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Inflammaging

The science of staying young

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Live **long(er)** and **prosper**

The healthy aging space has had its ebbs and flows depending on whether you're looking at extending actual lifespan or making life more tolerable for a longer period, which is known as healthspan.

You look at surveys and it turns out people say they don't want to live to 100. Life gets challenging come age 80, you want me to suffer 20 more years of frailty and slow moving? One crash-and-burn debate was all it took for Americans to say, yeah, no thanks with the octogenarian, in the political sense.

But there's a difference. What we'd really like is to live like we're 70 (the new 50) until we are 99 years and 364 days old, and then have one really bad day, if any.

So while extending lifespan remains sexy, healthspan might be more valuable. This is kind of the entire value proposition of dietary supplements, if you think about it. This digital magazine aims to help you figure out how to design your next new product launch to address consumer concerns around aging gracefully. Here are 10 key health concerns that supplements may play a role in helping to delay or diminish until that 365th day of our 99th year:

Bone health: It may not surprise you that 1 in 3 women globally get osteoporosis, but did you know that 1 in 5 men also get it?

Joint health: Osteoarthritis (OA) hits more than half of adults older than age 75.

Cardiovascular health is responsible for one-third of all deaths worldwide. There are many aspects here, from heart attacks to arterial stiffness.

Aging skin: Wrinkles start after age 25. Just look at all the young girls in those collagen ads!

Cognition and memory: An astonishing 1 in 3 adults older than 65 suffer from age-related cognitive decline. That's the new "big C" that might be scarier than cancer.

Autophagy and telomeres: Autophagy is a biological housekeeping process that helps to clean up cell damage. Unfortunately, action here declines with age, as with telomeres.

Sleep disorders are prevalent with aging.

Sarcopenia is age-related muscle loss. It hits about 10% of people over age 60.

Weight weight, don't tell me — obesity occurs in 42% of men older than age 65 and 43% of older women.

Sexual health in particular hits men, who get erectile dysfunction. It affects 67-89% of men between the ages of 50 and 75. Within this category, testosterone decline is another issue.

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The complex interplay between inflammation and aging

The nouveau term is creating opportunities for supplement makers to support inflammation reduction — without overstepping into degenerative disease states.

by Peter Rejcek

Masterful musical mashups can seamlessly blend two or more songs into a transformational new recording that transcends the original compositions. Fusion cuisine, like marrying elements of Korean and Mexican dishes, can create an innovative style of cooking all its mouth-watering own.

Similarly, the merging of concepts within the health space can dramatically shift how we approach wellness. One such example is inflammaging, a portmanteau of inflammation and aging — first introduced a quarter of a century ago by renowned gerontologist Claudio Franceschi. The groundbreaking theory posits that aging is characterized by a low-grade, chronic inflammatory state that develops over a lifetime of exposure to various stressors.

While the concept has been around for some time, inflammaging has attracted more attention of late. About 75% of the 2,100-plus studies related to the theory have been published since 2020, based on data from PubMed. The timing with the start of the Covid-19 pandemic is probably more than mere coincidence, considering the inflammatory havoc wrought by the disease through eliciting an exaggerated immune response in some people.

Out of balance

However, well before the coronavirus, scientists had increasingly focused on the multidimensional aspects of inflammation and healthy aging, including the influence of epigenetics — how lifestyle and environment can affect gene expression over time, according to Susan J. Hewlings, Ph.D. She is SVP of scientific affairs at Radicle Science and

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co-founded Substantiation Sciences; she also wrote on the topic of inflammaging several years ago.

"Integrative health has gone mainstream and we are finally accepting that all systems are interrelated, and if one system is off balance it will have negative impacts on the other systems of the body," Hewlings explained. "It sort of makes sense that inflammaging would catch more attention because the term in and of itself speaks to integrative health."

Indeed, studies suggest a number of interconnected mechanisms contribute to the development of inflammaging. Cellular senescence plays a significant role; dormant, so-called zombie cells are a notorious source of inflammation. Microbiome dysbiosis in the gut can lead to increased intestinal permeability and the release of pro-inflammatory molecules. Mitochondrial dysfunction also plays a role, producing free radicals and releasing mitochondrial DNA that triggers inflammatory responses.

Inflammaging is not inherently harmful or beneficial. Its impact depends on the balance between different pro-inflammatory factors and anti-inflammatory mechanisms. This balance is influenced by genetic predisposition, lifestyle behaviors, mental health and environmental factors, leading to significant variability in how individuals age — the anomaly of Keith Richards notwithstanding.

Inflammaging interventions

Understanding inflammaging opens new avenues for interventions aimed at promoting healthy aging, with nutritional approaches potentially playing a crucial role. The Mediterranean diet — rich in polyphenols, omega-3 fatty acids and antioxidants — has been associated

Top 10 inflammaging ingredients

Omega-3 fatty acids:
Support an anti-inflammatory effect in older age and metabolic issues associated with aging.

Resveratrol:
Demonstrates anti-inflammatory and anti-aging properties.

Curcumin:
Aids in the management of oxidative and inflammatory concerns.

Quercetin:
Shows senolytic properties, meaning it potentially reduces senescent (dysfunctional) cell burden.

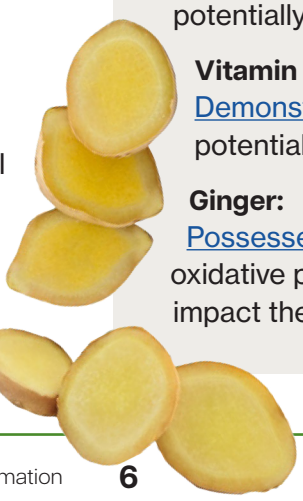
Probiotics:
Increase gut microbiota diversity, protect the gut barrier and reduce chronic low-grade inflammation associated with aging.

Zinc:
Decreases incidence of infections and generation of inflammatory cytokines (proteins) in the elderly.

Fisetin:
This flavonoid demonstrates senolytic and anti-inflammatory effects.

Vitamin C:
Acts as a powerful antioxidant, potentially reducing oxidative stress.

Vitamin E:
Demonstrates antioxidant properties, potentially mitigating inflammaging.



Ginger:
Possesses anti-inflammatory and anti-oxidative properties that may positively impact the aging process.

Innovation from the deep

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> Inflammaging is **not inherently harmful or beneficial**. Its impact depends on the **balance between different pro-inflammatory factors** and **anti-inflammatory mechanisms.**

with reduced inflammation and lower risk of age-related diseases.

However, not everyone has the luxury of retreating to a Greek island in order to live to 100. Thankfully, other studies suggest specific nutrients and bioactive compounds have shown promise in mitigating the effects of inflammaging. For instance, omega-3 fatty acids — particularly EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) — have demonstrated an ability to reduce inflammatory markers in chronic diseases associated with aging.

Philip Calder, Ph.D., a professor at the University of Southampton who has published extensively on fatty acids and human health, explained that essentially, EPA and DHA are incorporated into cell membranes through which they act to dampen inflammatory responses.

"Inflammation is caused by chemicals produced by activated cells," he detailed. "Through their actions in those cells, EPA and DHA act to create a weaker inflammatory response. In addition, it is now known that EPA and DHA can be converted into chemicals called specialized pro-resolving mediators (SPMs) that act to turn off inflammation if it is already underway."

Additional studies have suggested potential roles for other nutritional interventions to inflammaging. Polyphenols like resveratrol, found in grapes and red wine, have exhibited anti-inflammatory and anti-aging properties. Curcumin, the active compound in turmeric, has garnered attention for its potent

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Inflammaging takes the blame for growing old

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The **complex mechanisms** related to inflammaging may require a **multi-ingredient, multi-mechanism** formulation.

anti-inflammatory effects, potentially inhibiting key inflammatory pathways. Antioxidants such as vitamins C and E play crucial roles in combating oxidative stress, which is closely linked to inflammaging.

A multidimensional mechanistic approach

Hewlings suggested formulations that attempt to address inflammaging need to take a mechanistic approach.

"It isn't enough just to throw an ingredient into a formula that has anti-inflammatory effects, but rather, research the mechanism by which that ingredient achieves the benefit and choose the appropriate one for exactly what you are targeting, such as systemic inflammation, gut inflammation, etc.," she noted.

Additionally, Hewlings said that the complex mechanisms related to inflammaging may require a multi-ingredient, multi-mechanism formulation. "It is a challenging area to make strong claims around, and that may be another reason why it is catching on so many years after it was identified," she stated. "The science behind epigenetic testing and cellular age is evolving quickly, and I think will help provide substantiation for claims in this area." ■

Formerly the world's only full-time journalist in Antarctica, Peter Rejcek is a professional editor and writer with nearly 30 years of experience covering science, technology, business and health, including the natural products industry. He also previously served as a senior editor for the supplements and health section of the Natural Foods Merchandiser.

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Every anti-inflam ingredient you can think of

19 m read

Here's how supplements can add **quantity** and **quality** to people's years.

by Yasmeen Nkrumah-Elie

Fine cheese is similar to aging. Some people appreciate it – and others think it stinks.

One description of the aging process is the progressive deterioration of physiological aspects of the body. As people age, the risks for chronic illnesses also seem to increase.

Declines may be seen in vision, hearing, memory and mobility. Frailty increases the risk for falls, which then leads to fractures, which then leads to disability. Urinary incontinence is not fun for anybody.

Nobody looks forward to these possibilities, so the quest for healthy aging becomes about how people can live healthier for longer.

While longevity generates a lot of excitement, most people really think of healthy aging as being about healthspan. How can we help ensure people are living with vitality throughout their days?

How scientists study aging

Scientists are trying to figure out how to slow down this aging process. How do we actually study this? We study the best, the blue zones – areas around the world with an unusually high number of individuals living past 100 years old.

When researchers evaluated the blue zones, they found that many of the residents had a healthy weight throughout their lifetimes and primarily followed a plant-focused diet. They may have consumed some meat or fish, but mostly ate fruits and vegetables that were high in polyphenols. These study subjects had additional positive lifestyle factors, including daily exercise, movement and interaction, as

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> We can take different supplements that hopefully **encourage senescent cells** to graduate and **move on.**

well as many aspects of supporting each other through community. Scientists also found these individuals consumed healthy fats more frequently, and thus these fats may also be contributing to a healthier lifestyle.

We also study rapid diseases of aging. This is looking at diseases where – particularly related to molecular function – aging happens really fast, so we ask what is happening. Maybe if we understand those processes a little bit better, we can improve healthy aging for everyone.

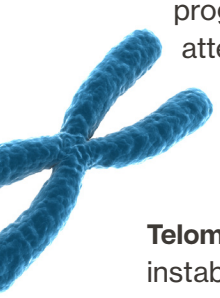
We also look at animal models, like worms and fruit flies. One really interesting endeavor is the dog aging project. The idea is that our companion animals live a life quite similar to ours, which is very different than that of a laboratory animal. So if we can see what our pet's environment looks like – and the types of food and food scraps they eat – then we may have a better understanding of the entire exposure that's very similar to humans. In looking at how our dogs are aging, it may give us insight into how we are aging as well.

And when we evaluate that as scientists, we want to be able to look at the molecular hallmarks of aging.

The hallmarks of aging

The hallmarks of aging were introduced in 2013. Characteristically, these indications must

> We want to be able to create supplements that are going to target the **root causes of aging.** And from those, maybe we can find a **proverbial fountain of youth.**

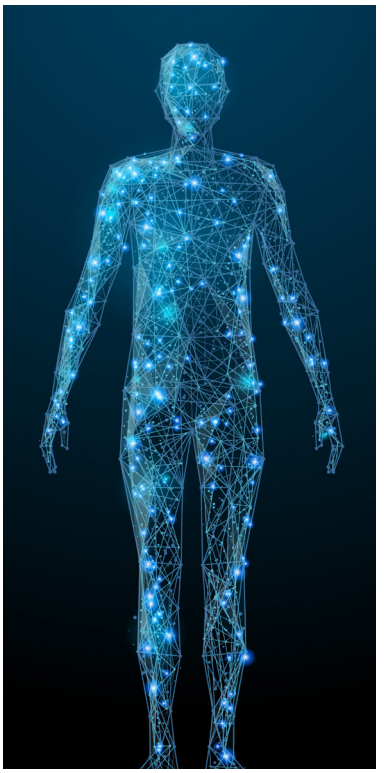


progress with age but are also able to be attenuated and reversed through various interventions. Nine hallmarks were initially determined, and a few more were added in 2023.

Telomere attrition and genomic instability are two of the top hallmarks. This reinforces the importance of our DNA.

Telomeres are at the ends of our DNA. Think of the plastic at the tips of shoelaces. The more we utilize our shoelace — or in this case, the more that our DNA is replicating — little pieces of that are coming off. The telomeres shrink faster in those who are experiencing various stressors.

Genomic instability deals with every aspect of our genome, from the impact of double-strand and single-strand breaks on our DNA, to how mutations affect us. Older people tend to have more mutations and more strand breaks.



Epigenetic alterations is a topic that's all the rage. It's what happens when genes turn on and off, and how those changes could come from things in our environment (like cigarette smoke) or our diet.

Proteostasis is how our proteins stay in balance, whether they are in synthesis mode or utilization mode. Our bodies are constantly imbalanced and when that balance is off for our proteins, we see signs of aging.

Cellular senescence has great potential to impact our industry because you see these cells that are just hanging around. … I was a freshman, I was a sophomore, I was a junior, then a senior, time to go. Oh wait! Second-year senior, still hanging around. That's cellular senescence. There are ways that we can take different supplements that can hopefully encourage those cells to graduate and move on.

Mitochondria are the powerhouses in our cells, but they are doing so much more than providing energy for the cell. Although well-known for that aspect, they're involved in many other functions within our cells — but when our mitochondria are no longer functioning properly, then unfortunately, our cells are no longer healthy.

The regulation of nutrient sensing is when the body actually needs nutrients versus when

it doesn't need nutrients; for example, why it stores things as fat when it should be utilizing or getting rid of them.

Stem cell exhaustion is a situation where stem cells do well when they are young, but then over time they do not function as well.

These issues, as well as various other communication within our cells, can be taking place simultaneously and are not in silos. They all affect one another.

Supplements can help

We can learn much from our elders in the blue zones. These groups of individuals have shown that living a healthy lifestyle in a healthy environment (that also includes having a healthy community) may be a key to healthy aging.

But in the meantime, for those of us who are not able to live quite those lives, we want to be able to create supplements that are going to target the root causes of aging. And from those, maybe we can find a proverbial fountain of youth.

Aging can be slowed down or reversed when we start targeting these molecular mechanisms of aging. From improvements in eye health to cellular aging, we may be able to find ways to turn around the biological clock.

While our chronological clock measures how many years old we are, our biological clock represents how fast our bodies are aging. It shows how they are dealing with stressors and life, and how resilient we are throughout our lives.

PRODUCT PICKS

Qualia

NAD+

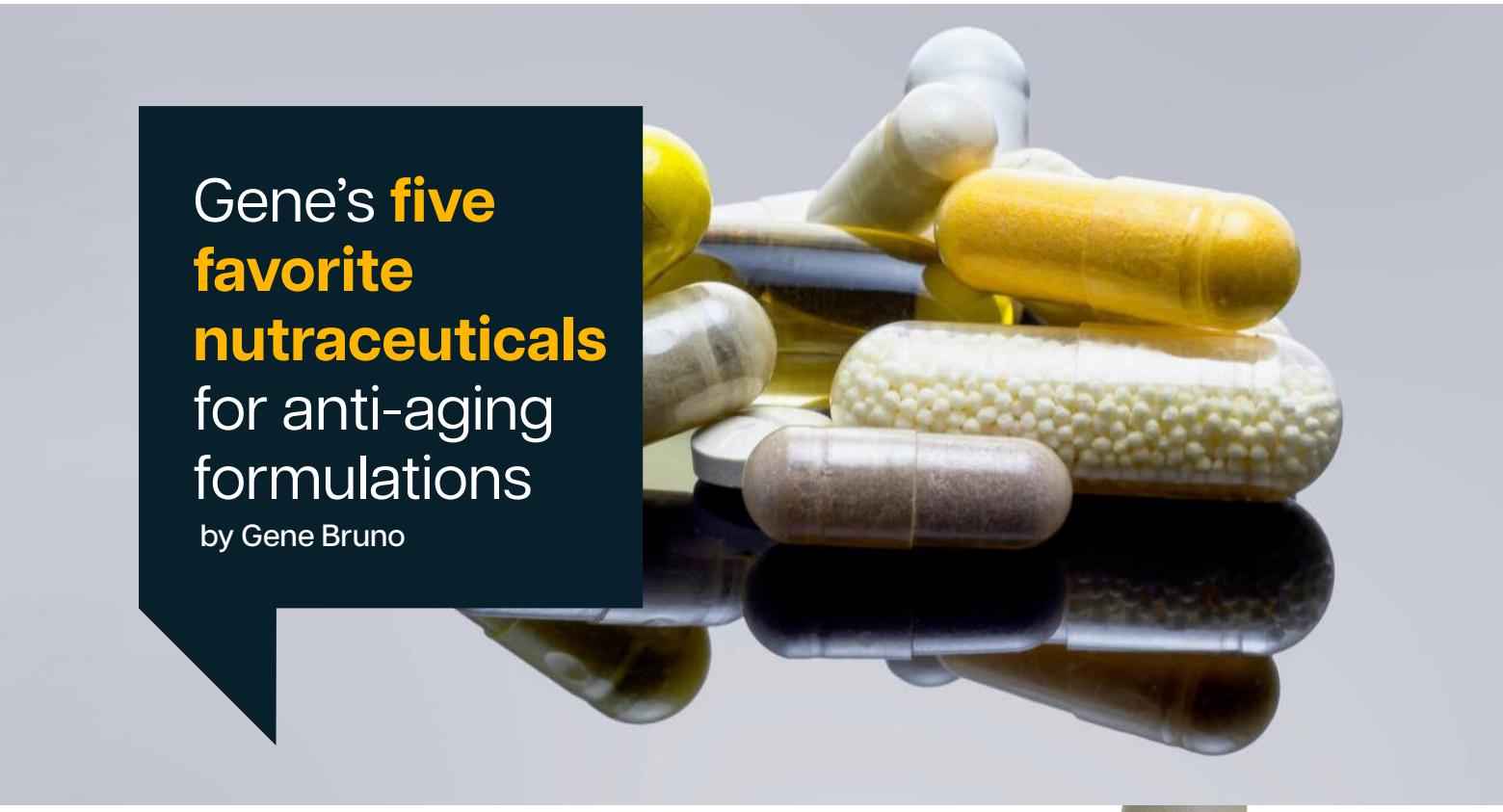
A veritable multi for immortality, this contains 300 mg of NAD+ (nicotinamide adenine dinucleotide) precursor nicotinamide ribidise (brand name Niagen, from Chromadex), along with 234 mg niacinamide (another NAD+ precursor), reservatrol, coffeeberry (*Frangula californica*) to protect the brain, and a host of B vitamins.

Many supplements that may support these hallmarks and physiological indicators of aging are at our fingertips, but there's more science — including some clinical work — that still needs to be done. It will be important to focus on how nutritional bioactives can influence one or more of the molecular mechanisms of aging. And those of you who are in scientific affairs can figure out how to take some of this fun science and interpret it for the masses. ■

Yasmeen Nkrumah-Elie, Ph.D., is the global director for external research at bioscience company ChromaDex. She heads CERP, the ChromaDex External Research Program, which provides interdisciplinary technical and material support for investigators.

Gene's **five favorite nutraceuticals** for anti-aging formulations

by Gene Bruno



Vitamin K2.

The most celebrated form of vitamin K is MK-7, short for menaquinone-7. In a three-year randomized clinical trial, for a large number of postmenopausal women, 180 mcg a day helped maintain bone mineral content.

A 12-month randomized controlled study on 148 postmenopausal women with osteopenia found using a higher dose, 375 mcg a day, helped preserve bone structure.

And in an additional study, 90 mcg/day was shown to reduce bone loss in women.

With a dose of 180 mcg per daily dose, benefits are seen on both bone loss and arterial calcification. Using 180 mcg allows for supported claims on both bone health and arterial stiffness.

These areas are definitely something to consider when you're doing formulation work. The MK-7 version of vitamin K is one my favorite nutraceuticals to formulate with because it does so many different things.

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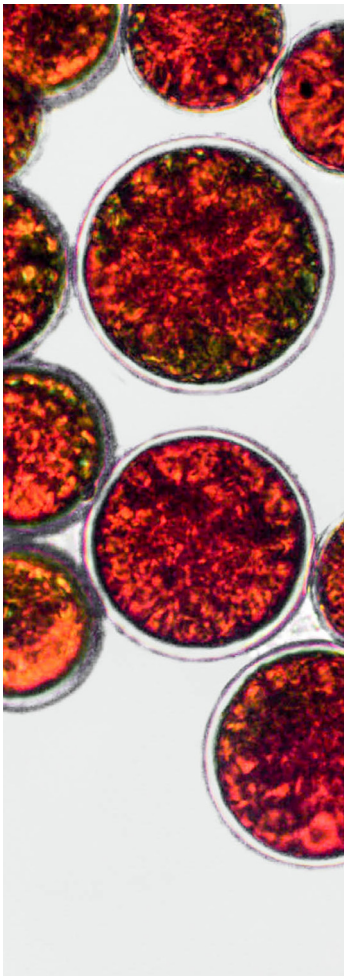

Astaxanthin.

This carotenoid comes from the microalgae *Haematococcus pluvialis*. It's got incredible antioxidant activity, 10 times stronger than the other carotenoids lutein and zeaxanthin (a dynamic duo well-known for eye health). Some solid research has also come out on the combination of lutein, zeaxanthin and astaxanthin working really well together. They not only help form the basis of the macular carotenoids and perform against age-related macular degeneration, but also fight against the potential damage from blue light that people are exposed to from digital devices, especially the phones and computers in front of their faces all day, every day. These carotenoids could be very beneficial. The typical efficacious dose of these three together is 6 mg astaxanthin, 10 mg lutein and 2 mg zeaxanthin.

What I like about it is if I'm formulating a product for skin health and I want to be able to have a spectrum of claims, 4 mg of astaxanthin has been shown in studies to offer some significant benefits.

One of the studies was done in middle-aged women. Compared to placebo, the astaxanthin group had a 50% reduction in fine lines and wrinkles, as well as 50% improvement in skin moisture and elasticity. Extra impressive — the study was done in Maine in the wintertime, and they still got fantastic results, which says a lot for the ability of astaxanthin to help with healthy skin.

One comprehensive analysis concluded that both oral and topical applications of astaxanthin can effectively reduce skin aging, improving moisture content and elasticity while helping diminish fine lines and wrinkles.

Another study used 3 mg of astaxanthin and found it alleviated damage to the skin barrier, alleviating dryness. This is just a highlight, so I encourage you to think about the use of astaxanthin in other products.

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Formulators: 19 healthy aging ingredients

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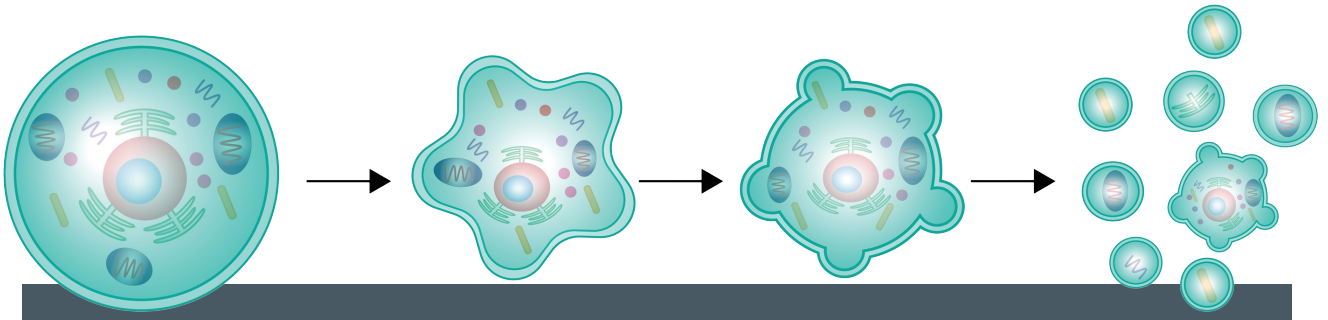


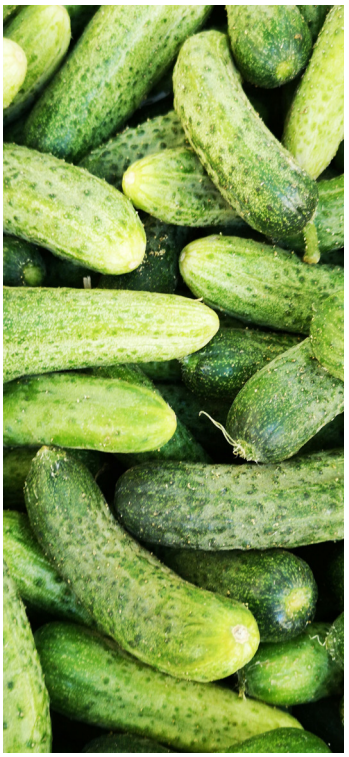
Spermidine and polyamines.

These organic compounds are synthesized in every living cell. Spermidine in particular has been found to increase autophagy – the housekeeping process that gets rid of the old, damaged cell parts and declines with aging. The use of spermidine can actually help stimulate this process.

An interesting review was written on the NAD (nicotinamide adenine dinucleotide)/autophagy axis. They both require each other to do their function. A cool formulation concept would be combining nicotinamide riboside (NR) with spermidine to address – or synergistically address – all those things at once.

Also, spermidine has been found to inhibit various aging-associated pathologies and pro-inflammatory states, as well as extend the lifespan of mice.

It also protected against a decrease in telomere length in mice. Telomeres cap our chromosomes, protecting DNA during cell division. Shortened telomeres accelerate aging and increase disease risk. Preserving telomere length promotes longevity.



Cucumber extract.

Q-Actin is the branded name of a cucumber extract. An iminosugar called ido-BR1, it has been shown to reduce inflammation because it reduces tumor necrosis factor (TNF)-alpha. When that happens, people with arthritis may find the body heals itself.

The effective dose is 20 mg, which was found to be more effective than 2,700 mg of glucosamine-chondroitin. The classic glucosamine-chondroitin combination reduced Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) pain scores by 14.8% and 32.8% at 30 and 180 days, but the cucumber extract reduced WOMAC scores by 22.4% and 70.29% over the same times.

In a 180-day randomized controlled trial on 101 patients with osteoarthritis (OA), using 20 mg or 100 mg or placebo, the 20 mg dose reduced WOMAC pain scores by 32.1% and the 100 mg reduced WOMAC scores by 39.5%, while placebo reduced scores by only 5%.

Vitamin D.

A discussion on healthy aging ingredients would not be complete without the "sunshine vitamin," as it plays a pivotal role in numerous key functions of the body. Vitamin D deficiency is also prevalent among aging adults. Additionally, vitamin D deficiency may increase with age, which makes sense among elderly folks who increasingly opt to stay indoors, getting less sun/exposure for the conversion of the cholesterol under their skin (vitamin D is a certain kind of cholesterol).

Vitamin D2 has shown to have less than one-third the potency of D3, so the latter is typically used in formulation. The standard of cholecalciferol, D3, is created from lanolin (from sheep wool). Be advised it's not a natural process – it's created in a lab via a synthetic process. Lanolin does not contain vitamin D. It must be converted in a lab via esterification, dehydrogenation, saponification, photo reaction and concentration in order to make it vitamin D3, but it works perfectly fine. ■

Gene Bruno, MHS, RH(AHG), is professor emeritus of nutraceutical science at Huntington University of Health Sciences and chief scientific officer of Nutraland USA Inc. With 45 years in the dietary supplement industry, he's an award-winning formulator, educator, author, and podcast host, specializing in nutrition, herbal medicine and nutraceutical science.

Innovating for ‘inflammanagement’

A long innovation runway remains for brands looking to help consumers with the vagaries of inflammation-mediated health concerns. Here’s an insider’s look at how to create hot products.

by Adel Villalobos

Managing the effects of both acute and chronic forms of inflammation — as well as regulating the body’s natural response to inflammatory triggers — are important aspects of consumer wellness.

From a product developer’s perspective, we should focus not only on supporting good health for a person’s lifespan, but we should also be doing it for healthspan — the well-being and quality of life throughout all one’s years.

For those individuals seeking to lead a healthier lifestyle and to address various health concerns through an increasingly active lifestyle, making the transition from a more sedentary to active state can be particularly challenging for the body. To assist with combating and managing inflammation in this transitional period, many consumers are looking to dietary supplements as a means of additional support.

A 2024 report estimated the U.S. market for inflammation-focused dietary supplements at $19 billion in 2022, projecting it to reach $32.8 billion by 2027 — attributing the increasing aging population among the major growth drivers.

For brands developing supplement products in the anti-inflammatory space, another new target market or crossover area of opportunity to consider is providing complementary support in the weight management space. Excess weight and obesity can lead to chronic inflammation. In fact, being overweight is an inflamed state. Our industry can help combat inflammation not only through products that support weight management and the inflammatory response, but also through products that support a healthy weight — which can lead to a more active lifestyle, which in turn supports long-term inflammation management.

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With a vastly growing consumer base using glucagon-like peptide-1 (GLP-1) medications for glucose and weight management (read: Ozempic), the consumers who experience weight loss and start to become more mobile and active could potentially benefit from dietary supplements to help manage inflammation that may occur with increased levels of physical activity.

Key ingredients to consider

Inflammation is a body's vital defense mechanism, acting as the immune system's response to harmful and perceived harmful stimuli, which can include things like pathogens, damaged cells, toxic compounds and exercise-induced damage. Inflammation acts by removing these injurious stimuli and initiating the healing process. These triggers can be a result of certain negative health issues, but they can also stem from an increase in positive healthy behaviors, including exercise and greater physical activity.

For brands looking to enter or expand in the inflammation management space, a number of key ingredients aim to provide direct anti-inflammatory benefits or broader holistic support for other important related health areas. This includes support for aiding sleep, the immune system and even gut flora, which can all have a significant impact on inflammation.

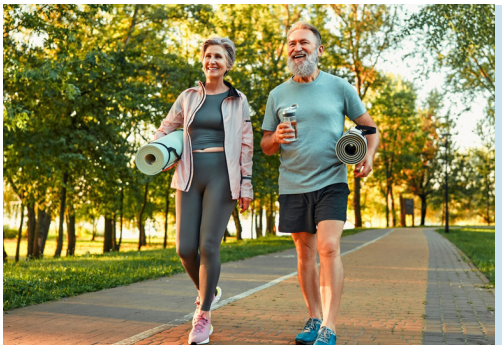
Omega-3 fatty acids: Taken in supplement or food form, omega-3 fatty acids have been found to reverse the progression of a number of inflammatory conditions.

PRODUCT PICKS

Source Naturals

TAURINE 1000

Contains straight up 1,000 mg of taurine, the "elixir of life." Taurine was found in a 2023 study to extend lifespan of mice and monkeys; levels decline with age in humans and supplementation seems to slow key markers of aging.



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CoQ10 wars: Make room for ubiquinol

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Ozempic consumers could potentially benefit from dietary supplements to help manage inflammation that may occur with increased levels of physical activity.

Curcumin: The active component of the yellow Indian spice turmeric, curcumin has shown significant anti-inflammatory effects, and a large volume of preclinical or clinical research has studied its effect on managing inflammation by managing an overreactive immune response.

Melatonin: Research indicates that sleep loss and deprivation can lead to inflammation, while studies have shown melatonin offers positive effects on improving sleep quality.

Nicotinamide riboside (NR) and nicotinamide mononucleotide (NMN): Potential anti-inflammatory benefits have been expressed in NR and NMN, two key nicotinamide adenine dinucleotide (NAD+) intermediates. NAD+ is a coenzyme for redox reactions, making it central to energy metabolism.

Probiotics: Research revealed "probiotics immediately activate anti-inflammatory mechanisms by producing anti-inflammatory cytokines ... and hindering [certain] pro-inflammatory cytokines." Among the probiotic strains that have shown positive effects are *Lactobacillus plantarum*, *Lactobacillus rhamnosus*, *Lactobacillus casei*, *Lactobacillus reuteri, Bifidobacterium longum* and *Bifidobacterium breve*.

Product development guidance for brands

Developing successful supplement products entails more than merely using effective ingredients in the inflammation management space and beyond. Brands want to create products that will best serve their focus audience and market. To succeed here, brands need to have a firm understanding of who their target end consumer is, what they are trying to combat, and where the consumer is in their health journey and life cycle.

Equally important, when working with a contract development and manufacturing organization, these collaborators should have a strong understanding of the brand's needs, including expertise in the science and nutritional functions relevant to the brand's supplement products.

Ideally, a contract manufacturer partner employs in-house staff who have not just industry experience, but backgrounds in pharmacology, biochemistry and clinical nutrition, among other scientific areas. Without science-backed knowledge in the ingredient formulation and product development processes, brands may miss the mark in their ability to deliver high-quality and effective supplements for their customers.

Outlook for the inflammation space

Looking ahead to the future of dietary supplements and the inflammation market,

expect to see interesting opportunities related to the gut microflora and its role in helping manage concerns. This could include advancements in growing and identifying specific strains of healthy gut bacteria that can support inflammatory homeostasis and modulation.

As demand for anti-inflammatory supplement support continues to grow across a range of consumers, I'm excited about the industry's potential to deliver an even greater amount of science-driven, high-quality products to this dynamic space. ■

PRODUCT PICKS

StemRegen

Stem cells are the latest frontier in healthy aging because they renew and regenerate cells and tissues. This elite SKU (read: $$$$) does not contain stem cells per se but ingredients that optimize the firmament for stem cells to act.

Adel Villalobos is the CEO and founder of Lief Labs, a Valencia, California-based formulation and product development innovator and manufacturer of dietary supplements. He completed a degree in biochemistry and an executive MBA from UCLA's Anderson School of Management. Villalobos has been in the industry for more than 25 years and has extensive experience in manufacturing, product development, regulations and government advocacy.

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Anti-aging and the science of nicotinamide riboside (NR)

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Healthy aging directory

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Ambe Group:
AKBA Ultra is a complex of *Boswellia serrata* extract used for joint health.

Astareal USA:
These astaxanthin offerings come in a variety of oils, powders, emulsions, softgels and other formats.

Bioenergy:
RiaGev combines the company's flagship ingredient, Bioenergy Ribose, along with niacinamide to increase cellular NAD (nicotinamide adenine dinucleotide) levels, according to an unpublished company study.

Bionap USA:
Olea-HT 10 is geared toward skin aging.

Bioriginal:
Novusetin is a fisetin (flavonoid) extract, a new player in the nootropic category.

Chromadex:
Niagen is a well-established nicotinamide riboside (NR), a NAD+ precursor.

Gnosis by Lesaffre:
MenaQ7 is a long-standing brand of vitamin K2.

IminoTech:
Q-Actin cucumber extract is marketed for applications ranging healthy aging, joint health and more.

Indena USA:
The company offers Meriva curcumin phytosome (a complex).

India Glycols Ltd.:
One study indicated Maxicuma was 172 times more bioavailable than commodity curcumin.

Kaneka:
CoQ10 in the form of the Ubiquinol brand showed twice the absorption level as conventional ubiquinone CoQ10.

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LODAAT:
Aquaturm is a water-soluble curcumin extract.

Maolac:
MaolactinFMR (fast muscle recovery) is a protein blend formulated to target exercise recovery, inflammation and muscle comfort.

Nutraland USA:
Miricell is an award-winning, patent-pending and self-affirmed GRAS (generally recognized as safe) rice germ extract rich in polyamines (spermidine).

NXT-USA:
A patented extract blend of tamarind seed (*Tamarindus indica*) and turmeric root (*Curcuma longa*), TamaFlex was shown to influence inflammation-related issues in as quickly as five days.

SunWay Biotech: Ankascin 568 is a red yeast rice that demonstrated to support heart health.

PRODUCT PICKS

GNC

TAMAFLEX

Features TamaFlex, derived from tamarind seeds and turmeric root extracts, and shown in just five days to decrease knee pain associated with getting old.