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SILKE WATKINS, Editor-in-Chief

Will vital substances only be available in pharmacies in the future?

Dietary supplements have been very popular for years. Demand has increased rapidly in the course of the coronavirus crisis. In particular, people who look after their personal health have recognised just how important preventive measures are for better protection against infections and to boost their immune system. Studies show that a good supply of vital substances reduces the risk of infections or can make the course of illness milder.

Now the German Federal Minister of Food, Agriculture and Consumer Protection has set the goal of reorganising and regulating the European dietary supplement market by demanding maximum quantities for vitamins and minerals in dietary supplements and enriched foods in the EU. This is by no means a new issue and certainly also sensible in a certain form, especially since consumers can readily order products with different maximum quantities in various EU member states over the Internet. So far, reaching an agreement has failed because the member states are unwilling to compromise.

What irritates, however, is the statement that establishing maximum limits is intended to ensure legal certainty and effective monitoring and control. From a legal perspective, dietary supplements are however foodstuffs and, as the name says, intended to supplement one's diet. The requirements for foodstuffs apply with respect to safety. After scientific investigation, the EFSA prepared health-related statements for vitamins that can also be applied to dietary supplements. Thus the dietary supplement market is neither unregulated nor are dietary supplements unsafe.

They can bridge a nutrition gap when one's diet does not provide sufficient vitamins and minerals. Here too, studies have shown that dietary supplements can reduce the risk of diet-related diseases.

The argument that such regulation could prevent overdosing due to taking various dietary supplements is worse than weak. I have never heard of any fatalities caused by dietary supplements. Furthermore, I am confident that most people inform themselves very well in advance and also stick to the recommended dosage. I get the impression that politics once again wants to prevent people from looking after their own personal heath and make access to dietary supplements more difficult. Will we ultimately need a prescription to get vitamins and minerals?

Fortunately, politics is not yet considering the regulation of reading material that explores this topic. Enjoy your reading!

With best regards,

Silke Watkins

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With its two leading ingredients trade shows – Food ingredients Europe and Health ingredients Europe – being co-located on an annual basis from this year onwards, organizer Informa Markets mirroring a decisive shift in nutrition. Given the fact that increasing numbers of consumers are expecting more from what they eat, alongside just food and just nutraceuticals, the functional foods category has evolved. Wellness Foods & Supplements talks to Julien Bonvallet, Brand Director at Informa Markets, about breaking down boundaries and about the trends and challenges that this category brings. (see interview at page 48)

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Glucono-delta-Lactone in silken tofu

Johanna Kurrat, Lena Perkins

Introduction

Long gone are the days when soy products like tofu and bean curd were eaten only in Asia. They have also been finding their way onto the shelves of Western food outlets for decades now. And as health and sustainability awareness continue to grow alongside concerns about animal welfare, soy products are gaining significantly in market share and shelf prominence. After soy drinks the most familiar product is tofu, with growth in the market recently being driven by the constant launch of innovative tofu-based products like burgers, ice creams, shakes and desserts, as well as raw tofu.

Tofu itself consists mainly of water, soy protein, fat, and minerals and is therefore an excellent source of protein, especially for vegetarians, vegans and flexitarians. Since the protein profile of soy milk is considered to be one of the best among foods of plant origin, tofu represents an outstanding alternative to meat or milk products.[1]

Tofu comes in many different forms. It can be natural or smoked. It can be flavoured with spices, herbs and nuts. It also comes in several textures: extra firm, firm, soft and silken tofu. This last has the softest texture and is characterised by a very smooth mouthfeel, almost like yogurt. Its mild taste makes it suitable for both savoury and sweet dishes. The unique texture of silken tofu is achieved by adding coagulants such as Glucono-delta-Lactone or calcium sulphate. In contrast to firmer tofu products, silken tofu production does not include a pressing step. As a result more whey is bound in the product, giving the silken tofu its particular texture.

This article advises how best to use Jungbunzlauer Glucono-delta-Lactone to obtain a high yield of silken tofu characterised by a pleasant firmness and increased breaking strength.

Glucono-delta-Lactone – a fermentation-based mild acidifier

Glucono-delta-Lactone (GdL) is a neutral cyclic ester of gluconic acid formed by the removal of water. Gluconic acid is an organic acid occurring naturally in plants, fruits and other foodstuffs such as wine (up to 0.5 %) and honey (up to 1 %).

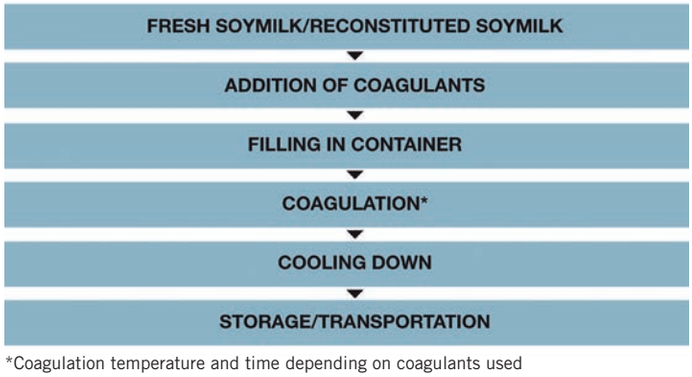
Jungbunzlauer's gluconic acid is produced by aerobic oxidative fermentation of glucose syrup from non-GMO maize. GdL is obtained by direct crystallisation from the aqueous solution of gluconic acid, resulting in a fine, white, crystalline powder. GdL is practically

odourless and has a slightly sweet taste. Being non-toxic, it is metabolised completely in the body, like a carbohydrate.

When added to an aqueous solution, GdL dissolves rapidly. It hydrolyses slowly to gluconic acid to provide mild acidification. The decrease in pH is progressive and continuous until equilibrium, which makes it an outstanding acidifier compared to other acidulants, which tend to provide instantaneous acidification. The initial sweet taste of GdL becomes slightly acidic during hydrolysis. However, the final flavour of an aqueous solution of GdL remains much less tart than that of other common food acids (the relative sourness of gluconic acid is only one-third that of citric and lactic acids and a quarter of that of acetic, malic and tartaric acids).

Production of silken tofu

The production of tofu starts with fresh or reconstituted soy milk. Soy milk is won by soaking soy beans in water, grinding them, and filtering the liquid. Only soy milk high in protein is suitable for the production of tofu products. Soy milk can also be processed to powder by spray-drying and later reconstituted.



*Coagulation temperature and time depending on coagulants used

Fig. 1: Production chart of silken tofu

The fresh or reconstituted soy milk is pasteurised and cooled to room temperature before coagulants are added while agitating the mixture. This is then filled into containers for immediate in-place coagulation. The containers are closed and heated to catalyse coagulation. Once this has taken place the containers are cooled and the silken tofu is ready for consumption or storage.

Coagulants for silken tofu

The coagulants added to soy milk to form a curd can be salts or acids. Tofu coagulants can be divided into four major groups: nigari-type or chloride-type coagulants, sulphate-type coagulants and acid coagulants, including Glucono-delta-Lactone. Different coagulants are used for different types of tofu. Nigari, for example, which is simply sea water and was traditionally used to prepare tofu, is most suitable for firm or extra firm tofu. It mainly consists of magnesium chloride, which is still used nowadays, but in purified form. Another commonly used coagulant is calcium sulphate, which belongs to the sulphate-type coagulant group. Of the acid coagulants, GdL is best suited to preparing soft and silken tofu. Sometimes mixtures of different coagulants are used and synergistic effects have been reported.[1]

The coagulants named differ with regard to their coagulation mechanism. Pasteurisation of soy milk leads to an initial denaturation of soy proteins and the heat treatment exposes the hydrophobic regions which in the native state of the proteins are hidden.[1] As a progressive acidifier, GdL slowly decreases the pH and releases hydrogen ions to neutralise the denatured proteins, inducing their aggregation.[2,3] Hence gelation with GdL produces smooth tofu with a homogenous structure, whereas acid coagulants such as vinegar or lemon juice, which decrease the pH instantly, give rise to a crumbly, curdled tofu structure.

Chloride-type coagulants also release ions which aggregate proteins and form the soy curd, but here too aggregation is immediate and rapid. Thus the tofu obtained using this coagulant group has a spongy texture. GdL is unique in dissolving slowly to release acid progressively, enabling the production of all kinds of protein products with smooth, pleasant textures.

How to produce silken tofu using Glucono-delta-Lactone

The variables that determine the quality of silken tofu differ immensely, as do the available production parameters. All raw materials, but especially soybeans, vary in respect of origin, age and quality. Key to the quality of tofu are protein content and composition. In addition, the temperature at which soy milk is processed for tofu production, as well as the type, concentration and amount of coagulants used, have major impacts on its texture.

With this in mind, Jungbunzlauer has drawn up support and guidance for producers of silken tofu including recommendations for the optimal use of GdL. Our recommendations are substantiated by texture analysis and rheological measurements of silken tofu produced from fresh soy milk, as shown in the following sections.

Is gluconic acid suitable for silken tofu production?

Gluconic acid, the completely dissolved form of Glucono-delta-Lactone, is not suitable for production of silken tofu. It provokes an immediate pH drop and rapid acidification resulting in a crumbly curd, which is unsuitable for silken tofu.

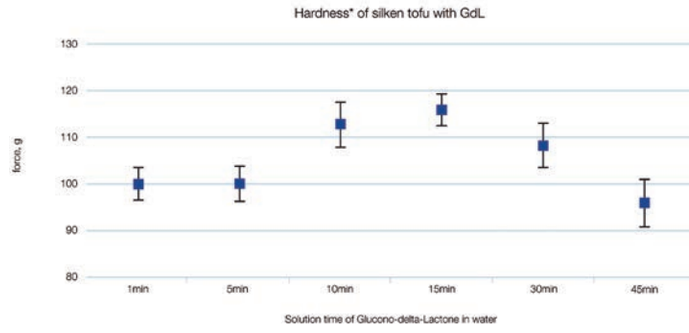
What is the best way to add Glucono-delta-Lactone to soy milk?

For silken tofu production Jungbunzlauer recommends 0.26% GdL ure, then allow to gel for 45 minutes at 90 °C/195 °F. This ratio of GdL to water in combination with the recommended mixing time was shown to deliver the firmest and most stable tofu. At a ratio of 1:3 GdL hydrolysis was insufficient and holes were formed, whereas a ratio of 1:5 resulted in inhomogeneous tofu with an uneven, brittle surface. The ratio of 1:10 GdL in water ensures proper GdL hydrolysis and protein gelling, producing silken tofu with a smooth surface (Fig. 2).

Fig. 2: Silken tofu made from GdL solutions in water with ratios 1:3 (left), 1:5 (middle) and 1:10 (right)

Achieving the best texture and stability of silken tofu with Glucono-delta-Lactone

Silken tofu was prepared from GdL solutions that were stirred for 1–45 minutes. Five batches of silken tofu were produced from every solution and measured for their hardness using a texture analyser. Figure 3 shows the firmest silken tofus were obtained when the GdL solution was stirred for 10–30 minutes, whereas shorter or longer times resulted in softer tofu. A similar trend was observed when analysing the breaking strength of these same samples (data available on request).



*Hardness represents the force needed to crush a product. Measurement method: Grid stamp, 0.8 mm/s, 50% deformation

Fig. 3: Hardness of silken tofu made from different Glucono-delta-Lactone solutions

How does Glucono-delta-Lactone perform in comparison to other coagulants?

Calcium sulphate is another well-established coagulant and widely used. Silken tofu was prepared with 0.26% GdL, with 0.4% calcium sulphate or with combinations of both in varying ratios (total coagulant concentration 0.3%). The hardness of the tofu obtained using the single coagulants or the mixtures was analysed (Figure 4). GdL produced firmer tofu than calcium sulphate when using soymilk taken from the same batch. This confirms reports by Cheng et al. (2005).[4] A combination of the two coagulants at a ratio of 50:50 led to increased firmness. This finding suggests that the hardness of silken tofu produced traditionally

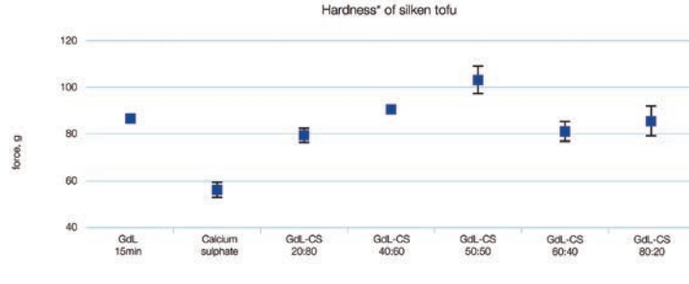
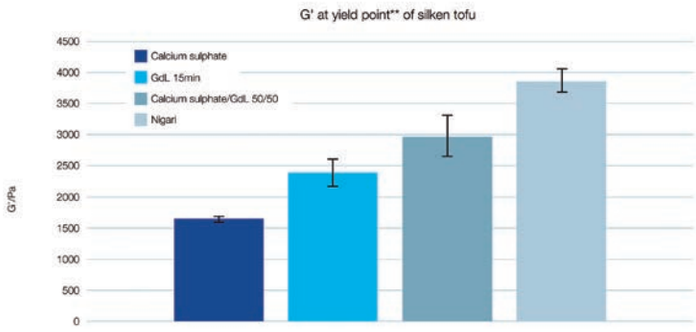


Fig. 4: Hardness of silken tofu made from 0.26% GdL, 0.4% calcium sulphate and 0.3% combinations thereof

with calcium sulphate can be enhanced by a partial replacement with GdL.

The combination of calcium sulphate with GdL was further investigated based on rheological measurements including a comparison to nigari, as another widely used coagulant. Figure 5 shows the results of the amplitude sweep determining storage modulus G' at yield point. The yield point is defined as the end of the linear viscoelastic range and the minimum force that must be exceeded in order to break down a sample's structure at rest and thus make it flow. After this point a sample is irreversibly destroyed. Storage modulus at yield point can be consulted to obtain information about the structure strength and hardness of the tofu sample (Fig. 5).[5]

Figure 5 confirms once again that silken tofu prepared with GdL is firmer than that obtained with calcium sulphate, whilst a combination of the two coagulants results in an even higher value. Nigari tofu had the firmest structure in this measurement, due to its immediate, rapid coagulation of soy protein and strong whey separation. However, nigari is not suitable for the production of silken tofu because of its fast reaction time, which makes it difficult to achieve the smooth, uniform blocks desired for silken tofu.[6]



**Amplitude sweep with lgγ = 0.1–100 %, ω = 1 1/s, PP25 (plate-plate), T= 21 °C/ room temperature, double determination

Fig. 5: Solid behaviour G' at yield point of silken tofu prepared with different coagulants

Legal aspects of Glucono-delta-Lactone use

In the European Union, GdL is a generally permitted food additive (E575). It may be added to all foodstuffs, following the "quantum satis" principle, as long as no special regulation restricts the use (Regulation (EC) No 1333/2008).

The US Food and Drug Administration (FDA) assigned GdL the "generally recognised as safe" (GRAS) status and permits its use in food without limitation other than current good manufacturing practice (GMP) (CFR Title 21 Ch. I Sec. 184.1318). Among others, GdL may be used as a curing and pickling agent, pH control agent and sequestrant (CFR 21 Ch. I Sec. 184.1318(c)(1)).

In the International Numbering System of the Codex Alimentarius GdL has the INS number 575 and is categorised as an acidifier/acidity regulator as well as a raising agent.

The Acceptable Daily Intake (ADI) of GdL has been classed as "not specified" by the Joint Expert Committee on Food Additives (JECFA) of the FAO/WHO and the Scientific Committee for Food (SCF) of the European Community.

Purity criteria have been laid down for GdL by the main food and pharmaceutical compendia like the Food Chemicals Codex (FCC), the specifications of JECFA, Japan's Specifications and Standards for Food Additives (JSFA) and the US Pharmacopoeia, etc.

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Summary

This facts article provides guidance on using Jungbunzlauer Glucono-delta-Lactone to obtain a high yield of silken tofu characterised by a pleasant firmness and increased breaking strength.

For high-quality silken tofu, Jungbunzlauer recommends using Glucono-delta-Lactone of the granulation grade F5010. Granulation size plays an important role in the dissociation rate of GdL and it was found that F5010 yields the most desirable dissociation rate. The smoothest surface of silken tofu can be achieved if GdL is added in the form of a solution with a ratio of 1:10 GdL to water. To obtain silken tofu with good firmness and breaking strength we recommend stirring the solution for 10–30 minutes. During this time, GdL slowly hydrolyses into gluconic acid and progressively lowers the pH. If not enough time is given for GdL to dissolve properly or if the solution is stirred for too long, most of the GdL is already transformed into gluconic acid, which significantly reduces the hardness of silken tofu. To enhance the firmness and the breaking strength even further, consider a combination of GdL and calcium sulphate in a ratio of 1:1.

In combination with soy proteins GdL provides very good water-binding capacity and thus reduces whey separation. GdL also enables in-place coagulation, i.e. coagulation, storage and transport in individual packaging containers – yet another benefit for producers.

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Force of nature: Making the most of astaxanthin

Astaxanthin represents one of the strongest antioxidants on the planet. SagaNatura's CEO, Lilja Kjalarsdottir, explains how the Icelandic biotech company's innovative new technology is delivering a high-quality product in a highly sustainable way

Astaxanthin is one of nature's most powerful compounds, with remarkable antioxidant activity and potent anti-inflammatory effects.[1,2] A red carotenoid pigment that is naturally synthesized by microalgae, bacteria and yeast, astaxanthin's antioxidant activity is 10 times higher than other carotenoids such as β-carotene, lutein and zeaxanthin, and 500 times higher than vitamin E.[3]

Antioxidants combat the damage caused by free radicals, helping the body to relieve the oxidative stress that can lead to chronic disease.[4] Astaxanthin has attracted significant scientific interest for its positive effects in relation to aging, diabetes, eye health and many more areas.[5]

For example, studies have also indicated that astaxanthin can enhance cardiovascular health, including improving HDL and LDL cholesterol levels[6,7]; boost muscle strength and endurance[8,9]; and support skin health, protecting against UV and reducing photo aging.[10,11,12]

Natural vs. synthetic

While the research underlines its enormous potential, not all astaxanthin is created equal.

In the wild, the astaxanthin consumed from sources such as algae and phytoplankton provides animals including shrimp and salmon with both dietary benefits and their red and pink coloration.[13,14] In breeding farms, where the natural dietary sources are not present, animals such as salmon are often given synthetic astaxanthin as a feed additive to provide the expected pigment.[15]

Synthetic astaxanthin, which is produced from petrochemicals, is commonly used in aquaculture and has recently been made available in the form of human dietary supplements too.

Synthetic astaxanthin has been shown to be significantly inferior to algal-based astaxanthin as an antioxidant[16] and differen-

tiating between wild and farmed fish is straightforward by analyzing their astaxanthin content.[17] Natural astaxanthin from the microalgae *Haematococcus pluvialishas* earned particular recognition for its high quality. As such, it has now become established as the main source of astaxanthin for a variety of human applications including dietary supplements, cosmetics and food.[18]

A new solution

Numerous methods are used to produce astaxanthin from *Haematococcus pluvialison* an industrial scale: some use open-pond technology, cultivated outdoors, while others produce the algae indoors in tubular or flat-panel systems.

At SagaNatura, we chose a different route. As a leading Icelandic dynamic biotech company, our team of scientists continuously develop and test new products and manufacturing equipment. Innovation is at the heart of what we do, and this enterprising spirit led us to create our own patent-pending microalgae culturing technology. Our closed-tank photobioreactor (PBR) system is highly efficient, utilizing significantly less space and energy per kilogram of microalgae biomass than other traditional photobioreactors.

Our process starts with the propagation of the *Haematococcus pluvialis* microalgal culture in a disinfected cultivation lab, and we then scale up by transferring the seed culture to one of our special photobioreactor tanks.

The astaxanthin production begins when the green microalgae are moved to our tank-based PBRs, where they thrive in pure Icelandic spring water. Microalgae naturally produce astaxanthin to provide protection from the sun's UV rays, turning red as they do so; our process makes use of strong lights, powered sustainably using only clean geothermal and hydro-electric energy and the latest energy-saving LED lighting technology. Once this 'red phase' is complete, the astaxanthin can be harvested and processed.

Photo©:SagaNatura

Our method not only allows us to produce top-quality astaxanthin but also ensures stable productivity levels. The meticulously engineered PBRs secure a microalgae harvest in any climate. Additionally, by using our space-saving, tank-based technology, we have the ability to produce 15–20 tons of astaxanthin-rich biomass per only 1,000 m^2, and scale-up is fast since the tanks are essentially plug-and-play systems.

Sustainability is absolutely fundamental to our approach. In addition to using highly efficient tanks and the cleanest possible energy sources, we help combat climate change by breaking down carbon dioxide – our only waste product is oxygen. We also work to minimize water loss by evaporation.

Getting the best out of astaxanthin

Natural astaxanthin's potential health benefits are huge, and even more so when combined with complementary ingredients.

At SagaNatura, we offer a variety of consumer products that highlight the possibilities for synergistic formulations. AstaSkin, for example, is an all-in-one skin product that contains three active ingredients – 6 mg astaxanthin, 30 mg Myocream™ and 250 mg collagen – as well as a range of vitamins. AstaSkin protects the skin against UV and environmental pollutants, maintains its moisture and structure, and keeps it strong, healthy, soft and supple.

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AstaCardio, meanwhile, features 4 mg astaxanthin as well as omega-3 – both derived from the algae – and helps maintain a healthy heart, vision and brain activity. AstaEye contains 4 mg astaxanthin, EPA and DHA, riboflavin, β-carotene, lutein and zeaxanthin. It supports healthy vision, fighting dry- eye syndrome and protecting against age-related macular degeneration.

The possibilities for formulations are endless, and manufacturers can create their own products using our AstaKey astaxanthin powder and oleoresin. We can also produce finished or private label products according to requirements.

Quality is key, and that comes down to the astaxanthin's source and production process. With an innovative and sustainable production process that makes use of Iceland's pristine water and air, it's clear that our algal-based astaxanthin ticks every box.

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Optimize your calcium fortification

Calcium and health

Consuming an adequate amount of Calcium is essential for people with increased Calcium requirements like children of school age, pregnant women, athletes, seniors or people who have to take resorption-inhibiting medication. Calcium aids in preventing deformities and softening of the bones such as rickets, osteoporosis or bone fractures. Moreover, Calcium plays a role in muscle function, heart function and in the nervous system.[1]

Calcium, together with magnesium, is the best-known mineral in public and is the most abundant mineral in the body. Calcium Citrate is the Calcium salt of citric acid. Citrates occur naturally in the metabolism and are part of every body cell. Thus, Calcium Citrate shows a high bioavailability.[2] It has no effect on stomach acid and is easy to digest. Therefore, Calcium Citrate is considered to be one of the most usable forms of Calcium for the human body. With the latest launch of high performance *Tricalcium Citrate 4-hydrate superfin*e, Dr. Paul Lohmann® introduced a new product to the dairy industry that delivers on taste, texture and nutritional value. Moving from a niche position as a health ingredient for nutritional supplements, Tricalcium Citrate 4-hydrate superfine has become a favorite of dairy food and milk substitute manufacturers.

Challenges and solutions

Product appearance and labelling give consumers a first indication about a product's taste and quality. Apart from that, more and more people are aware of the interactions between different nutrients and their benefits in health and well-being. As Innova Market Insights reveals, consumers are consciously looking for all-round solutions with added value, e.g. in regards of health benefits. The customer's desires are trending toward food to be healthy, easy to consume and tasty at the same time.

A growing number of consumers are relying on fortified foods and beverages. Dairy-based beverages, cream cheese, yogurt and even

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ice cream are in the focus as innovative delivery vehicles for a more nutritious treat. With those functional foods, they see the possibility to achieve the required amount of nutrients without having to consume additional portions or calories.

Yet, the main goal in marketing of a valuable product is not the fortification per se but to keep foods delicious and appealing at the same time. For dairy foods and dairy analogues foods, fulfilling these demands can be challenging. For example, the use of soluble Mineral Salts – especially Calcium – can lead to coagulation reactions with milk proteins. Insoluble salts, on the other hand, may lead to sedimentation or chalky taste. To overcome these challenges in creamy and solid products such as yoghurt, fromage frais and cream cheese, Dr. Paul Lohmann® has the solution: Tricalcium Citrate 4-hydrate superfine. This product offers food manufacturers unique advantages in terms of technical, sensory and nutritional parameters.

Super fine results in milk

With the newly developed Tricalcium Citrate 4-hydrate superfine, Dr. Paul Lohmann® found the answer to a high demand on a Calcium Citrate with a clearly reduced speed of sedimentation in dairy and plant milk products. With this superfine powder, customers will be able to fortify their dairy products with Calcium with a significant reduction of sedimentation during the production process.

The Research and Development department did a lot of application trials with Tricalcium Citrate 4-hydrate with different particle sizes like normal powder, micronized powder, fine powder and superfine powder. The products were tested on their performance in different kinds of dairy products, e. g. milk (1.5 % fat and 3.5 % fat), cream and oat milk. The test results showed that the superfine powder was the best performing product within this series of tests, with the slowest sedimentation velocity and the smallest amount of sediment at the bottom of the testing tubes. Another positive effect is the improvement of taste and mouth feeling by using the superfine powder.

Nice in ice

The special particle design of this insoluble Mineral Salt enables the fortification of e. g. ice cream with a reasonable amount of Calcium, without compromising one bit of flavor! While increasing the nutritious value, Tricalcium Citrate 4-hydrate superfine enhances foam structure, volume and optimizes the stability of ice cream. Apart from superior appearance and texture, the taste profile is enhanced, too. A well-rounded sweetness in vanilla ice cream is topped off with less bitterness in chocolate ice cream. With a health claim approved ingredient and a creamy-as-can-be texture, the ice cream is deemed nothing less than delightful.

This is a novelty within the dairy foods world. While the consumer benefits from healthy and delicious products providing micronutrients to meet their nutrient requirements in alternative sources. The dairy industry as well as the dairy analogue industry benefit from the development of innovative and appealing products that can be marketed as having high mineral contents and at the same time are highly economic.

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Technical advantages

Tricalcium Citrate 4-hydrate superfine shows a significant technological advantage. In essence, the special Calcium Citrate grade enables ice cream to be fluffy, healthy and delicious at once:

– High creaminess
– No chalky taste
– No sedimentation
– No interaction with milk proteins
– Natural/neutral taste profile
– Well tolerated with good bioavailability
– Good source of calcium
– Taste improvement

The product shows a high content of elemental Calcium (21 %). Even small amounts achieve a significant enrichment of foods. It is not soluble in liquids with neutral pH. In order to prevent sedimentation and not to influence the taste profile, Tricalcium Citrate 4-hydrate superfine forms a stabilization system intrinsically (micelle stabilization) due to specially adjusted particle sizes.

Regulatory status

Tricalcium Citrate 4-hydrate superfine is approved for the fortification of foods in accordance with Regulation (EU) No. 1925/2006. It is a health claim approved ingredient and can be used either for the fortification of food or due to technological improvements (E 330) of several food items like e. g. dairy, baby food, ice cream, beverages or fine food specialties.

According to EU guidance levels the intake recommendations for Calcium of 800 mg/day are sufficient to meet the nutrient requirements.[3] For people with increased requirements like adolescents in the growth phase and pregnant women, 1200 mg is targeted and for breastfeeding women, 1300 mg daily should be consumed.

For a quick comparison, ice cream fortified with Tricalcium Citrate 4-hydrate superfine can boost Calcium levels from 50 mg (a scoop of vanilla ice cream of 50 grams) to 120 mg calcium. Therefore, one serving of ice cream (100 g) allows the nutrition claim “high in calcium” to be indicated on the label. Complimenting a healthy diet that contains other sources of Calcium, this provides a good basic supply when people splurge for a treat.[4]

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Next-generation calcium mineral

Lalit Sharma

For the first time in history, most people can expect to live into their 60s and beyond. According to the World Health Organization, one in five people will be 60 or over by 2050.[1] Yet while there's no doubt that a longer life brings great opportunities, the extent to which they can be enjoyed depends on an individual's physical and mental state. Healthy ageing is the process of maintaining the functional ability that enables well-being in older age, beyond merely prolonging life – put simply: how you look and feel is more important than your actual age.

Prevention starts early

From early on in life, people can do a lot to protect their future health. A balanced diet with sufficient nutrients, vitamins and minerals is the foundation of optimal ageing. The mineral calcium, for instance, is vital for various bodily functions: it helps maintain strong bones, control blood pressure, ensure proper muscle contraction and nerve conduction, and supports heart health. An adequate daily calcium intake throughout life is therefore essential. It also reduces the risk of fragility fractures, thus enhancing mobility and overall quality of life.

However, for many, particularly athletes, the elderly and those who avoid dairy products, it can be difficult to achieve an adequate dietary intake. In addition, at certain times of life, such as during adolescence, the body requires more calcium to build strong bones. Postmenopausal women also need more calcium because they absorb the mineral less efficiently, and additional intake helps to slow down loss of bone mass. For these groups, calcium supplements and fortified foods can be helpful.

Bioavailability is key

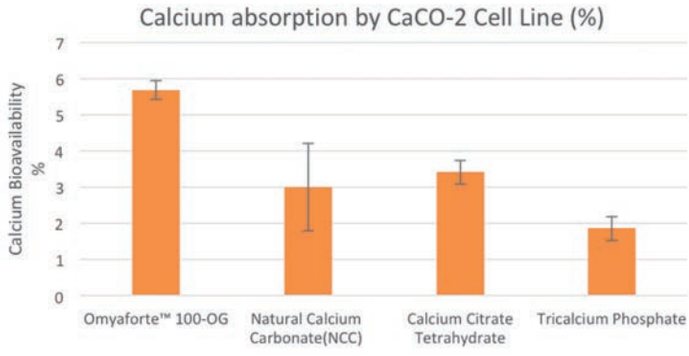
The amount of calcium in the diet is not the only thing that is important for strong bones. Also crucial is the bioavailability of this mineral – in other words, the amount that is absorbed by the body through intestinal cells.

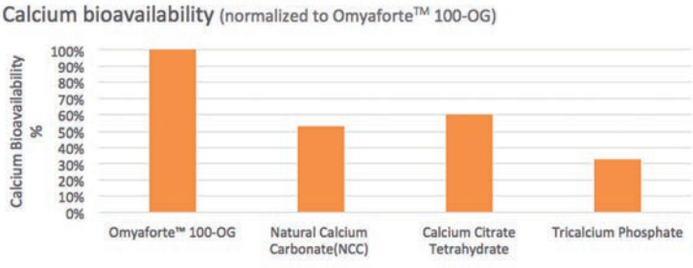
Recently, mineral producer Omya launched Omyaforte™ 100-OG, a highly bioavailable source of calcium suitable for powdered formulations targeting healthy agers and others who may be calcium-deficient.

From a nutritional point of view, two factors are important: the amount of elemental calcium in the salt and the bioavailability of the calcium. Compared to reference products, Omyaforte™ 100-OG offers a higher elemental calcium content and greater bioavailability. It contains 39 % elemental calcium – almost twice as much as calcium citrate, which contains just 21 %. As a specially tailored calcium source, it consists of calcium carbonate and tricalcium phosphate, combining the best properties of both. Thanks to a patented recrystallization process, Omyaforte™100-OG offers a new mineral composition and structure with high porosity, which allows for faster access to gastric juices in the stomach. The accelerated dissolution in acidic environments results in a quicker release of calcium ions, which are then ready to be absorbed into the bloodstream via the small intestine.

Backed by science

To verify the enhanced intestinal absorption of Omyaforte™ 100-OG compared to other commercially available calcium sources, researchers tested the bioavailability with a Caco-2 cell line model, which is a widely used in-vitro method to determine nutrient absorption by the intestine.





The results show that Omyaforte™ 100-OG is almost twice as biologically available as calcium citrate and natural calcium carbonate (NCC). On average, calcium uptake efficiency for tricalcium phosphate was 1.85 %, for NCC 3 %, for calcium citrate tetrahydrate 3.41 % and for Omyaforte™ 100-OG it was 5.68 %. These results suggest that the type of calcium salt may affect the bioavailability of calcium, since the uptake efficiency values vary.

The world's increasingly ageing population means that demand for calcium supplements and calcium-fortified foods will continue to grow. Beyond healthy agers, professional athletes and weekend warriors are also seeking targeted nutritional support. Omyaforte™ 100-OG is suitable for them all – from sports nutrition products to vitamin and mineral mixes, bone health blends and rehydration powders. In addition, the ingredient is suitable for a variety of foodstuffs, without affecting sensory properties. Since it combines both high levels of elemental calcium and effective calcium uptake, only a small amount is needed to reach recommended daily intakes: as little as 770 mg of Omyaforte™ 100-OG is required to reach 30 % of the daily recommended dose of 1000 mg calcium, compared to 1428 mg of calcium citrate tetrahydrate. The result is fortified foods with pleasant taste profiles that require very little intervention while promising high bioavailability.

Table 1: Comparison of 30 % RDA amount of different calcium sources

Calcium source	Amount required to satisfy 30% RDA	Elemental calcium	Bioavailable calcium
	milligram		
Calcium citrate	1428	300	10.2
Omyaforte™ 100-OG	**770**	**300**	**17.1**
Calcium carbonate	750	300	9.0
Tricalcium phosphate	770	300	5.6

This research clearly demonstrates that Omyaforte™ not only contains a high percentage of 39 % elemental calcium, but is also extremely bioavailable, making it an excellent and proven source of calcium.

From seniors to sportspeople

Consumers view health and wellness as a holistic, proactive and ongoing pursuit. Their needs can be readily addressed through fortified foods, drinks and nutritional supplements, whether these are for medical purposes or preventative measures. According to Mintel research, the leading markets for bone health products are India, China, Great Britain, Germany and the USA. More than 70 % of new products with bone health claims are launched in Asia-Pacific and Europe.[2]

Thus, Omyaforte™ 100-OG opens up new opportunities for manufacturers who are looking for nutritious, effective and easy to process ingredients that address concerns about bone health.

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Collagen solutions for sports nutrition: getting back in the game faster and stronger

Frank Engel

Driven by society's growing health-consciousness and awareness of the importance of leading an active lifestyle, sports nutrition is one of the hottest trends for 2020 and beyond. In fact, the European sports nutrition market is projected to grow at a CAGR of 8% between 2020 and 2025.[1] Consumers – from professional athletes to sports enthusiasts – are increasingly looking for proven sports nutrition solutions that help them accelerate the recovery time after intense exercise. When formulated with the right nutrients, these solutions can help support muscle repair – speeding up recovery and reducing muscle soreness; ultimately, allowing consumers to achieve their health and fitness goals.[2]

The growth of the sports recovery market over the past few years and the expected continuation of this trend are a promising incentive for manufacturers to expand their portfolio and capitalize on this thriving category.[3] The challenge is to identify the best-suited ingredient solutions that enable them to develop innovative, effective sports recovery products that appeal to consumers.

Why is sports recovery important?

The role of sports recovery in achieving fitness goals and living a healthy, active lifestyle is increasingly recognized by not only professional athletes and bodybuilders, but also by the mainstream, sports enthusiastic consumer. Demanding training regimes can challenge the human musculoskeletal system. The smallest muscle unit, the muscle cell, incorporates specialized proteins that generate movement. These cells form thin muscle fibres, which are wrapped into bigger muscle bundles by a sheath of extracellular matrix (ECM). During intense exercise, both the muscle cells and the ECM suffer microscopic damage that can result in swelling, pain and reduced strength — negatively affecting athletic performance and extending the recovery time. The level of muscle damage determines the time of recovery between training sessions, as well as the intensity of the following training load. In other words, to get back in the game faster,

it is essential to reduce muscle soreness and support muscle repair after demanding training sessions.

Who are today's sports nutrition consumers?

Once a niche market for professional athletes and bodybuilders, nowadays, the sports nutrition industry has created strong appeal for more diverse consumer groups, who have different expectations for sports nutrition products. Recreational athletes are, for example, drawn to trusted brand names that offer wholesome solutions with short, recognizable ingredient lists. While healthy agers are looking for natural products that help them maintain joint and bone health to remain active throughout the later life stages, lifestyle users (often young professionals) are willing to invest in convenient, science-backed products with clean labels that support their high-performance lifestyle and allow them to meet their fitness goals. A newly emerging consumer category, mobile consumers are likely to continuously track their fitness and health performance with wearable smart devices and apps and are looking for personalized nutrition solutions that support their fitness and wellbeing journey.

Addressing these various consumer needs is crucial for manufacturers to create appealing products that stand out in a crowded marketplace. A vital first step to achieving this, is to select the most effective ingredients that are proven and safe. Backed by science, collagen solutions can help sports nutrition manufacturers meet evolving market demands.

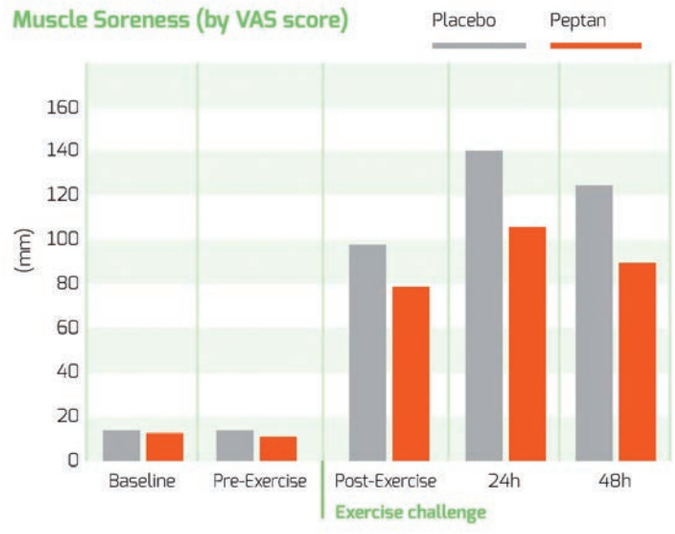
Collagens for sports nutrition

1. Peptan® type I collagen peptides

A study carried out by Newcastle University and Rousselot, and published in the peer-reviewed journal Amino Acids found that the intake of Peptan collagen peptides – a hydrolyzed form of collagen – contributes to a faster post-exercise recovery and performance improvement.[4]

Having already established Peptan's ability to improve joint and bone health to support mobility, as well as its pain-alleviating and anti-inflammatory capabilities[5,6,7,8,9,10] – Rousselot focused on the impact of Peptan supplementation on sports recovery in this research. Two specific indicators of exercise-induced muscle damage were investigated – muscle soreness and function. The study was designed as a double-blind, randomized, placebo-controlled trial, in which 24 active young men were given a daily dosage of either 20 g of Peptan or a placebo for nine days, including a run-in period of seven days to allow the supplement to take effect. This was followed by the intense physical exercise of 150 drop jumps aimed at inducing muscle damage.

The results showed that Peptan collagen peptides lower muscle soreness and improve performance in the period after exercise. This indicates that Peptan helps to accelerate the recovery process after muscle-damaging activity. In addition to this data and considering that collagen is a key component of the ECM sheath that enwraps the muscle fibres, it is expected that Peptan supplementation either prevents damage to the sheath or repairs it faster. This will allow athletes and sports enthusiasts to increase their training load and minimize disruptions to their fitness program.



Peptan collagen peptides are 100% traceable and neither contain nor process substances prohibited by the World Anti-Doping Agency (WADA), upholding the highest safety standards. This solution is:

- Clean label
- Highly soluble and neutral in taste
- Highly versatile; suitable for a broad range of applications, including dairy, powder drinks, tablets, capsules and nutrition bars
- In line with the requirements for the Keto diet

What about the bioavailability of Peptan?

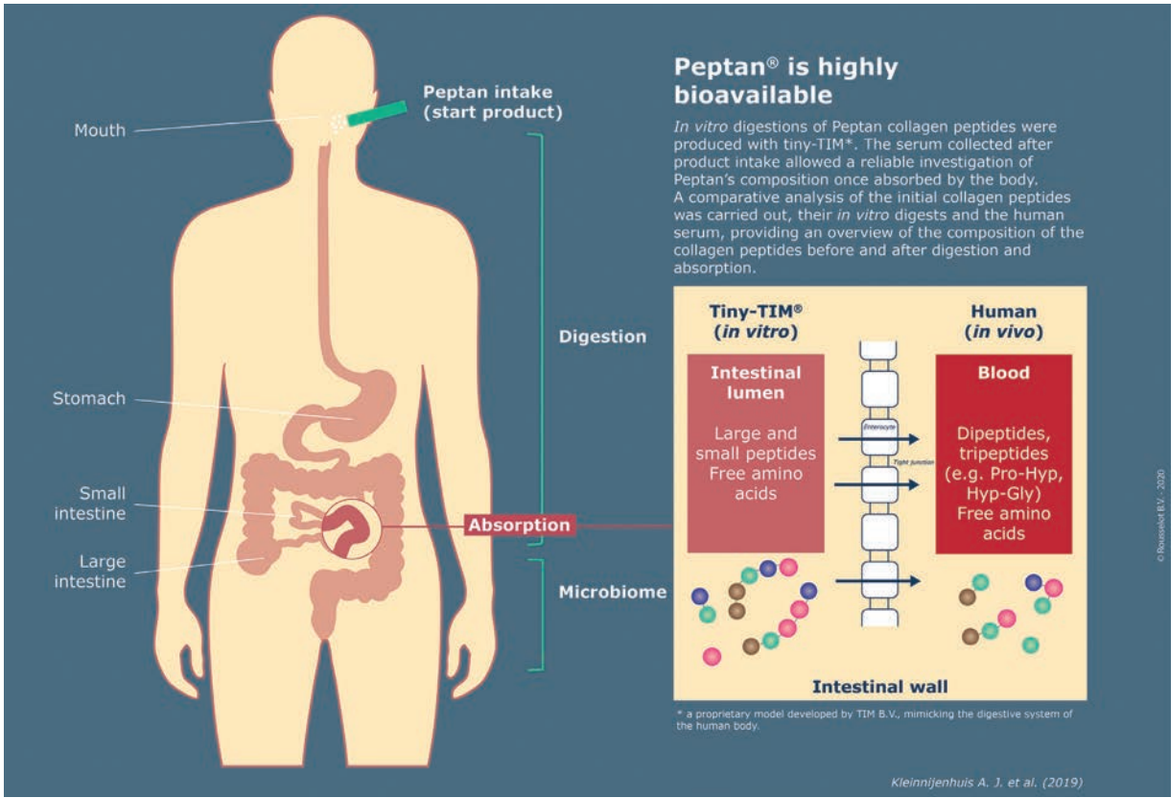
The level of bioavailability of collagen peptides is a crucial contributing factor – amongst others – to their efficacy. To be effective and provide benefits to consumers, ingredients must be bioavailable to an extent that allows them to be efficiently digested, absorbed and delivered to the site of action, which refers to the targeted tissue (e.g. muscles or joints). The high bioavailability of pure collagen peptides is a prerequisite to deliver a reasonable fraction of small bioactive peptides to the targeted tissue and to guarantee the biological efficacy of the ingredient.

Committed to investing in fundamental research that analyses the mechanism of action behind the health benefits of collagen peptides, Rousselot recently conducted a study that analysed Peptan's bioavailability. Published in collaboration with the French National Institute for Agricultural, Environment and Food Research (INRAe) and contract research organization Triskelion, the study investigated the changes that collagen peptides undergo when digested and absorbed by the body, with results confirming Peptan's high bioavailability.[11]

Alongside Peptan collagen peptides, Rousselot's portfolio for sports nutrition also includes Peptan® IIm for joint health and ProTake™ for protein enrichment:

2. Peptan® IIm hydrolyzed collagen type II matrix

A natural, bioactive, non-drug ingredient extracted from cartilage, Peptan® IIm contains a matrix of hydrolysed glycosaminoglycans (GAGs) and collagen type II fibres, the two key building blocks of healthy cartilage. The ingredient promotes three key benefits: protecting cartilage from degradation, promoting lubrication in joints by stimulating the production of a lubricating matrix (proteoglycan) within chondrocytes cells, and reducing inflammation in the encasing membrane (synovium).[12] Effective at a low daily dosage (0.75-3 g/day), Peptan IIm can easily be added to a broad range of applications, such as capsules, tablets and shots, that allow athletes and sports enthusiasts to support their joint health throughout all life stages.



3. ProTake™ hydrolysed collagen

Meanwhile, ProTake is a hydrolysed collagen solution for the protein enrichment of functional products like sports nutrition bars and shakes. A dust-free powder with binding, emulsifying, stabilizing and fining properties, it allows manufacturers to increase the protein content of recipes without compromising taste and texture. This enables producers to develop high-quality, great tasting protein products with enhanced health appeal that support both athletic performance and a healthy, active lifestyle.

Reaching further together

With the popularity of sports nutrition products – those that support the recovery process, in particular – soaring worldwide, producers are presented with an exciting opportunity to capitalize on rising demand. Collagen solutions can help manufacturers deliver on all consumer needs without compromise, allowing them to reach more people with proven sports nutrition products that are trusted and safe.

Finding the right partner who can supply high-quality ingredients and provide technical and application support, is vital to develop targeted, on-trend sports nutrition concepts and bring them to market more quickly. Part of Darling Ingredients, Rousselot Health & Nutrition offers a broad portfolio of premium ingredient solutions and can support sports nutrition brands throughout the product development process, including R&D, formulation, regulatory approvals and branding via Rousselot's co-innovation opportunities.

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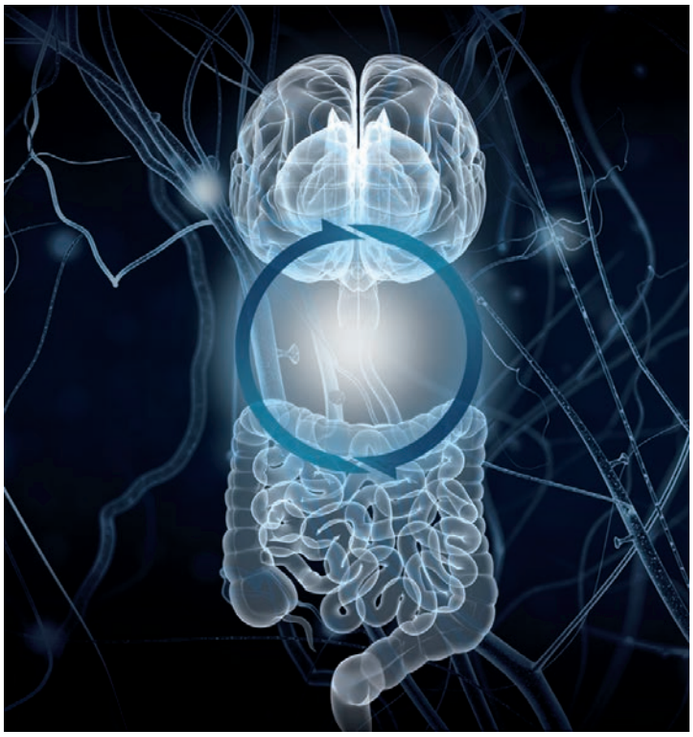

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CEREBIOME®: Pioneering psychobiotic. Game-changing science

Lucie Lingrand and Marilou Luneau

Humans as superorganisms

Humans are superorganisms living in symbiosis with trillions of microbes distributed throughout the body. More than 90 % of human cells are from microorganisms. But due to today's modern lifestyle – excessive hygiene and changing diets led to a loss of diversity. Recent research suggests that a high-fat diet, for example, may have a negative influence on both the gut microbiome and the brain. A diet rich in saturated fatty acids can have detrimental effects, not only on the gut microbiome – characterized by lower diversity in gut microbial species – but also on brain function, inducing depression-like behavior [MyNewGut project]. In the field of psychology, researchers and practitioners have increasingly come to recognize patients as superorganisms, and to consider the microbiome as a way to identify disease (biomarkers), as well as a way to stratify and even treat those in their care. Unlocking the secrets of the microbiome could therefore give access to a treasure trove of personalized nutrition and treatment resources.

Enhancing patient response to medical drugs based on individual microbiotal identity?

Researchers have observed significant differences in gut microbiome between healthy people and sick patients; this is just the first step toward assessing what constitutes a healthy microflora. Based on available research, diversity seems to be essential, as much as relative abundance of *Firmicutes and Bifidobacteria*. Germ-free animal models demonstrate that neither the brain nor behavior can develop fully or normally without a gut microbiome. Although this area of research is still in its infancy, these observations offer new hope to many nutritionists and neuropsychiatrists who may now be able

to stratify patients based on microflora. This will potentially enhance patient response to medical drugs based on individual microbiotal identity.

Gut-brain crosstalk

The gut is sometimes referred to as the "second brain", due to its hosting the enteric nervous system (ENS), a neural network that allows the gut to work without instructions from the brain. The ENS maintains control of the digestive system; it plays an important role in peristalsis, secretion and pain perception. The gut is not only home to the ENS, but it also provides food and shelter for commensal microorganisms: the gut microbiome. The evolution of laboratory techniques and omics over the past decade has allowed scientists to gain a better understanding of these microorganisms. There is now evidence that the gut and its microbiome work together to affect immunity, endocrine functions, gut functions and neurotransmission. The key role played by the digestive microbiota in the main physiological functions is of rising interest and regularly makes it into the mainstream media.

As early as in the 1880s, scientists and clinicians began to examine the relationship between the brain and the gut, along with the gut's resident bacteria. This relationship is nowadays call the brain-gut axis (BGA) or Microbiota-Gut-Brain (MGB) axis. Over time, advances in research have revealed additional evidence about the crosstalk between the brain and the gut. This bidirectional communication takes place between these structures, which intensifies in times of stress (i.e. an important event, an exam, a first day in a new job, a big meeting, etc.).

Probiotics to improve psychological wellbeing

The idea of using probiotics to improve psychological wellbeing through the brain-gut axis also appeared around 1880, but it was not until 2006 that this idea was tested in preclinical studies. The benefits of probiotics for the brain-gut axis are described in several studies and meta-analyses. A recently published meta-analysis looked at 27 probiotic or symbiotic interventions and showed a significant improvement in depression and anxiety [Liu 2019]. It is important to note that the benefits are not homogeneous for all the probiotics tested, but are strain-dependent, which is the case for most of the beneficial effects of probiotics.

CEREBIOME®: The first and only probiotic recognized by Canadian and Brazilian health authorities for its benefits on stress, anxiety and mood balance

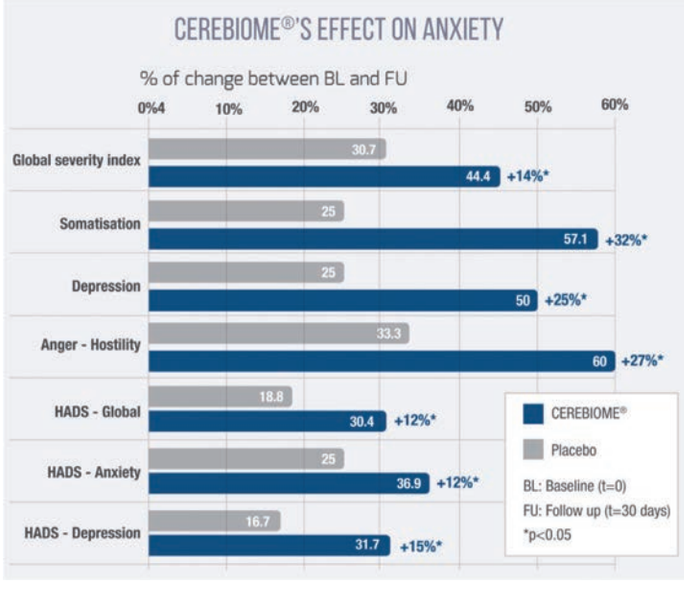
CEREBIOME® (previously known as Probio'Stick®) is an innovative psychobiotic formulation combining *Lactobacillus helveticus* Rosell®-52 and *Bifidobacterium longum* Rosell®-175 developed by the Rosell® Institute for Microbiome and Probiotics by Lallemand. "CEREBIOME® is a unique and strongly documented psychobiotic formulation. It is the most documented psychobiotic with five clinical studies and several pre-clinical studies allowing to highlight eight mechanisms of action on the brain-gut axis. CEREBIOME® helps alleviate the physical and psychological symptoms of stress and feelings of anxiety. Such consistency of results is rare in this innovative field." notes Lucie Lingrand, Product Manager at Lallemand Health Solutions".

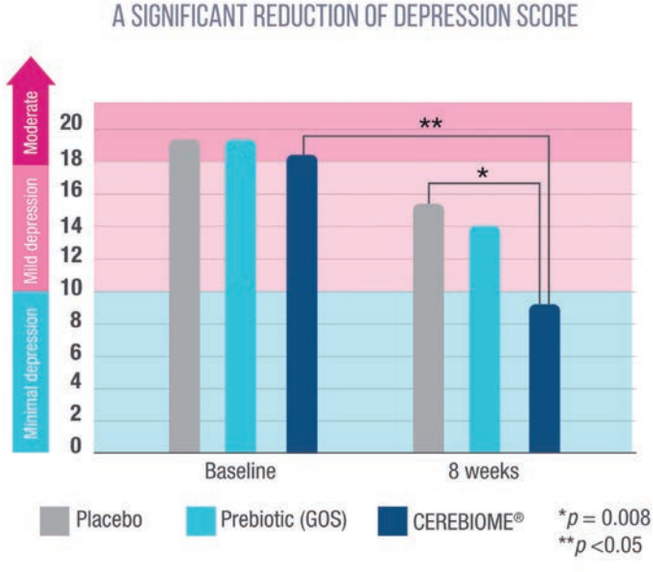
Investigating healthy adults

The first-ever human clinical study involving healthy stressed adults and probiotic intake was published in 2008 by Diop et al. This double-blind, placebo-controlled, randomized, clinical trial involved

healthy adults who were frequently exposed to stress, and whose symptoms were evaluated using a self-assessment visual analog scale (VAS). Over a three-week period, the subjects received a daily dose of either CEREBIOME® or a placebo. Results after three weeks confirmed that the group receiving the probiotic showed a 49% reduction in stress-induced gastrointestinal symptoms. These symptoms included abdominal pain and nausea, with some subjects also reporting a decrease in bloating and flatulence.

Two years later, Messaoudi et al. conducted a clinical study on chronically stressed healthy adults to look at improvement in psychological stress. In this double-blind, controlled, randomized, clinical trial, Messaoudi sought to determine whether oral intake of probiotics had a beneficial effect on psychological stress. Healthy participants were evaluated using a range of validated psychological assessment scales for anxiety, depression and stress, but they were also subjected to a stress biomarker sampling using a 24-hour urinary free cortisol test (UFC). Participants in the probiotic group received a 30-day supply of the probiotic preparation and the control group received a placebo. After one month, the data indicated that a daily dose of CEREBIOME® significantly alleviated psychological distress and had a beneficial effect on general feelings of anxiety and depression; more specifically on somatization and depression. This provided clinical proof that the BGA is characterized by bidirectional communication.





"These findings led to official recognition from Canadian and Brazilian health authorities. CEREBIOME® is the first and only psychobiotic with specific approved health claims on mood and stress [Claim NPN 80021343]. This recognition from competent authorities adds tremendous value and indicates that the scientific evidences supporting this psychobiotic are robust, reliable and verifiable." adds Lucie Lingrand.

Pioneering clinical studies on depressed participants

In 2017, a randomized, double-blind, placebo-controlled, study [Romijn, 2017], involved patients suffering from depression, not treated with antidepressants. Results indicated that the probiotic product CEREBIOME® significantly decreased dry mouth and sleep disruption ($p<0.05$). In 2018, another randomized, double-blind and placebo-controlled, study [Kazemi, 2018], using CEREBIOME® included 110 patients suffering from mild to moderate depression, receiving an antidepressant treatment for at least three months. The probiotic was used as an adjunct therapy to conventional antidepressant treatment and showed a significant decrease in Beck Inventory Depression (BDI) scores, from 18 down to 9 on average. These results are clinically significant, showing the patients were now categorized with "minimal depression" according to the validated assessment scale. Specifically, the CEREBIOME® group showed a decrease in the blood kynurenine/tryptophan ratio, which suggests that tryptophan was diverted toward the synthesis of serotonin and away from the inflammatory pathway ($p<0.05$).

Promising ongoing clinical trial

Finally, a 2018 open-label study by Wallace and Milev found that in treatment-naïve patients, CEREBIOME® had a positive effect on mood, anxiety, anhedonia and perceived stress, lasting up to eight weeks after treatment. This pilot study has been used as a proof of concept for a larger, gold-standard, ongoing clinical trial.

Lallemand Health Solutions: Pioneer and expert in research on the brain-gut axis

As pioneer and expert in research on the brain-gut axis, Lallemand Health Solutions launches a new informative hub. To find out more about this innovative ingredient, visit cerebiomebylallemand.com and download the free white paper: **Exploring the power of psychobiotics: New frontiers in research.** This document looks into the nature of the Brain-Gut axis and provides an update on the most recent research and insights emerging from these advances. It reviews the relationship between the Brain-Gut axis and stress, as well as the role of probiotics; their general benefits for the maintenance of health, for treating conditions, particularly stress-related conditions, and for tackling other specific conditions and disorders, paving the way to innovative science.

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cognitaven® – green oat herb extract for your cognitive performance

Dr. Stefanie Lang

Today's fast-paced everyday life increasingly demands our perception and forces us to react quickly to a wide variety of demands. Therefore, it is quite important to be able to concentrate and focus on simultaneous (multitasking) requirements in order to efficiently master these tasks with a certain serenity. In this context, a study by the University of Utah was able to impressively show that in drivers holding a cell phone or even using the hands-free kit while driving, the concentration drops significantly and is comparable with the restricted attention of a drunken driver with 0.8 per mill blood alcohol (1). Similar effects were observed when other people are in the car and in conversation with the driver (2). In addition, our work life is more and more demanding and thereby the cognitive performance of young professionals already needs to defy several challenges. However, not only working people are affected: likewise, pupils and students in exam situations or parents doing the balancing act between parenting and their job are under enormous pressure and stress.

Adaptogens for mental well-being

So-called adaptogens are bioactive phytochemicals that counteract the effects of stress on the body. In case of restlessness, sleep problems and depressive moods mainly lemon balm, valerian or St. John's wort are well-known and available in various formulation. Also gingko and ginseng do have adaptogenic effects. Both act – unlike the previous mentioned “botanicals” – less for mood enhancement and calming, but rather target the maintenance of mental performance. Furthermore, both plants have a long tradition in Asia. *Avena sativa* or better known as oat is another example of an established adaptogen that has been around since ancient times in our latitudes. For the above-mentioned effect, the immature green aerial

parts of the plant are used, which are clearly different from the use of the fruits, namely the ripe seeds (3). Green oat is also listed as a traditional medicinal product, which according to HMPC monograph, can be used for the treatment of mild mental stress symptoms and as a sleep aid (4).

As active ingredients in *Avena sativa* there are several potential compounds: for example terpenes like the saponin avenacin or numerous phenolic acids like avenanthramides (5). It could be shown that the chemical compounds occurring in oat do have a measurable effect on the nervous system. But the exact mechanism for this modulation in the neural network could not be fully elucidated yet. However, the influence of *Avena sativa* on certain neurotransmitters and their activity profile are known.

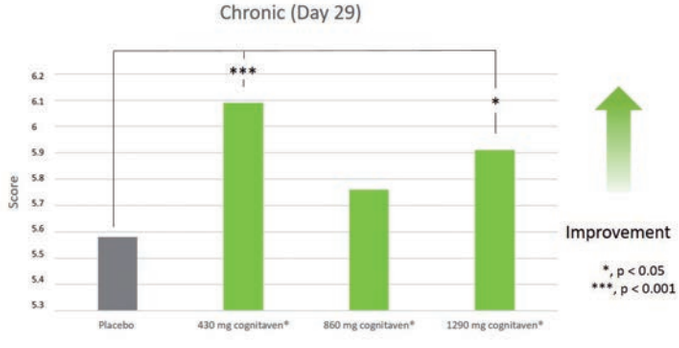
In this context, especially the enzymes phosphodiesterase 4 (PDE4) and monoamine oxidase B (MAO-B) were examined: both enzymes are active in the central nervous system (CNS) and play a regulatory role in memory formation or also in processes that control emotions (6, 7). To prove the effect of green oat on human beings, a large number of clinical trials has been conducted. As a result, EEG-measurements showed that *Avena* may modulate brain activity in the frontal cortex and positively influence the CNS (8). This specific brain region plays a pivotal role in action planning and control, formation of long-term memory as well as problem solution.

Studies on the influence of green oats

In accordance with this, a study from 2015 was able to prove that already a single intake of green oat extract has a significant impact on different aspects of cognitive performance (9). In contrast, statements on effectiveness with long-term intake are so far difficult to meet, as the study situation is quite limited at this point. Only two human studies were conducted with chronic green oat intake and both showed an improved peripheral as well as cerebral vasodilation after 24 weeks of ingestion (10, 11). With regard to a direct influence of *Avena sativa* on the cognitive performance a just recently published large-scale study with a total of 126 healthy subjects aged between 35 and 65 could provide essential information and covered the acute as well as chronic administration (12). The study was designed as a double-blind, randomised, and placebo-controlled parallel group trial (gold standard in clinical surveys) and conducted at a specialised centre in UK. A total of three different doses of the 70 % native *Avena sativa* extract (cognitaven®) were tested: 430, 860 and 1290 mg (corresponding to 300, 600 and 900 mg of the native extract). Verum as well as placebo (maltodextrin) were taken daily in the morning as green hard gelatine capsules for the duration of 29 days. cognitaven® is exclusively manufactured in Germany by Anklam Extrakt GmbH with a specially developed marker which guarantees consistent quality.

Task and results

In the course of the study, both the effectiveness of a single dose (acute) on study day 1 as well as the chronic intake on study day 29 were checked. Therefore, a variety of tests has been carried out to assess mood, cognitive performance, multitasking ability and the behaviour and responses to created stress situations – both psychologically and physiologically. The supplementation with *Avena* positively affected cognitive performance, conducting several tasks simultaneously and also a stress marker was significantly improved. In regard to perception, the consumption of the extract mainly promoted the so-called working memory. This was determined with a test called “Corsi Blocks”. Here, a computer displays nine identical blue squares on black background to the subject. With a defined speed, a randomly generated sequence starts in which, for a brief moment, the blue squares appear in red. The subjects must repeat this and subsequent sequences with increasing level of difficulty by clicking until it can no longer be correctly reproduced by the test person. Already after a single intake (study day 1), subjects who consumed 1290 mg of cognitaven® showed only four hours after administration a significant improvement in coping with the test compared to placebo group. After four weeks of intake, the overall result was even further improved since now the group with the lowest dose (430 mg) also showed significant differences (see figure 1). The examination of multitasking ability included two tasks that were evaluated with



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three different criteria. For this purpose, the test subjects were led in a room and had to face an interview situation in front of a jury. Latter ones then requested the study participant to count backwards loudly in steps of 3, 7, or 17 from a given initial number between 800 and 999. Both the correctness of the results and the speed of the calculations were considered. In parallel to this first task, the subjects should track a fast moving object on a screen with the computer mouse. Here, the precision was measured based on the resulting distance from the cursor to the moving object. Based on these three aspects, it could be demonstrated that cognitaven® significantly enhanced multitasking ability. Already at the acute ingestion on day 1 as well as after chronic supplementation, subjects that consumed the highest or the lowest dosage for 29 days displayed a significant improvement, especially in the second task (object tracking). But also subjects that received 860 mg cognitaven® showed a positive trend on the subtraction correctness and the object tracking in comparison to the placebo group after the acute intake. It is easy to understand that this experimental setup will not just challenge the multitasking demands but can also cause stress in the test subjects. The study also examined this parameter. Even though the extract did not influence classic stress markers such as cortisol or alpha-amylase in saliva, skin conductivity, also known as galvanic skin response, changed favourably. The principle of the test is based on psychophysiological changes, where through emotions or stress alterations in skin conductivity are evoked. These changes occur due to sweat secretion triggered by the sympathetic nervous system. A similar system is also used for a lie detector test. The significant decrease in conductivity at 1290 mg cognitaven® supplementation therefore indicates the test subjects' unconscious relaxation. This is the very first time that it was possible to measure and demonstrate a scientifically based response to stress related to green oat intake.

Conclusion

Finally, it can be summarised that cognitaven® contributes to substantial improvements in the area of multitasking and evokes positive effects in the working memory sector. Furthermore, the results of the study indicate an influence of cognitaven® in the relaxation area. Thus, cognitaven® can be used as a natural solution ingredient for finished products that aim to increase cognitive performance, mental fitness, and for better coping with stress.

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Coenzyme Q10: Anti-ageing by supporting and protecting the powerhouses of the cell

Philipp Gebhardt

The risk of various diseases increases with age. As “powerhouses of the cell”, mitochondria are of particular importance for the prevention and therapy of age-related diseases. Adenosine triphosphate (ATP) is the universal energy currency of the cell. Via oxidative phosphorylation, the energy production with oxygen consumption, more than 90 % of the energy of the organism is generated in the form of ATP in the mitochondria. Reactive oxygen compounds, so-called “free radicals”, are formed as a by-product of aerobic energy generation. Free radicals can react with and damage mitochondrial and cellular membrane and protein structures. Radical-induced damage is associated with various ageing processes. Coenzyme Q10 is a fat-soluble antioxidant that accumulates in membrane structures. In the mitochondria it serves as an electron and proton carrier between the respiratory chain proteins. As it supports mitochondrial function and is able to neutralize free radicals directly at their place of origin, coenzyme Q10 is a promising anti-ageing supplement.

Ageing is a biological process that accompanies us throughout life. Medical advances and improvements in hygienic conditions have almost doubled life expectancy of people in the western world in the past 100 years. At the same time, the frequency and severity of age-related diseases such as cancer, heart and vascular diseases, type 2 diabetes mellitus and dementia have increased.

Mitochondria are cell organelles that contain the electron transport chain. These are enzyme complexes that gradually transfer high-energy electrons to lower energy levels and finally transfer them to oxygen and protons in order to form water (so-called “controlled oxyhydrogen reaction”). Since more than 90 % of the organism’s energy is generated via the electron transport chain, mitochondria are called the “powerhouses of the cell”. Mitochondria also provide an environment that is particularly suitable for various biochemical reactions. For this reason, they are also responsible for the formation of porphyrins, which are required as key-compounds of haemoglobin, for the synthesis of steroids, for the maintenance of cellular redox homeostasis and for the initiation of programmed cell death. Mitochondria form a central hub of metabolism and offer an interesting starting point for influencing ageing processes and for the prevention and therapy of diseases that occur with increasing age.

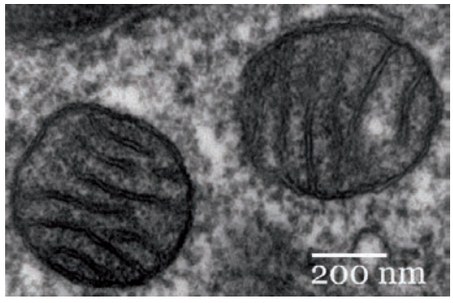

Fig. 1: Mitochondria under an electron microscope. The inner membrane structures are clearly visible.

Mitochondria are characterized by an outer and an inner membrane (Fig. 1). The outer membrane serves to delimit the environment and to control the exchange of substances with the cytosol, the inside of the cell. The inner mitochondrial membrane carries the electron transport chain. These are protein complexes that are arranged on the inner membrane or integrated into it. The electron transport chain complexes enable oxidative phosphorylation, energy generation while consuming oxygen. Aerobic energy production can produce up to 36 moles of adenosine triphosphate (ATP) from one mole of glucose, which is the universal energy currency of the cell. Compared to anaerobic glycolysis, in which only two moles of ATP can be obtained from the comparable amount of glucose, oxidative phosphorylation is characterized by its high efficiency. At the same time, the handling of oxygen poses special dangers. The transfer of electrons to oxygen creates particularly reactive compounds, so-called "free radicals". Free radicals can react with the phospholipid structures that make up cellular and mitochondrial membranes. They are also responsible for damage that occurs to proteins such as enzymes or to the respiratory chain complexes themselves. Above all, the mitochondrial genome has a rather simple structure and is therefore particularly sensitive to oxidative damage. Over time, radical-induced damage to the power houses of the cell accumulates. Together with mutations of the mitochondrial genome, there is an increased generation of radicals and reduced energy production. The decreasing availability of ATP and the increasing formation of free radicals ultimately lead to a progressive loss of cellular functions. [1]

The role of coenzyme Q10 in cellular metabolism

The electron transport chain catalyses a chain of biochemical redox reactions in which electrons and protons are gradually transferred to oxygen. Coenzyme Q10, a quinone derivative that has a side chain consisting of ten isoprene units, acts as a mediator of the electron and proton flow between the respiratory chain complexes. Coenzyme Q10 is not very polar and therefore lipophilic ("fat-friendly"). It accumulates in mitochondrial and cellular membrane structures. At the same time, coenzyme Q10 is a powerful antioxidant that can neutralize free radicals. In the area of the electron transport chain, it is able to neutralize superoxide radicals directly at their place of origin (Fig. 2).

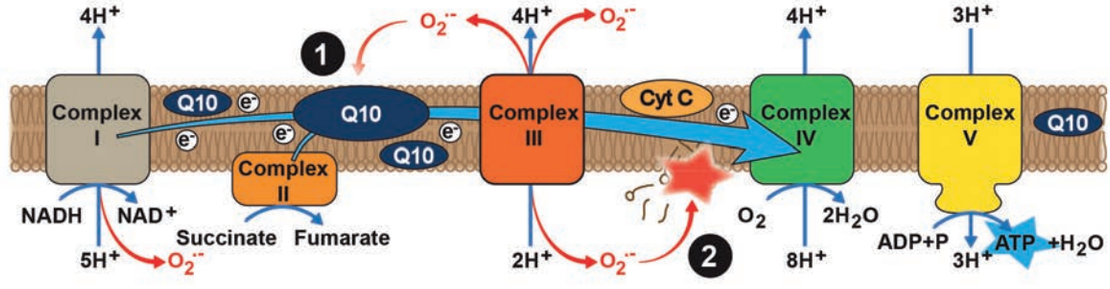

Fig. 2: Electron transport chain and radical formation: Oxidative phosphorylation occurs in the mitochondria. By this process, electrons (e-) from complex I and II of the electron transport chain are transferred to coenzyme Q10, which then transfers them to complex III and via cytochrome C to complex IV. The electrons are brought to a lower energy level and the released energy is used to pump protons (H+) through the membrane to build up an electrochemical gradient. At complex IV, the electrons are transferred to oxygen and protons to form water. The excess of protons on the inside of the membrane is broken down at complex V. The enzyme ATP-synthase located here uses the energy of the proton flow to regenerate ATP from ADP and phosphorus. Especially at complexes I and III, electrons are also transferred to oxygen, which creates superoxide radicals (O2-). The superoxide formation is estimated to be in the range of 2 % of the oxygen conversion of the oxidative phosphorylation. Oxygen radicals can be neutralized by antioxidants such as coenzyme Q10 (1). Inadequate antioxidant capacity causes radical-induced damage to protein and membrane structures (2).

The highest concentrations of coenzyme Q10 are found in organs with high metabolic activity or high energy turnover, such as the liver, kidneys and heart. Coenzyme Q10 is not a vitamin by definition, because it can be made by the body itself. The body's own coenzyme Q10 synthesis decreases with increasing age (Fig. 3). [2] With the falling tissue concentrations the anti-oxidative capacity of the organism decreases. This causes an increase in radical-induced damage, which can be detected by appropriate markers. [3]

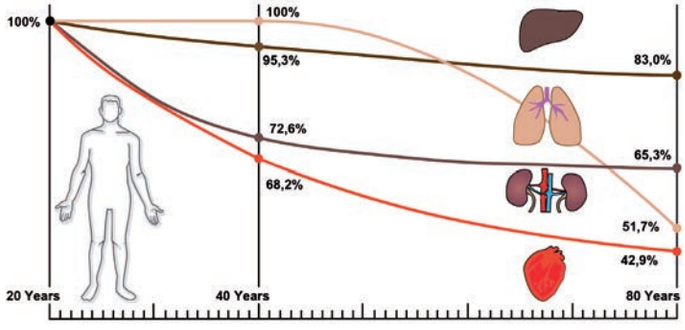

Fig. 3: Since coenzyme Q10 can be produced by the body itself, it is therefore not a vitamin by definition. With increasing age, the formation of the coenzyme decreases. A decrease in the Q10 concentrations manifests itself in varying degrees in different tissues. The most obvious is the decrease in the heart muscle tissue. At the age of 40 about 70 % of the concentrations could still be measured, which could be measured at the age of 20. By contrast, values of only around 43 % were measured at the age of 80. [2]

Coenzyme Q10 as an anti-ageing supplement

An additional supply of coenzyme Q10 leads to an accumulation of the active substance in the tissues. It could be demonstrated that after oral supplementation in heart failure patients, an accumulation in the heart tissue occurs [4], as well as in mitochondria extracted from tissue samples [5]. Coenzyme Q10 supplementation can alleviate the damage caused by the ageing process and significantly improve mitochondrial function, which weakens with increasing age. With regard to its anti-ageing effect, the active ingredient has been studied very well in the context of skin ageing. As an enveloping organ, the skin is exposed to a wide range of environmental influences, of which the ultraviolet portion of solar radiation has a significant influence on ageing. Because of its longer-wave character, UVA radiation can penetrate deeper into the skin and induce the formation of free radicals. In addition to cells of the epidermis, it can also damage fibroblasts of the dermis. The short-wave UVB radiation, on the other hand, is almost completely absorbed in the epidermis. The energy released can primarily damage DNA and proteins of epidermal keratinocytes.

In addition, photostress also influences the function of the mitochondria of the skin cells. A decrease in ATP formation and a decrease in mitochondrial membrane potential can be clearly measured after irradiation of human skin fibroblasts with UV light. This has a markedly negative impact on cell metabolism, since repair capacity, like most other biochemical processes, depends on sufficient ATP formation. It could be demonstrated that incubation of skin cells with coenzyme Q10 promotes regeneration after UV radiation. Coenzyme Q10 accelerates the restoration of cellular ATP levels and mitochondrial membrane potential. Coenzyme Q10 also helps to limit light-induced chromosome damage by stimulating enzymes that repair damaged DNA. [6] As in all tissues, the energy formation of the skin cells decreases continuously with increasing age. The reduction in mitochondrial respiration and the synthesis of energy in the form of ATP could be clearly demonstrated by measuring the respiratory quotient of skin cells from donors of different ages.

The respiratory parameters improved markedly after the cells were incubated with coenzyme Q10 (Fig. 4). [1] A recent study (2017) also showed that oral supplementation of coenzyme Q10 affects visible signs of ageing in a positive way. In the investigation, 33 study participants received either 50 or 150 mg of a coenzyme Q10 formulation with improved bioavailability. After 12 weeks, participants in both groups showed a reduction in wrinkles and microrelief lines and an improvement in skin smoothness. The participants who received the higher dose of the active ingredient also demonstrated an additional improvement in nasolabial folds, corners of the mouth and upper radial lip lines. [7]

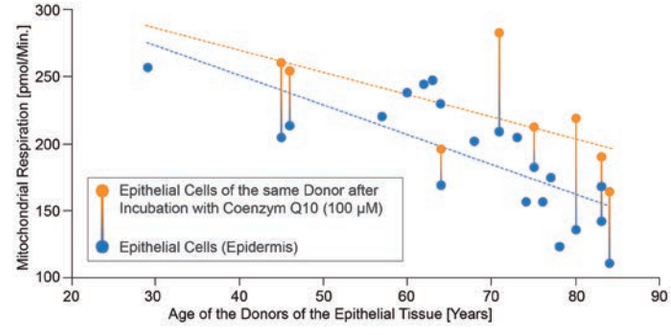

Fig. 4: Effect of coenzyme Q10 on the mitochondrial respiration rate of epithelial tissue with trend lines. Mitochondrial respiration and ATP synthesis decrease with age. Incubation of the tissue with coenzyme Q10 led to a significant increase in respiration, which was attributed to an improvement in electron transport chain function. [1]

Coenzyme Q10 in age-related diseases

Many mitochondria are found in tissues with high energy consumption. In cardiac muscle cells, their volume share reaches more than a third. The capacity of the energy production in the heart muscle depends on sufficiently high coenzyme Q10 concentrations in the mitochondria of the heart muscle cells, so that even small deficits can result in a deterioration of cardiac function.

In heart failure, coenzyme Q10 supplementation can contribute to a significant improvement in symptoms. It could be shown that patients with severe heart failure usually have low coenzyme Q10 plasma levels. With right heart failure and global insufficiency, there

is often abdominal oedema that worsens the absorption of nutrients. If these patients receive high doses of coenzyme Q10 as ubiquinol, significant improvements in ejection performance and the severity of heart failure can usually be observed. [8] Ubiquinol is the bioactive form of the coenzyme, which is characterized by improved bioavailability.

In people with high blood pressure, coenzyme Q10 has a normalizing effect on blood pressure, which also relieves stress on the heart muscle. As a lipophilic ("fat-friendly") substance, it accumulates in the cell membranes and protects them from oxidative damage. It improves the integrity and fluidity of the membranes of the blood cells. This makes them more fluid and mobile and allows them to pass through the narrow capillaries of the vascular system more easily. In people with high blood pressure, an antihypertensive effect in the range of 17 mmHg systolic and 8 mmHg diastolic could be demonstrated. [9]

With increasing age, the risk of developing type 2 diabetes mellitus also increases. According to estimates, about 15 % of 55–74 year olds in Germany are affected by the disease. It is expected that this number will continue to increase until 2030. Type 2 diabetes mellitus is usually associated with a high oxidative burden on the metabolism. The high glucose concentrations lead to saccharification of the body's own protein structures. In diabetes, saccharified hemoglobin ("HbA1c") is used as a marker for the quality of blood sugar control over the past eight to twelve weeks. Like hemoglobin, other structures are saccharified that are broken down by the immune system. Immune cells such as macrophages generate superoxide radicals with the aim of dissolving damaged structures. The radical formation also attacks "healthy" structures and leads to an enormous oxidative burden on the organism. [10] Supplementation with antioxidants such as coenzyme Q10 is therefore particularly suitable for people with diabetes. In addition to an improvement in markers that show oxidative damage, it was also possible to demonstrate improvements in the function of the β-cells and insulin resistance. [11] Positive effects on diabetic polyneuropathy could also be shown following a supplementation of coenzyme Q10 [12].

Coenzyme Q10 should be supplemented when taking medications that interfere with the body's synthesis of the coenzyme. Endogenous biosynthesis depends on the precursor mevalonic acid, from

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which the side chain of the coenzyme is formed. Mevalonic acid is also required for the body's own cholesterol synthesis and rate of synthesis is reduced by taking statins. The cholesterol-lowering medication therefore simultaneously leads to a reduction in the level of coenzyme Q10 in the tissues. A decrease in the coenzyme Q10 blood level by up to 40 % could be measured. [13] Coenzyme Q10 was investigated as a complementary therapy together with statins in clinical settings, in doses between 100 and 600 mg daily. A significant reduction in statin-associated side effects such as muscle pain, muscle weakness and cramps could be shown. [14]

Conclusion

As a fat-soluble antioxidant, coenzyme Q10 accumulates in membrane structures. In the "power houses of the cell", the mitochondria, it serves as an electron and proton carrier between the electron transport chain complexes. Here it can also neutralize free radicals directly at their place of origin. The concentration in the tissues decreases with increasing age. A supplementation of coenzyme Q10 can support the function of the mitochondria and protect the body's own tissues from the harmful effects of free radicals. As a body's own substance, coenzyme Q10 is extremely well tolerated.

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The sea's best-kept beauty secret: GELITA's new fish-derived collagen peptides

Oliver Wolf

Glowing, younger-looking skin is no doubt something many strive for. Yet there can be a confusing array of options in the quest to achieve that longed-for radiance – from lotions and potions to facials and fillers.

That's why scientifically backed beauty-from-within concepts are emerging as a hot new trend, particularly those that contain specific Bioactive Collagen Peptides® proven to have a positive effect on skin elasticity.

Collagen has attracted a lot of attention in the mainstream media in recent months, through advertisements, documentaries and testimonials. And as word of its health benefits continues to spread, it's no wonder that people are growing ever-more curious about it.

The specific collagen peptides VERISOL® are one example of this powerful ingredient, and have been part of GELITA's Bioactive Collagen Peptide® portfolio for many years, enabling manufacturers to create new and innovative ingestible skincare solutions.

Now, however, the company has further developed the concept of these popular peptides with the launch of a new fish-derived version of the VERISOL® peptides, which are traditionally obtained from mammalian sources.

Gaining in popularity

Fish collagens are gaining in popularity because they allow manufacturers to meet the needs of an increasing number of consumers who – for dietary, ethical or religious reasons – want to avoid meat or meat-derived products.

"We investigated how we could bring a fish-derived Bioactive Collagen Peptide® with optimal benefits into the VERISOL® portfolio of skin health products, while ensuring the same end-point benefits

to consumers," explained Dr Stephan Hausmanns, Vice President of the Business Unit Health & Nutrition at GELITA.

So how and why does collagen intake have such an impact on overall skin health?

The answer lies in the fact that collagen is the most abundant protein in the human body, accounting for approximately 30 per cent of overall protein content. It is a vital component of blood vessels, bones, joints, spinal discs, eyes, dentin and facial tissue. It is also a key constituent of all connective tissues, and responsible for helping to maintain the firm structure of the dermis. During the ageing process, however, the body's own collagen production begins to decline, which means the skin begins to lose its elasticity, leading to wrinkles and sagging. That is when supplementation with collagen peptides becomes relevant, as it plays an essential role in wrinkle reduction and the maintenance of specific connective tissues.

While topical beauty products may help reduce the signs of ageing temporarily, traditional collagen peptides such as GELITA's VERISOL® have been scientifically proven to contribute to lasting rejuvenated skin by decelerating wrinkle formation. Neutral in both taste and smell, these peptides are non-allergenic and free from E-numbers, and can be easily processed into a wide variety of products.

Proven benefits for skin health

Yet when it comes to fish-derived collagens, some critics have suggested that they do not deliver the benefits promised. Hausmanns explains: "One possible reason is that there are some important differences between collagens obtained from fish and from species that are very similar to humans, such as mammalian sources. This may explain the suboptimal effects of fish-derived collagen in previous skin studies." Noting these observations, GELITA was eager to develop an effective fish-derived alternative for its VERISOL® peptides with the same proven benefits for skin health. And, as a newly published study confirms, it has succeeded in doing so.

„With the launch of a new fish-derived version, GELITA has further developed the concept of their Bioactive Collagen Peptides® VERISOL®."
(Photos©: GELITA AG; Adobe Stock 237530191)

The study consisted of a randomized controlled trial conducted by Proksch et al, in Kiel, Germany, with only healthy women between the ages of 35 and 80 included. It's also important to note that only GELITA's specific Bioactive Collagen Peptides® under the brand name VERISOL® – which are derived from a specific hydrolysis of marine collagen – were used in this study. Accordingly, the effects described in the study cannot be applied to other fish-derived collagen peptides.

The participants were split into two groups, one of which was given VERISOL®, while the other was assigned a placebo. Both groups were instructed to ingest a daily dose of 5 g for 8 weeks. The study period was subsequently extended by 4 weeks without further product administration to investigate the ongoing effect of the treatment. The overall goal of the study was to compare the alterations in skin elasticity and eye wrinkle formation between both groups.

Eye wrinkle reduction

The results show that over the course of the study, skin elasticity increased significantly with the intake of VERISOL®. These benefits were determined at all measurement time points after the treatment. In contrast, for the placebo group, a significant decrease of skin elasticity could be observed. Regarding eye wrinkle volume, a clear decrease was shown in the collagen peptide group.

All in all, the study results proved that – compared to a placebo – a continuous intake of fish-derived VERISOL® leads to a statistically significant improvement in skin elasticity. Additionally, the eye wrinkle volume of the study participants who were treated with the Bioactive Collagen Peptides® decreased significantly. In conclusion, Proksch, et al were able to prove that a daily intake of 5 g of

fish-derived VERISOL® has a positive impact on skin elasticity and eye wrinkle volume reduction.

Body of scientific evidence

The considerable effects of fish-derived VERISOL® on epidermal and dermal skin structures, which result in an enhanced overall appearance, is the next chapter in the story of placebo-controlled human clinical studies previously conducted with GELITA's standard VERISOL® collagen peptides. One was designed to verify the effectiveness of these collagen peptides on biophysical skin parameters related to cutaneous ageing. In a double-blind, placebo-controlled trial, 69 women aged 35–55 were randomized to receive 2.5 g or 5.0 g of VERISOL® or a placebo once a day for 8 weeks. Each treatment group included 23 subjects.

Skin elasticity in both VERISOL® groups showed a statistically significant improvement compared with the placebo group after just 4 weeks of treatment. In some women, a maximum increase in skin elasticity of up to 30 % was observed after the 8-week treatment period. Interestingly, this effect was even more pronounced in women aged 50 and over. With regard to skin moisture and skin evaporation, the collagen peptide treatment's positive influence was also seen among this age group. The positive effect on skin elasticity was still detectable at the end of the 4-week washout phase, suggesting a long-lasting dermal physiological effect.

Cellulite reduction success

Another study investigated the ability of GELITA's VERISOL® to treat cellulite in normal and overweight women. In the double-blind, placebo-controlled study, 105 women aged between 24 and 50 received a daily dose of 2.5 g of VERISOL® collagen peptides or a placebo (maltodextrin) and were classified as being of normal weight or overweight, depending on their BMI.

In terms of skin waviness, an average and statistically significant reduction of 8 % was observed via 3D skin surface profile measurement after 6 months of treatment. This was even more pronounced in the normal BMI study group, with a decrease in thigh skin waviness of 11.1 %. Moreover, dermal density was significantly improved compared with the placebo. After the treatment period, the skin tissue became measurably more compact, indicating a strengthening of the connective tissue. Finally, the borderline length between the dermis and the subcutis was notably shorter after collagen peptide supplementation. As the length of the borderline correlates with the degree of cellulite, this measurement also highlights cellulite reduction after 6 months.

The cellulite of the subjects was assessed both visually and by using the so-called pinch test. After only 3 months of treatment and compared with the baseline readings, a statistically significant cellulite score reduction was observed. At the end of the 6-month study period, a mean reduction of approximately 9 % (compared with the placebo) was determined in subjects with a normal BMI. This improvement was also recorded in overweight participants with a BMI of >25, although the beneficial effect was less pronounced (4 % reduction).

Safe, effective and trusted

To ensure the health benefits and safety of its products, GELITA has been commissioning clinical trials for years. The results show that GELITA's Bioactive Collagen Peptides® are completely safe and have been proven to have positive effects on specific collagen-containing parts of the body.

Furthermore, in a consumer study, 500 women aged between 25 and 65 were interviewed in Germany, Spain and the USA about their perceptions and acceptance of collagen. More than 80 % of the participants associated it with beauty, specifically in relation to connective tissue and elasticity. And in general, most of the interviewees considered a beauty-from-within concept based on VERISOL® to be trustworthy and more effective than topical applications.

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Turmeric and bilberry: Two plants for a natural support to eye health

Vision impairment, a global issue

Quoting the recent WHO's World report on vision (1) "the most dominant of our senses plays a critical role in every facet and stage of our lives. We take vision for granted, but without vision, we struggle to learn to walk, to read, to participate in school, and to work. Vision impairment occurs when an eye condition affects the visual system and one or more of its vision functions. Vision impairment has serious consequences for the individual across the life course. Many of these consequences can, however, be mitigated by timely access to quality eye care and rehabilitation. Eye conditions are remarkably common. Those who live long enough will experience at least one eye condition during their lifetime. Globally, at least 2.2 billion people have a vision impairment or blindness, of whom at least 1 billion have a vision impairment that could have been prevented or has yet to be addressed. Eye conditions that can cause vision impairment and blindness are, for good reasons, the main focus of prevention and other eye care strategies; nevertheless, the importance of eye conditions that do not typically cause vision impairment – such as dry eye and conjunctivitis – must not be overlooked. A range of effective strategies are available to address the needs associated with eye conditions and vision impairment across the life course. These include health promotion, prevention, treatment and rehabilitation strategies, some of which are among the most feasible and cost-effective of all health care interventions to implement" states the WHO report.

An effective support for eye wellbeing comes from the nature as well. Indena's research has been working for years on that specific area and got important results from two plants: bilberry and turmeric.

Mirtoselect®: the most studied bilberry on the market

Vaccinium myrtillus L. is an edible berry which grows on small wiry shrubs on hillsides

throughout Central and Northern Europe. Among the 450 species belonging to the genus Vaccinium, the traditional medicinal use of *Vaccinium myrtillus* L. has been documented since the Middle Ages, when its fruits were recommended for a variety of conditions, and from the 16th century the plant has been systematically mentioned in all major herbal treatises.

Bilberry is one of the richest sources of anthocyanins, healthy antioxidants found naturally in a number of foods - in red wine, certain varieties of cereals, and certain leafy and root vegetables (aubergines, cabbage, beans, onions, radishes) but most abundant in coloured fruits (2). In this context *Vaccinium myrtillus* L. contains the highest amounts of anthocyanins than any other berries (3).

Unlike most other berries, *Vaccinium myrtillus* L. is extremely difficult to grow; it does not produce clusters of berries, but single or, more rarely, pairs of berries, in limited numbers considering the biomass of the plant. Bilberries are softer and juicier than most other berries, and therefore more susceptible to damage and more difficult to transport. Bilberries cannot be cultivated, and are therefore picked from wild plants growing on publicly accessible lands; nor can they be processed unfrozen, since tissue damage triggers the deglycosidation of anthocyanins, with detrimental effects on their chemical stability.

In the early 1970s, Indena developed a standardized bilberry extract whose efficacy has been extensively clinically evaluated in vascular health, with over 60 positive studies, including at least 30 controlled or double-blind studies published in peer-reviewed titles. From the beginning, the biomass collection and transportation was organized to protect wild crops. Thanks to technologically advanced process, from raw bilberries Indena produces Mirtoselect®, a standardized bilberry extract containing ≥36 % of anthocyanins, and characterized by a very specific and consistent HPLC profile that represents the "fingerprint" of the extract. Mirtoselect® is the authentic bilberry extract (*Vaccinium myrtillus* L.) obtained exclusively from fresh fruit harvested when ripe, between July and September.

Mirtoselect® is today not only the most extensively studied bilberry extract available, but also the market leader and benchmark. The major applications investigated so far for Mirtoselect® are in the realms of vascular health and ophthalmology (eye protection at the retina level).

Mirtoselect® has been shown to help support healthy visual function due to eye fatigue. In a crossover, double-blind, placebo-controlled study on 20 people (4), four weeks of daily supplementation with 250 mg of Mirtoselect®, showed positive effects in subjective perceptions like the occurrence of vision sparks (80 % of subjects), eyesight dimming (73 % of subjects) and ocular fatigue (70 % of subjects) in

Photo©: Indena

computer operators. Flicker values ameliorated significantly following the administration of bilberry anthocyanins, and an overall positive effect on eye fatigue could be suggested.

Prolonged intake of Mirtoselect® has been associated with favourable changes in visual acuity. An 8-weeks trial (5) with a daily dosage of 150 mg of Mirtoselect® was carried out on 63 school children. This suggests that Mirtoselect® could be a powerful tool in the support of ocular health related to increased eye accommodation associated with prolonged reading and computer work, activities that are typical of school education. The anthocyanins in Mirtoselect® have an affinity for small blood vessels and have been shown to support the blood flow in the eye bulb tissues, activating the nutrition supply.

Through the beneficial effect on vascular circulation, Mirtoselect® can optimize oxygen and blood delivery to the eye, maintaining the functionality of tear secretion. Furthermore, the free radical scavenging properties balance oxidative stress, one of the major risk factors of dry eye discomfort. Recently, new positive data have emerged regarding the supportive role of Mirtoselect® in dry eye conditions. The new randomized, double-blinded, placebo-controlled human study (6) offers further proof of the efficacy and safety profile of Mirtoselect®, where preserving adequate tear levels and maintaining the ocular surface healthy may possibly help in attenuating discomfort and visual disturbance. Clinical findings are also linked with an optimal tolerability profile.

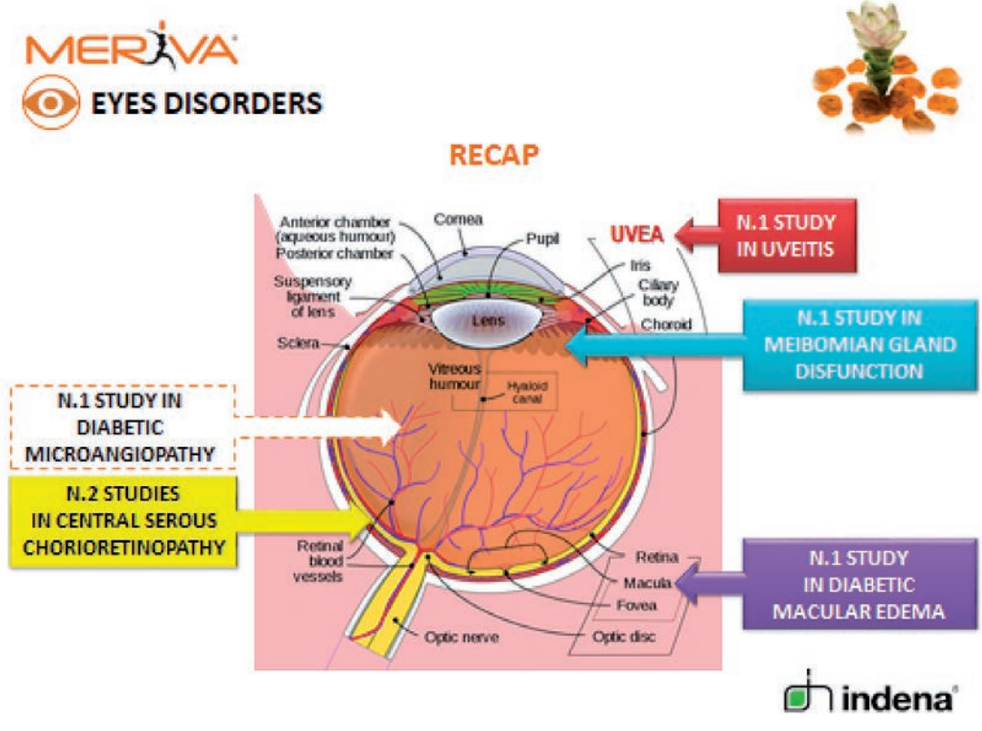
Those evidences are the result of careful biomass collection, storage and consistency of batch to batch industrial production.

Meriva®: the life guardian, also for eye health

The health support of Meriva®, Indena's turmeric formulated with Phytosome® delivery system, is demonstrated by 35 scientific studies in humans, of which at least a third were conducted with the randomized controlled scheme. Its tolerability and effectiveness in maintaining an overall wellbeing thus keeping low-level chronic inflammation far away, grants Meriva® the role of The Life Guardian™ as it can be taken for a long-term life-maintenance strategy.

Among the fields of Meriva®'s application, is the eye health, as showed in the last decade by 6 human studies: one in diabetic microangiopathy, two in central serous chorioretinopathy, one in chronic anterior uveitis, one in meibomian gland disfunction and one in diabetic macular edema.

The evaluation of uveitis relapses during 1 year of supplementation with Meriva® and follow up compared with the previous period of 1 year before the study enrollment showed a prolonged period of eye healthy functionality in the total number of subjects with



relapses and in the total number of relapses overall (7).

Two studies on central serous chorioretinopathy showed that supplementation with Meriva® maintained visual acuity in 61% of eyes, and neuroretinal or retinal pigment epithelium health in 95% of eyes (8).

Meibomian gland dysfunction (MGD) is a chronic, diffuse abnormality of the meibomian glands. It is an inflammation-based condition and represents the main cause of dry eye. The study, focused on subjects affected by MGD, showed, after three months of dietary supplementation with Meriva®, a significant maintenance of an healthy level of TBUT (Tear Breakup Time) and, in 86% of subjects involved, kept their cornea substantially spotless (Oxford Test) (9).

Another study with Meriva® in the eye health area focused on Diabetic Macular Edema (DME), an accumulation of fluid in the macula—part of the retina that controls our most detailed vision abilities—due to leaking blood vessels. (10).

Diabetic microangiopathy and retinopathy is a consequence of long terms diabetes mellitus and its signs are increased vascular permeability, tissue ischemia and neovascularization. Along with DME, they are other areas where Meriva® efficacy has been studied, with results which showed positive effects on visual acuity and eye wellbeing (11).

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Potent affronEYE® saffron extract may lower risk of glaucoma

Saffron extract shows protective antioxidant, anti-inflammatory actions against glaucoma

A new animal study suggests affronEYE® saffron could help prevent the onset of glaucoma. The antioxidant and anti-inflammatory characteristics of this potent saffron extract, developed by Pharmactive Biotech Products, S.L., demonstrated an ability to protect retinal cells from damage and death and reduce intraocular hypertension — a key aspect of glaucoma development. AffronEYE was an award winner at the 2019 Nutraingredients Asia expo.

The study, published in the *International Journal of Molecular Sciences* on August 2019 was led by Jose Fernandez-Albarral, PhD, of the Complutense University of Madrid, demonstrated the neuroprotective and anti-inflammatory effects of Pharmactive's proprietary hydrophilic saffron extract (standardized to 3% crocin content) in a mouse model of unilateral, laser-induced ocular hypertension (OHT).

Subjects were comprised of two groups of glaucoma-induced male Swiss albino mice. One group received a single oral daily dose of affronEYE over a period of seven days; the other group served as a control.

After treatment with AffronEYE, the number of living retinal ganglion cells in the treated group was significantly higher in comparison to the non-treated group. The treated group maintained healthy eye levels by the end of the intervention. Protein biomarkers of inflammation were also reduced.

Glaucoma is a neurodegenerative disease characterized by the loss of retinal ganglion cells (RGCs) which serve to send the visual signals to the brain. These cells do not regenerate and are irreplaceable. Cell death leads to a progressive loss of the visual field

and eventually blindness. According to the World Health Organization (WHO), glaucoma is the second leading cause of blindness in the world and has stricken more 60 million people worldwide.
Intraocular pressure is the principal modifiable risk factor for such loss. The increase in intraocular pressure generates an immune response in the retina that induces the death of retinal ganglion cells and the onset of glaucoma. Age, diabetes, and genetic predisposition are other risk factors.

AffronEYE's activities are attributed to its naturally occurring bioactive compounds, specifically *crocins* and *crocetins*. These carotenoids are reported to possess a full spectrum of anti-inflammatory, antioxidative, and neuroprotective properties through their ability to scavenge free oxygen radicals, thus reducing retinal cell damage and cellular self-destruction.

"Saffron has been appreciated for its culinary and functional values for centuries and is considered in many traditions as 'the spice of life'," says Alberto Espinel, head of R&D for Pharmactive. "AffronEYE is a next-gen ingredient formulated specifically to address eye health. It is extracted from genuine Spanish saffron derived from the delicate dried stigmas of *Crocus sativus L.* grown in Pharmactive-owned fields in Castilla-La-Mancha in Spain. Our proprietary extraction process allows affronEYE to claim the lowest therapeutic dose available on the market at 20 mg/day and ensures the fastest absorption — faster than other traditional carotenoids."

Photo©: Pharmactive

Previous studies have also noted the "sacred" spice's unique ability to penetrate the blood–brain barrier and reach retinal tissue effectively. "Crocins significantly increase the blood flow in the retina," explains Espinel. "They are believed to improve oxygenation and nutrient supply to retinal structures, serving to slow or completely prevent the development of glaucoma.

AffronEYE is all-natural, water-soluble, non-GMO, and has not been irradiated. The ingredient also carries kosher, halal, and organic certifications.

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Form meets function

With its two leading ingredients trade shows – Food ingredients Europe and Health ingredients Europe – being co-located on an annual basis from this year onwards, organizer Informa Markets is mirroring a decisive shift in nutrition. Given the fact that increasing numbers of consumers are expecting more from what they eat, alongside just food and just nutraceuticals, the functional foods category has evolved. Wellness Foods & Supplements talks to Julien Bonvallet, Brand Director at Informa Markets, about breaking down boundaries and about the trends and challenges that this category brings.

Wellness Foods & Supplements (WFS): Functional foods versus food supplements: how do consumers choose?

Julien Bonvallet (JB): For a very long time, for most people, the goal was simply to be able to eat a healthy diet. A balanced intake of fruits, vegetables, protein, whole grains and minimum of fat and sugar was sufficient. However, today's consumers want more.

In recent years, whether perceived or real, nutrient deficiency has become a hot topic. Food supplements were introduced as a simple way of plugging nutrient gaps and consumers still love them. However, increasing numbers of people now want more than this, and hence we are witnessing the rise and rise of functional foods.

WFS: What does this rise of functional foods mean for everyday nutrition?

JB: The boundaries between dietary supplements and food have become so blurred in the eyes of consumers that they are now almost irrelevant – and as a hybrid of food and food supplements, functional foods supply tailored nutrition in a convenient way: They satisfy hunger and are an alternative to pills. Let's take it to the extreme: After a breakfast of superfood ancient grain bread, consumers can grab a mid-morning probiotic shot to support their digestive health and immunity. Hunger in the afternoon can be satisfied with a protein-enriched, low-glycaemic fruit yoghurt, while an isotonic thirst quencher can boost momentum during training. Dinner is probably a "normal" meal,

but higher in protein and lower in carbs. To save on calories, popping a food supplement will plug any perceived nutrient gaps.

WFS: Does this blurring of boundaries represent an opportunity or a challenge for manufacturers and suppliers?

JB: With consumers more open to new product developments than ever, there are many lucrative opportunities. The time is ripe for companies who in the past may never have dreamed of collaboration to get together and create novel hybrid products.

Driven by Health Claim regulations, scientific research methods and comprehensive studies have become an important part of the process, and they can deliver many benefits. However, strictly controlled trials and medical studies can be costly and take time. Interestingly, consumers are not always searching for approved health claims: often, they are more interested in creating a wellness "halo" for themselves. So, a matcha-infused near-water drink with a woman doing yoga on the packaging is attractive. For the consumer, it's about reaching performance highs – there is a huge drive for self-optimisation and wanting to take what Nature gave you and create a better version of yourself.

But with all products, consumers are looking for optimal taste and mouthfeel, and this can be a manufacturing challenge. Consumers are also concerned about sustainability as well as clean label and naturalness. These aspects too can present challenges, as can the lack of globally reliable standards for packaging claims.

By holding Fi Europe co-located with Hi Europe, we are creating the perfect platform for the pooling of ideas: Companies can network and develop solutions to overcome many of the market's challenges through innovative new partnerships.

WFS: What influence has the ageing global population had on the market?

JB: The over-60s are a huge influence. Healthy ageing is a massive trend, with people keen to live their best lives for as long as possible. The shift from dietary supplements towards functional foods is particularly evident among this group, who are concerned about a long list of issues, from preserving immunity, energy and beauty to joint, eye and heart health. Age-related problems with swallowing pills and "pill fatigue" mean they are especially receptive to new nutrient delivery forms.

For instance, it used to be difficult to utilise active ingredients such as CoQ10 and its active form ubiquinol in food supplements because of their instability. But foods fortified with these ingredients are now much more common. Take the omega-3 DHA too: People no longer have to take pills or capsules – they can simply buy DHA-enriched sausages.

WFS: What other key trends are driving the market?

JB: Sports nutrition is more important than ever and is expected to enjoy above average growth of 12.2 % in the coming years, according to Mordor Intelligence. Within this, we will see diverse functionalities being addressed. It will no longer be solely about high protein, low sugar and minimal fat. Sports nutrition will evolve with tailor-made products for specific types of training and vegan solutions will grow.

Beauty from within is another important trend. With pioneers in Japan having created high-tech soft drinks rich in vitamins, collagen and hyaluronic acid, the European market has followed with products such as collagen drinks and keratin gummies.

Digestive health is also a huge driver. No longer simply regarded as a matter of inner wellbeing, digestive imbalances are seen as contributing to various illnesses. Fibre-enriched foods and probiotic dairy products continue to be popular, but active cultures have also moved into areas such as probiotic chocolate and muesli bars.

Photo®: FiE/HiE

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Finally, naturalness is still a major trend. In fact, it is so important that we have a show-within-a-show devoted to the subject: Natural ingredients (Ni). This year in particular, botanicals are hot, especially in the field of heart health.

WFS: How fast is the functional foods market growing?

JB: Market research consultant Grand View Research forecasts a CAGR of 7.9% worldwide for functional foods and beverages until 2025. Another analyst, Research and Markets, says the same, and considers this growth to be long-term, stating: "The increasing trend of consuming these products is expected to sustain."

WFS: Does this mean the dietary supplements market is in decline?

JB: Definitely not: both markets are enjoying similar growth. Mordor Intelligence predicts the global food supplements market will enjoy CAGR of almost 7% in the next five years, with the vitamin segment steadily growing and fatty acids expanding, thanks to the popularity of omega-3 supplements. The most important thing, however, is be it shot, functional food or capsule – you, the consumer, have the choice to grab the delivery format that best suits your everyday life.

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