2024) determined that this may occur through B12's functional regulation of microglia — cells associated with the immune facet of the nervous system.¹¹ Similarly, Jadavji et al. (2017) found that B12 supplementation in a mouse model significantly increased "proliferation, neuroplasticity and antioxidant activity" in the brain area impacted by stroke in a mouse disease model.¹²

OTHER FACTORS INFLUENCING B12'S HEALTH-BOOSTING POTENTIAL

The human body is a complex system, with hundreds of cellular pathways operating simultaneously to maintain homeostasis. Many of the functional ingredients that feature in today's nutraceuticals work through a wide

There must be closer collaboration between academics, formulators and developers to standardise their research methods

range of different mechanisms, so it's unsurprising that certain combinations can boost or diminish their positive impact on the body.

A notable example of this is omega-3, with a study from the University of Oxford finding that B vitamins — including B12 — work to prevent cognitive decline in elderly adults with MCI significantly better with high levels of omega-3 in the blood.¹³ In fact, there was no marked impact on MCI prevention with B vitamins alone.

Diet is also a significant factor that should be accounted for when discussing the benefits of supplementation as it is integrally linked to overall health and well-being. Lopez et al.'s 2023 study found that vitamin B12 levels significantly correlated with improved memory retention in older adults, although only when they adhered to a Mediterranean diet.¹⁴

THE CHALLENGES ASSOCIATED WITH VITAMIN STUDIES

Although there's a significant body of evidence suggesting that vitamin B12 is an asset to cognitive health, it's evident when reviewing literature on the topic that it's very difficult to make any conclusive statements about B12's brain health benefits in a supplemental context. There are studies focusing on almost every area of cognition that directly contradict the claims made for the vitamin's benefits, which poses the question: what can we conclude from this knowledge pool?

With the current lack of trial standardisation in study protocol and success measures, there are many research papers that come to vastly different conclusions. This then dramatically reduces the relevance of meta-analysis studies as only a select few pieces can be compared — resulting in the possibility of false or biased conclusions being drawn from the data. To mitigate this challenge, there must be closer collaboration between academics, formulators and developers to standardise their research methods and measures of “cognitive benefits, allowing more comprehensive comparisons and legitimate conclusions to be drawn.

Another challenge present when reviewing such a topic is the high prevalence of studies focusing on B12 deficiency in those with chronic illnesses, rather than supplementation with B12 in a healthy population with sufficient serum levels. As vitamin B12 supplementation in those who are deficient has shown such promise in terms of mitigating a range of symptoms, it would be logical for the nutraceutical industry to follow this up in populations who don't have a deficient serum level to determine whether any benefits are present in this cohort of consumers.

Although it appears that the interaction between functional ingredients, diet and key

nutrients can dramatically alter a person's health outcomes, these associations are often little understood. Uncovering the optimal nutrient combinations and dietary choices for those experiencing cognitive decline could be a game changer — and a collaborative approach within the healthcare, nutraceutical, functional food/beverage and research industries could help consumers to optimise their health and wellness.^{nbr}

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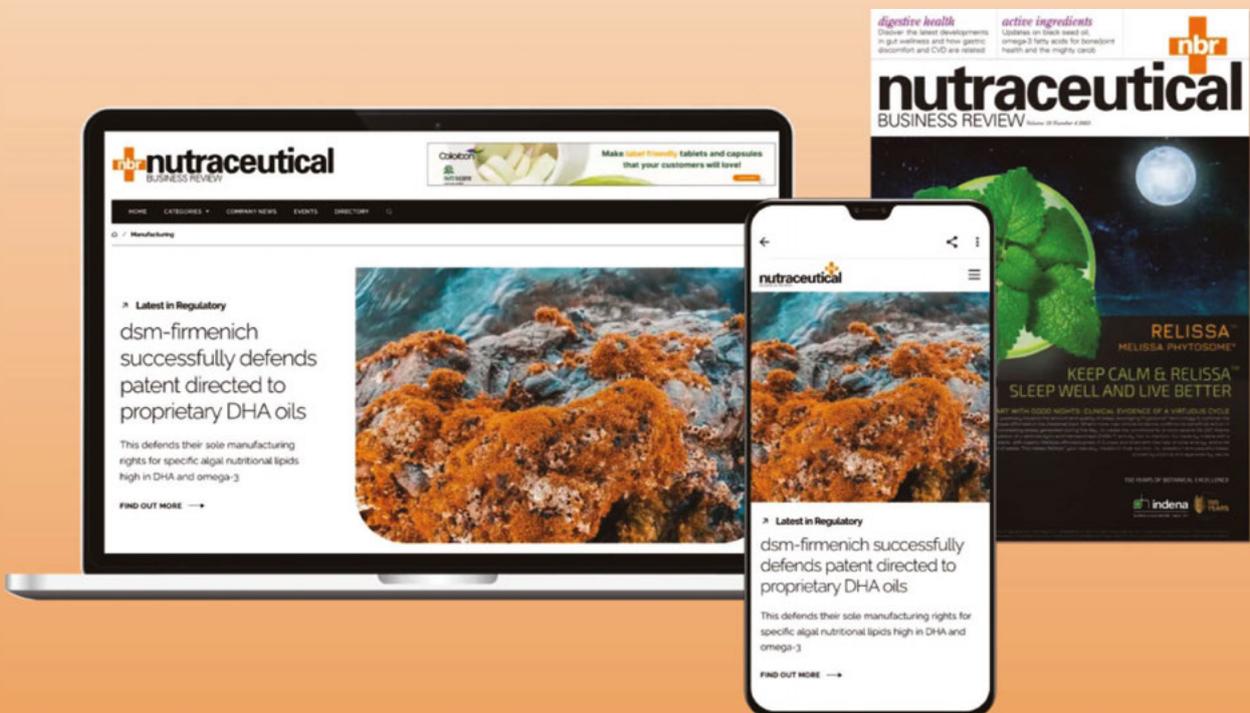
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An ever-growing number of consumers are looking to improve their cognitive performance

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NEW FOOD: PROCESSING PROTEIN POWDERS WITH VACUUM EXPANSION

ystral's Dr-Ing. Hans-Joachim Jacob describes a technology solution to optimise the dispersion of protein powders in "new food" formulations

Whether it's a plant-based lactose-free alternative to milk, vegan ice cream or a meatless steak, animal-free foodstuffs are on the rise. The most important components of these "new foods" are proteins; and although often plant-derived, processing these powdered ingredients can be difficult. To ensure optimum product quality, the proteins must be unlocked, starches must be degraded to the required degree and agglomerates/foam must be avoided during production. All of this can be achieved with the vacuum expansion process.

A quick glance at the supermarket shelves shows the increasing presence of vegan foods as replacements for animal-based items such as burgers, sausages or milk products. As an alternative to animal milk, for example, and in addition to oat, soy, rice, coconut or almond drinks, available options now also include varieties based on plants such as peas, lentils, adzuki or fava beans, cashews and peanuts. Not to mention the growing number of vegan items such as whipping cream, yoghurts and spreads.

Although vegetable proteins have, as yet, been the most important ingredients of new food products, other protein types are expected to gain in importance soon. This is particularly notable when it comes to fermented proteins: these are mainly obtained from bacteria or yeast, have a neutral taste, are inexpensive and cost-effective to produce. Importantly, they are also easily digestible and



contain — a crucial advantage compared with plant-based proteins — all the essential amino acids as well as vitamin B12, which is indispensable for the human organism.

NOVEL FOODS REQUIRE NEW TECHNOLOGIES

What the alternative proteins that are currently used in the new food segment have in common is that they are all difficult to process. They also have very different characteristics: wheat protein, for example, is extremely cohesive whereas soy protein is very adhesive. If protein powders derived from seeds, grains, nuts and pulses are mixed into water, they are prone to clogging, agglutinating and foaming. The proteins are both shear-sensitive and, counterintuitively, require high-shear processing to ensure dispersal (into a liquid). Therefore, rapid shearing under controlled conditions is essential.

To achieve optimum product quality, it's important to ensure that any powder agglomerates are instantly and fully broken up when mixed into a liquid. Ideally, these clumps wouldn't be formed at all. The use of time-consuming stirring steps to redisperse the particles can negatively affect both the process and the final product.

Dispersing the agglomerates damages the quaternary and tertiary structure of the hydrated protein and impairs both viscosity and texture. Similarly, when it comes to any

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starch content, the prevention of agglomerates is also very important. Starch degradation, when required, is usually done using enzymes (and occasionally acids). If powder particles are already separated before the introduction of a liquid, and highly dispersed during powder induction, the enzymatic degradation of the starch is enhanced and accelerated.

With conventional agitators, injectors or inline blenders, powder particles are generally fed into the liquid component as a compact discharge. This leads to sturdy, partially wetted agglomerates that are difficult to break down. Subsequent redispersion not only involves considerable amounts of time and energy, but the inherent air in the protein powder is also dispersed to form an undesired microfoam froth. When protein powder is fed into the liquid during conventional processing, it either flocculates or sticks to the (rotating) machine parts. This results in local overheating, discolouration or even burning, imbuing the end products with a slightly charred taste. A large proportion of the proteins that were not fully unlocked is filtered out and unused.

POWDER PARTICLE SEPARATION WITH VACUUM EXPANSION

The problems associated with conventional process engineering solutions can be avoided by using vacuum expansion. With this method, the air contained in the powder is expanded, which significantly enlarges the distance between the particles. The primary protein particles are, therefore, separated before they enter the liquid; they are fully wetted on first contact with the liquid, they are dispersed in situ under vacuum and subsequently hydrated — with no agglomerates — under pressure. The whole process takes 2–3 hundredths of a second with minimal heat input. The powder dissolves immediately, no agglomerates are formed and the overall texture is neither damaged nor destroyed. The process time compared with conventional technologies is significantly reduced.

Because of this intense dispersion, significantly fewer enzymes are needed to degrade the starch compared with conventional procedures. The air, which was previously contained in the powder, is separated from the heavier fraction because of the centrifugal effect of the fast-running rotor; this coalesces into large air bubbles, which can easily escape in the process vessel. Foam, which is often generated during protein processing, is almost completely prevented.

VERSATILE PROCESS OPTIONS

Technology from ystral can be precisely tailored to meet the requirements of specific powder types. To process oatmeal, for example (as for soy and rice), dispersal using vacuum

expansion with an inline powder wetting and dispersing machine (such as the YSTRAL Conti-TDS) is sufficient. Other powders containing protein (such as coconut or some pea flours) require additional dispersal under high-shear conditions to fully break down the product. In these instances, a Z-Inline Disperser is recommended (in addition to the Conti-TDS), which redisperses the protein powder while the entire mixture is introduced. The Z-Inline Disperser can be operated either in parallel in a separate circuit or in series.

With a special version of the YSTRAL Conti-TDS, strongly adhesive and/or powders that are especially prone to agglomeration can also be processed. Compared with other versions, no dispersing takes place at the time of wetting. The powder is neither in contact with the rotor nor the stator ... but is directly fed into the liquid flow at high speed. This method is called direct injection. The two input streams are monitored to prevent overly high concentrations of proteins being introduced too quickly. This occurs using control valves for protein concentrates or combinations. Nozzles are used for isolates and pure proteins.

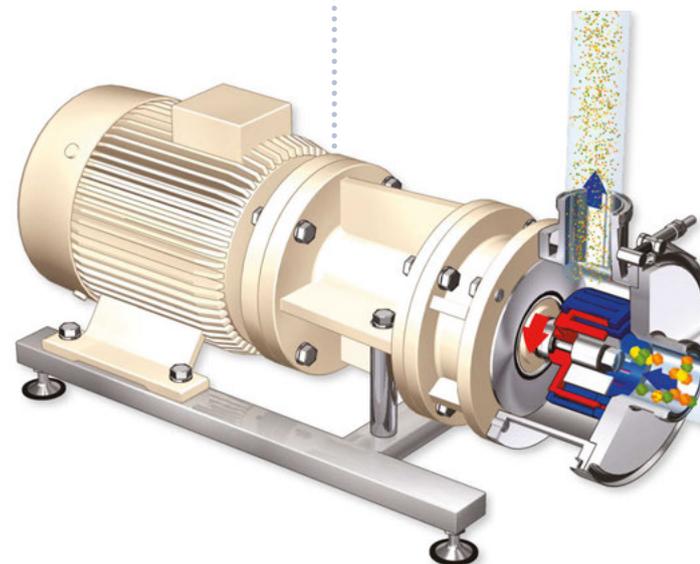
In addition, allergenic and non-allergenic powders can be accommodated and processed in separate liquid circuits. A Conti-TDS can also be integrated into existing process systems and connected to several process vessels or storage tanks. The disperser can either be operated inline or in a circuit on large process vessels; in addition, highly concentrated premixes can be created/used as a small batch and subsequently diluted in the main process vessels.

BETTER TECHNOLOGY, BETTER PRODUCTS

The choice of process equipment can significantly influence the taste, consistency, mouthfeel and visual impact of the final food product. To further improve the acceptance of vegan products in the public domain, it's important that they don't exhibit any negative attributes of this type when compared with traditional items. To meet these demands, one promising technology is the use of vacuum expansion to optimise protein powder dispersion in new food applications.✚

What the alternative proteins used in the new food segment have in common is that they are difficult to process

Technology from ystral can be precisely tailored to meet the requirements of specific powder types





PROTECTING ANIMAL IMMUNITY IS KEY AMIDST THE RISING HEALTHCARE COSTS OF PETS

With expensive vet bills and the mounting costs of medicines for pets, protecting and supporting the health of companion animals has never been more important

In the UK, with the Competition and Markets Authority watchdog launching a formal probe into high medicine prices, the extent of the issue is marked by speculation that price caps on vet prescription fees could be introduced. In the meantime, nearly half (46%) of all European households — equating to 90 million homes with an animal companion — own a “senior” pet that’s 7 years of age or older and suffers from a compromised immune system.¹

The immune system is an animal’s major defence mechanism. It develops early in life and identifies harmful stimuli including micro-organisms. The gut microbiota also plays a key role in terms of training the immune system and its proper function. As pets age, their gut microbiota changes and the efficacy of the immune response declines. This results in increased vulnerability to infectious diseases, reduced responses to vaccination and a higher susceptibility to age-related inflammatory conditions. The incline in the number of senior pets has triggered increased demand and a more pressing need for products that reinforce and strengthen their natural defences ... both in the run up to and during their later years.

MITIGATING THE DECLINING HEALTH OF PETS

After several years of industry research, development and testing, we believe that part of the solution to boosting pet health lies with innovating their food supplement options. For instance, our recently launched Profeed ADVANCED is a complementary compound that helps pets to stay healthier for longer.

Clinically proven to stimulate and enhance the immune systems of senior and immunocompromised dogs, Profeed ADVANCED signals a genuine step forward for the animal health industry by targeting many of the wellness issues that animals face in their later years.

Manufactured at Tereos’ facility in Chevieres, France, the premium neutral-tasting powder can be added to any existing wet or dry food by pet food manufacturers throughout Europe. In addition to our

presence in the animal health space, as a prominent player in the sugar, alcohol and starch market, we have been able to observe the parallels between both the pet nutrition and the food and beverage (F&B) industries. Often, human health trends are mirrored in the pet sector.

It is therefore inevitable that the health credentials of pet food will continue to come under increased scrutiny from customers, just as there has been a greater consumer push towards avoiding certain items — such as ultra-processed foods (UPFs) — in favour of championing products that are better for us and more sustainable.

THE SCIENCE BEHIND THE SOLUTION

At Tereos, our short-chain FOS prebiotic known as Profeed has been a long-established product leader in the animal health sector, encouraging the growth of beneficial gut bacteria. Produced to the highest EU quality standards, it has been used in more than 100 animal nutrition studies for more than three decades. With immunity in mind and to further enhance Profeed’s health benefits, we combined our prebiotic fibre with postbiotics comprising selected yeast fractions. Together, a synergistic effect is achieved that tackles gut microbiota changes and counteracts declining immunity in older dogs. This symbiotic pairing is the result of our partnership with Lallemand Animal Nutrition, a global leader in the development of yeast, bacteria and derivative ingredients, enabling us to pool our expertise and create the optimum compound feed for immune system enhancement.

Currently, Profeed ADVANCED is available to dog food manufacturers; but, we also have ambitions to demonstrate benefits in other senior animals in the pet sector, such as cats, thereby helping to improve the health of animals in multiple geographies. 🐾

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The gut microbiota plays a key role in terms of training the immune system



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Innovation is at our core with a world-class R&D. Our team of 45+ scientists boasts 230+ publications in peer-reviewed journals. We've isolated over 250+ phytochemicals for global reference standards and even contributed over 100 monographs to USP, IP, and API.

Our innovative Branded Ingredients offer a unique portfolio catering to trending categories. We have patented and registered some of them with various leading authorities like TGA, ANVISA & FDA. Safety and compliance are at the core of all we do. We adhere to the strictest regulations, ensuring our offerings comply with US & EU limits for pesticides, heavy metals, and aflatoxins.

Our offerings come along with a fully traceable supply chain combined with sustainable harvest programs.

We believe in partnerships that goes Beyond Branded Ingredients. We're not just ingredient suppliers; we're collaborative partners. We work closely with businesses to understand their needs and develop solutions that add true value and innovation to their products. We harness nature & apply science for health and happiness.



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