WHITE PAPER

# FEEL GOOD – LOOK GOOD – MISSION IMPOSSIBLE?

Is there a holistic way for food and supplement manufacturers to address today's complex consumer health demands? This whitepaper outlines the thriving health and wellness market and how collagen peptides can be used to achieve multiple health benefits from one single ingredient. It also presents the results of recent scientific studies showing Peptan® collagen peptide's ability to support skin beauty, bone and joint health, sports nutrition and healthy aging.

By Mai Nygaard, MSc, Global Director Peptan, Mar. 2017

Collagen Peptides for a Healthy Lifestyle

Peptan®

PRODUCED & MARKETED BY ROUSSELOT

DARLING INGREDIENTS

# HEALTH AND WELLNESS: A COMPLEX MARKET, FULL OF OPPORTUNITY

**The world we live in today bears little resemblance to the one many of us were born into. Technological, economic, demographic and social developments have transformed the way we live, work and enjoy life. No matter how it is referred to, faster-paced living is a mega-trend that is here to stay.**

With improving public health awareness, consumers know that diet can help them keep up with the demands of modern life. Healthy eating is no longer limited to people trying to manage their weight or fill in any nutritional gaps; it has become engrained in our everyday habits, because we understand it can support both our mental and our physical wellbeing at every stage of life.

And life is getting longer. Improvements in medicine and conditions of life mean people are living longer and so are susceptible to age-related health conditions like mobility issues, as muscle mass and bone density decrease and cartilage ages. Despite their bodies getting older, people do not want to "slow down." Added to this, in the era of "having it all," they also want to retain their youthful appearance. Fine lines and wrinkles are, for many, an unwelcome arrival, to be delayed for as long as possible.

The desire to look and feel good throughout our lives is a major driver of the thriving health and wellness market, which has enjoyed years of uninterrupted growth and is predicted by Euromonitor to reach a value of US$ 833bn by 2021.[1] According to Technavio, the health and wellness segment now accounts for more than half of the world's food industry[2] - a proportion that looks set to grow even further in the coming years. This presents a huge opportunity for providers of nutraceuticals and healthy food and drinks, but also a challenge in selecting the ingredients that will provide the necessary functionality, performance and taste.

Today's holistic approach to health and wellness is evidenced by an increased focus on exercise, relaxation, personal care, therapy and coaching.

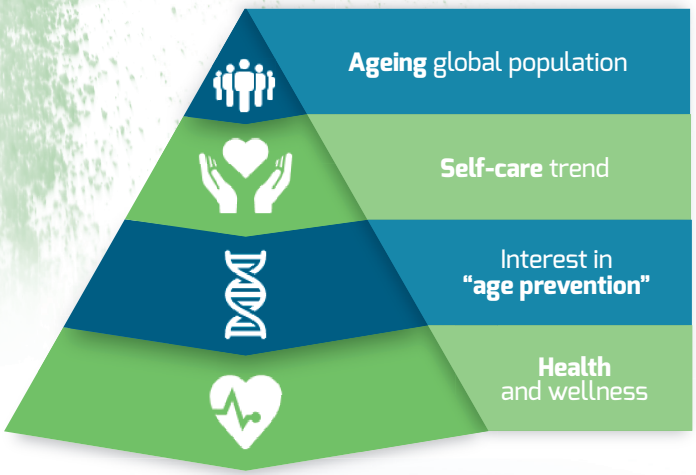
## INTRODUCING MAI NYGAARD

*Mai Nygaard holds a Master of Science degree in biology from the University of Copenhagen (Denmark, 1996) and a Master of Management degree in Innovation from University of South Australia (2010). She has 18 years' international experience in B2B in the food and beverage industry, initially working with R&D and Application for food ingredients and later in strategic marketing and business development, where she held senior management roles in Denmark and in Australia. Mai Nygaard joined Rousselot in 2012 and has taken on the role of Global Director Peptan since January 2015.*

[1] Euromonitor, January 2017, Free-from and organic becomes the fastest growing health and wellness categories in 2016
[2] Technavio, April 2016, Global Health & Wellness Market 2016 – 2020

# CONFRONTING A MULTIFACETED CHALLENGE

Although consumers know they should eat healthily and are highly motivated to do so, they rarely have the time or motivation to seek out numerous products to address all their individual health concerns or goals. Historically dietary supplements have been designed to address one specific condition or health concern but this approach is no longer fully in tune with consumers wishes. Now, foods, drinks and supplements with multiple benefits encapsulate the holistic approach to healthy living that resonates with consumers.




Source: Adapted from Euromonitor

However, achieving multiple benefits within a single product can be difficult. The equally marked trend towards clean labels means formulators need to choose their ingredients carefully in order to ensure consumer acceptance. Natural, rather than artificial, ingredients are a top priority and beyond this, they should be names that people recognize and value. Plus, with demand evolving from clean to clear, the ideal ingredient list is short as well as understandable. To convince a well-informed and sometimes sceptical audience, health and wellness ingredients also need to be proven to be effective. Health benefits must be substantiated through scientific research and (preferably independent) clinical trials.

# A NATURAL SOLUTION TO ADDRESS DIVERSE DEMANDS

All in all, developing health and wellness products that meet these diverse requirements might appear a daunting challenge. But one ingredient, first introduced into skin beauty supplements and functional food in Japan in the 90's, is emerging as a relatively simple but convincing solution to today's exacting consumer demands. Collagen peptides are not new, but thanks to their alignment with many current nutrition trends, including protein enrichment, more active lifestyles, clean / natural eating and beauty from within, are one of the industry's fastest-growing ingredients. Data from Innova Market Insights shows the number of new products containing collagen rose by a CAGR of 52% between 2010-2016 worldwide.[3]

Collagen peptides are a hydrolyzed (highly bioavailable)[4,5] form of collagen, which is the most abundant protein occurring naturally in the human body. Collagen is a key structural protein that ensures the cohesion, elasticity and regeneration of all connective tissues, including skin, cartilage, tendons, ligaments, muscles and bones. From the age of 30, less collagen is produced by the body, which can lead to the loss of skin elasticity and firmness, cartilage degeneration, joint stiffness, muscle mass reduction and lower bone mineral density and strength. The consumption of collagen peptides has a positive effect on all these regressive processes, as the small peptides are transported from the gut via the blood to the tissue cells, where they stimulate cells to produce more collagen,[6,7] and as a result help boost the level of structural collagen in the target tissues.

Besides counteracting the signs of aging, collagen peptides offer unique support to the musculoskeletal system at all ages. The high levels of the conditionally essential amino acids proline, arginine and glycine, paired with the hydroxyproline contained in collagen peptides are invaluable to the body's connective tissues. For athletes and sports enthusiasts in particular, supporting ligaments, cartilage and tendons is just as important as supporting muscles.

**Collagen distribution in human body (by weight ratio of dry mass)**

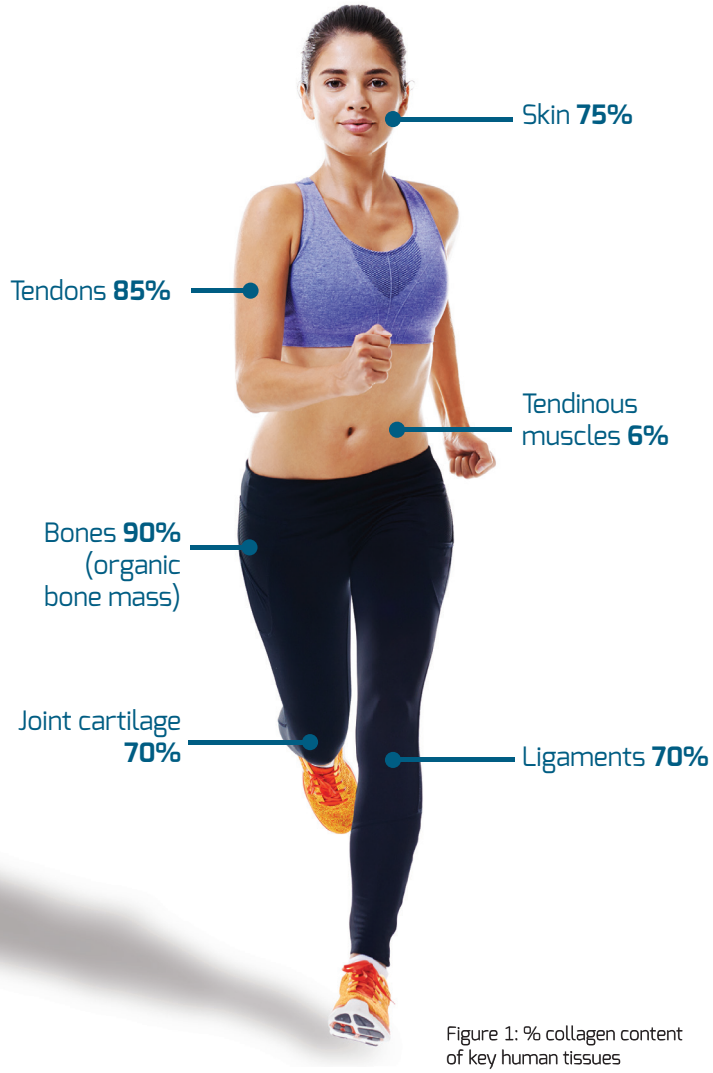



Figure 1: % collagen content of key human tissues

[3] Innova Market Insights, 2016, Collagen Product Launches: top active claims
[4] Shigemura, Y., et al., 2014, Dose-dependent changes in the levels of free and peptide forms of hydroxyproline in human plasma after collagen hydrolysate ingestion. Food Chemistry 159: 328-332
[5] Sugihara, F., et al., 2012, Quantification of hydroxyprolyl-glycine (Hyp-Gly) in human blood after ingestion of collagen hydrolysate. Journal of Bioscience and Bioengineering 113 (2): 202-203
[6] Oesser, S., et al., 1999, Oral administration of 14C labelled gelatine hydrosylate leads to an accumulation of radioactivity in cartilage of mice (C57/BL). Journal of Nutrition, 129: 1891-1895
[7] Oesser, S., Seifert, J., 2003, Stimulation of type II collagen biosynthesis and secretion in bovine chondrocytes cultured with degraded collagen. Cell Tissue Research, 311: 393-399

# A CAPTIVATING CONSUMER PROPOSITION

Collagen peptides' popularity is, to a large extent, attributable to the fact they are pure, naturally occurring proteins. Protein is well-recognized, trusted and in high demand worldwide. But the amino acid composition of collagen peptides sets them apart from other protein sources and enables benefits that cannot be achieved with other single-source proteins.

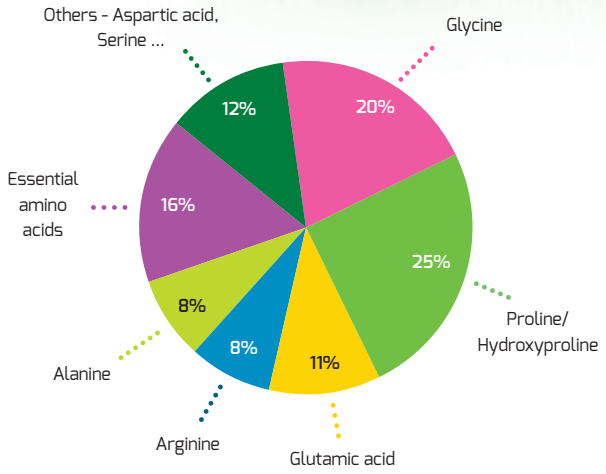



Figure 2: Amino acid composition of collagen peptides. Its glycine and proline concentration is 10 to 20 times higher than in other proteins

## SKIN BEAUTY

These benefits have been widely researched worldwide. In the area of skin beauty, for example, research has shown that oral intake of collagen peptides may act to trigger the synthesis of new collagen fibers by stimulating fibroblasts,[8 9] which are the skin cells responsible for collagen production. With collagen accounting for 70% of dry mass skin content, improved fibroblast action can have a significant impact on the appearance of the skin. Further studies have shown that daily intake of collagen peptides reduced collagen fragmentation by 31% enhanced skin moisture levels by 28%,[10] can help repair damage caused by UV radiation[11] and reduce the visible signs of aging[12] like dehydration, fine lines and wrinkles.[13]

**Decrease in collagen fragmentation after intake of Peptan F at week 0, 4 and 12**

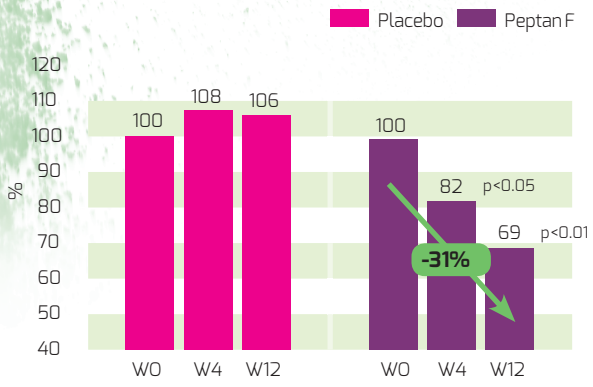



Figure 3: Collagen fragmentation (relative change) assessed by confocal laser imaging after intake of Peptan F

Asserin, 2015

**Skin hydration in the Peptan test group improved by 28% compared to placebo**

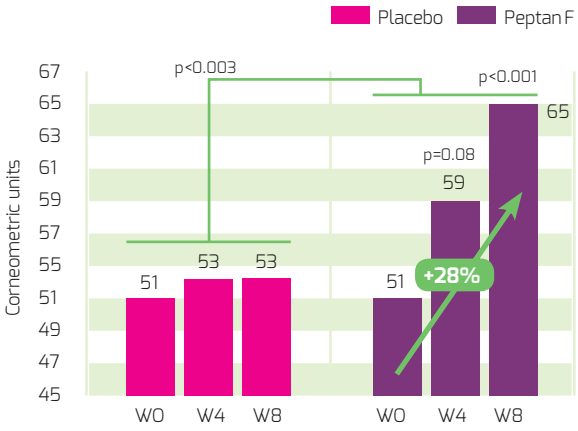



Figure 4: Skin moisture level increase – Corneometer® measurement

Asserin, 2015

[8] Shigemura, Y. et al., 2009, Effect of prolyl-hydroxyproline (Pro-Hyp), a food-derived collagen peptide in human blood, on growth of fibroblasts from mouse skin. Journal of Agricultural and Food Chemistry 57(2): 444-449
[9] Ohara, H., 2010, Collagen-derived dipeptide, proline-hydroxyproline, stimulates cell proliferation and hyaluronic acid synthesis in cultured human dermal fibroblasts. Journal of Dermatology 37(4): 330-338
[10] Asserin, J. et al., 2015, The effect of oral collagen peptide supplementation on skin moisture and the dermal collagen network: evidence from an ex vivo model and randomized, placebo-controlled clinical trials. Journal of Cosmetic Dermatology, 14:291-301. doi: 10.1111/jocd.12174
[11] Tanaka, M., et al., 2009, Effects of Collagen Peptide Ingestion on UV-B-Induced Skin Damage. Biosciences, Biotechnology and Biochemistry 73 (4): 930-932
[12] Cosgrove, M., et al., 2007, Dietary nutrient intakes and skin-aging appearance among middle-aged American women. American Journal of Clinical Nutrition 86 (4): 1225-1231
[13] Borumand, M., et al., 2014, Daily consumption of the collagen supplement Pure Gold Collagen® reduces visible signs of aging. Clinical Interventions in Aging 9: 1747-1758

## MOVE FREELY AND EFFICIENTLY

Joint health studies date back nearly 20 years, and demonstrate a range of benefits including the relief of discomfort,[14] improvement in tendon structure[15] and relief for joint discomfort.[16] For instance, a major study into elderly women suffering from knee joint problems recorded a 32% improvement in joint pain, 44% in stiffness and 22% in function when the participants regularly consumed collagen peptides.[17] Most recently, an *in vivo* study conducted at the University of Rochester, NY, concluded that the same specific collagen peptides stimulate chondrocyte cells, increase the synthesis of new cartilage matrix and reduce inflammation.[18]

### Peptan prevents cartilage degradation

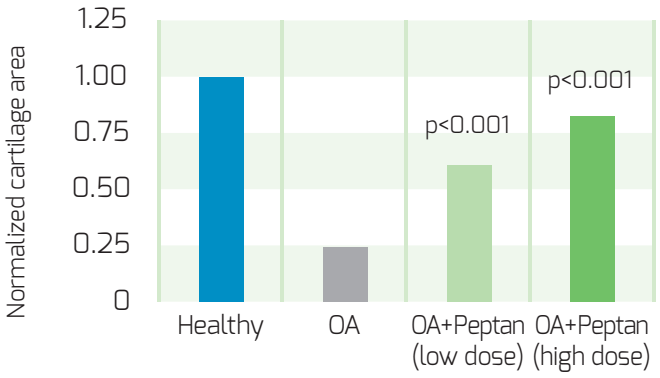
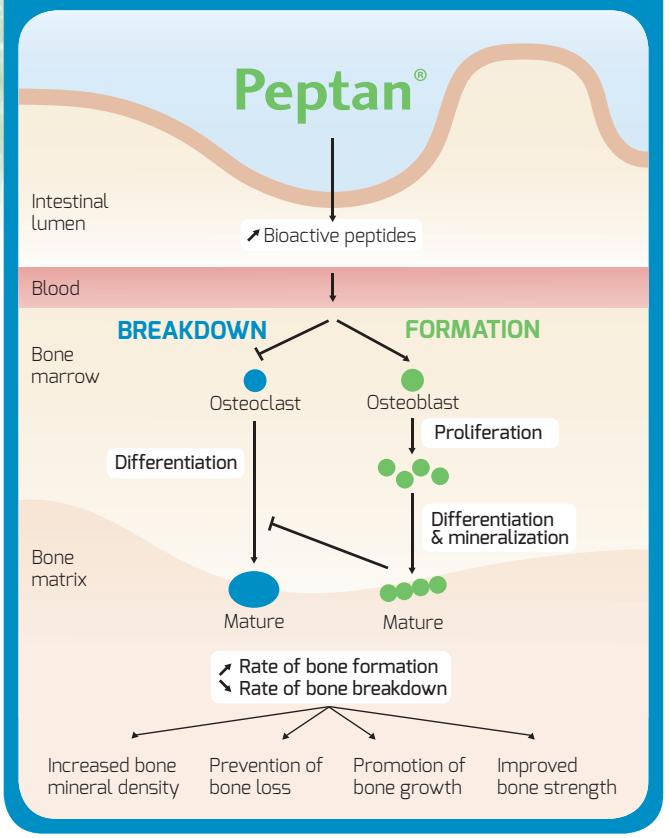



Figure 5: Osteoarthritis (OA) was induced by surgery in mice that received Peptan at two different dosages or a control twelve weeks after OA induction. Histology of the knee joints was performed and the area of the (tibia) cartilage was quantified.

Dar, 2016

### Peptan: the mechanism of action

Schematic summary of the effect of Peptan on bone metabolism, adapted from Daneault, 2015[21]




Bone health is another area where collagen peptides can provide convincing nutritional support. Key to musculoskeletal strength, they have been shown to boost bone mineral density,[19] help prevent bone loss,[20] and improve osteoblast differentiation,[21 22] shifting the bone metabolism balance towards bone building.[23 24] As well as having benefits in their own right supporting strong and healthy bones, collagen peptides can also boost the benefits of dietary calcium, improving its absorption, retaining high levels of calcium in bones, increasing bone mineral density and preserving bone strength, according to one recent *in vivo* study.[25]

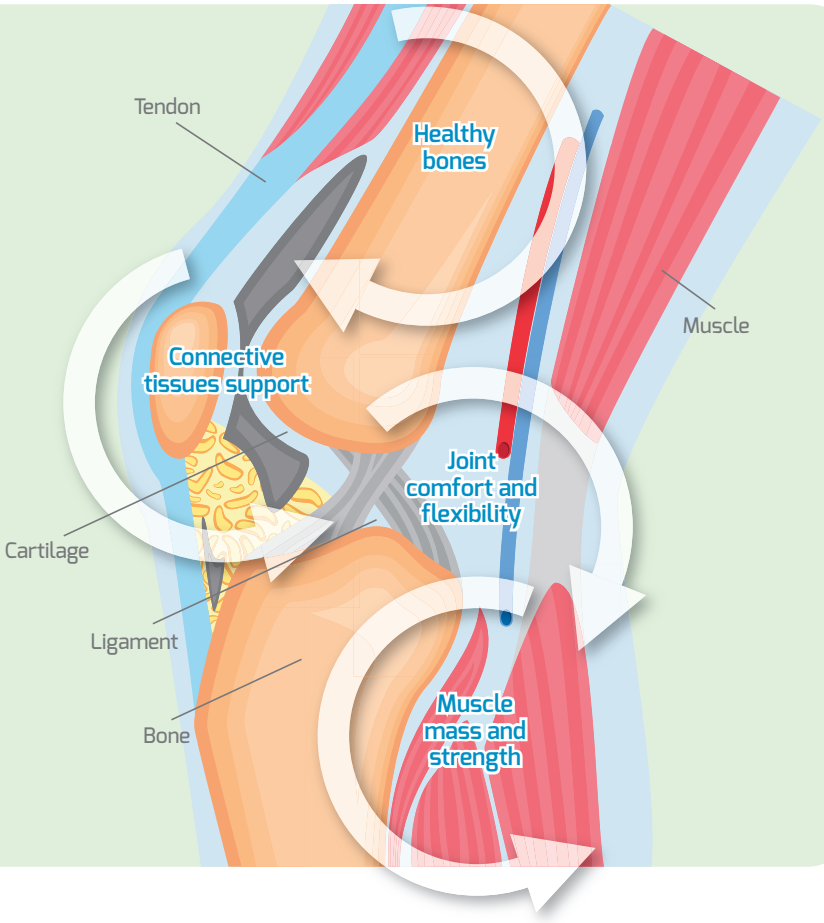
[14] Bruyère, O, et al., 2012, Effect of collagen hydrolysate in articular pain: a 6-month randomized, double-blind, placebo controlled study. Complementary Therapies in Medicine 20 (3): 124-30
[15] Minaguchi, J, et al., 2005, Effects of ingestion of collagen peptide on collagen fibrils and lycosaminoglycans in Achilles tendon. Journal of Nutritional Science and Vitaminology ,51: 169-174
[16] Moskowitz, RW, 2000, Role of collagen hydrolysate in bone and joint disease. Seminars in Arthritis and Rheumatism 30 (2): 87-99
[17] Jiang, J.X, et al, 2014, Collagen peptides improve knee osteoarthritis in elderly women. Agro food Industry Hi Tech 25 (2): 19-23
[18] Dar Q.A. et al., 2016, Oral hydrolyzed type 1 collagen induces chondroregeneration and inhibitis synovial inflammation in murine posttraumatic osteoarthritis. Osteoarthritis & Cartilage 2016, 24 (S1)
[19] Nomura, Y., et al., 2005, Increase in bone mineral density through oral administration of shark gelatin to ovariectomized rats. Nutrition 21 (11-12): 1120-1126
[20] Guillerminet, F., et al., 2012, Hydrolyzed collagen improves bone status and prevents bone loss in ovariectomized C3H/HeN mice. Osteoporosis International 23 (7): 1909-1919
[21] Daneault, A. et al., 2014 Hydrolyzed collagen contributes to osteoblast differentiation in vitro and subsequent bone health *in vivo*. Osteoarthritis and Cartilage, 22:S131
[22] Liu, J.L., et al., 2014, Bovine collagen peptide compounds promote the proliferation and differentiation of MC3T3-E1 pre-osteoblasts. PLoS ONE 9 (6): e99920
[23] Guillerminet, F., et al., 2012, Hydrolyzed collagen improves bone status and prevents bone loss in ovariectomized C3H/HeN mice. Osteoporosis International 23 (7): 1909-1919
[24] Daneault, A., et al., 2015, Biological effect of hydrolyzed collagen on bone metabolism. Critical Reviews in Food Science and Nutrition May 15: 0
[25] Liu, J.L, et al., 2015, Combined oral administration of bovine collagen peptides with calcium citrate inhibits bone loss in ovariectomized rats. PLoS ONE (8):e0135019

A recent study on connective tissue support in young men has further indicated that collagen can play a beneficial role in preventing injury and supporting tissue repair. Carried out by the Australian Institute of Sports, the study shows how consuming collagen enhanced with vitamin C and followed by high intensity exercise can potentially help build ligaments, tendons and bones,[26] confirming collagen's great potential in the sports nutrition market.

Very pure proteins have additional benefits in the areas of sports and senior nutrition, two further sectors booming in markets worldwide. For example, one study found that it improved the skeletomuscular response to resistance exercise training,[27] while improvements in body composition and nitrogen balance were found in older women during a 2009 study.[28] Nitrogen balance is essential to build muscle and maintain physical wellbeing. Research continues in both these areas.

## ONE INGREDIENT WITH MULTIPLE BENEFITS

- **JOINT COMFORT AND FLEXIBILITY:** can improve joint function and reduce inflammation and discomfort.
- **HEALTHY BONES:** can promote bone strength and density.
- **COLLAGEN PEPTIDES ALSO SUPPORT:**
  - Tendons and ligaments: help prevent injury and speed up recovery of connective tissues
  - Muscle mass and strength: promote lean muscle.




[26] Shaw, G. et al., 2016, Vitamin C-enriched gelatin supplementation before intermittent activity augments collagen synthesis. American Journal of Clinical Nutrition, doi:10.3945/ajcn.116.138594
[27] Zdzieblik, D., et al., 2015, Collagen peptide supplementation in combination with resistance training improves body composition and increases muscle strength in elderly sarcopenic men: a randomized controlled trial. British Journal of Nutrition 114 (8): 1237-1245
[28] Hays, N.P., et al., 2009, Effects of whey and fortified collagen hydrolysate protein supplements on nitrogen balance and body composition in older women. Journal of the American Dietetic Association, 109:1082-1087

# CHOOSING THE RIGHT COLLAGEN PEPTIDE

**Scientific studies stretching back over 20 years have consistently shown the multiple benefits collagen peptides have for consumers, but their appeal is just as strong for formulators too. Food, drink and supplement makers can tap into the widespread consumer awareness, acceptance and uptake of protein and, in notably in Japan, Brazil and the United States, collagen specifically.[29]**

With a long history of safe and effective use, collagen peptides are a key ingredient in a large (and growing) number of end-products, including supplements, RTDs and beverage dry mixes, bars, dairy products and even chocolate and confectionery. This versatility is attributable to the fact that premium grade collagen peptides are taste- and odour-free, easily soluble, transparent, pH-stable and heat-stable.

Furthermore, aligning with today's emerging trend towards condition-related and more personalized nutrition, collagen peptides are compatible with numerous other nutrients for the creation of more targeted end products. For instance, they can be combined with keratin and hyaluronic acid in a beauty supplement; calcium and vitamin D in a bone health yoghurt, or glucosamine, vitamin C and chondroitin in a joint health bar.

With the large number of benefits available from collagen peptides both for consumers and for the suppliers of their foods and supplements, it is easy to see why their popularity has rocketed in recent years. There are several manufacturers of collagen peptides and a number of products to choose from, but one brand stands out from the crowd.

Peptan® is a unique ingredient that offers all of collagen peptides' health and beauty benefits from one brand. This means that, no matter how manufacturers wish to position their products, they can use one tried and trusted ingredient. It is suited to sports nutrition and beauty foods right through to mobility supplements and senior nutrition, offering huge long-term market potential and brand loyalty.

Peptan has also been the subject of a large body of scientific studies which cements its position as the leading collagen peptide brand. Researched by world-leading academics and nutritionists for over 10 years, Peptan has consistently shown clear benefits in areas including skin, joint, bone and musculoskeletal health. Vague and unsubstantiated claims no longer appeal to the increasing discerning consumers and not being able to prove a product's health credentials can be hugely detrimental to a brand, so it is more important than ever to choose ingredients which have been thoroughly and repeatedly scrutinized by the scientific and academic community. Supported by a growing body of research across the health and wellness sector, Peptan offers brand owners, manufacturers and consumers the reassurance of rigorous and ongoing independent investigation into its efficacy.

## Peptan's variety of product applications

Dairy

Powder drinks

Beverages

Tablets and capsules

Nutritional bars

Confectionery

[29] Nutraingredients, 19.03.2015, Nutricosmetics: US market holds great potential but a few challenges must be overcome', says supplier

# MULTIPLE PEPTAN SOLUTIONS

Extensive clinical and scientific evidence of Peptan's efficacy is a top priority for consumers. But its consistent high quality standards, absolute traceability, global technical and applications assistance, regulatory advice, formulation expertise and cobranding support are equally valuable to the brand owners and product manufacturers developing the health and wellness products those consumers demand. Combining worldwide experience and detailed knowledge of regional and local dietary preferences to co-innovate with customers, Peptan is a highly attractive proposition for the successful health and wellness products of tomorrow. To find out more about how to incorporate collagen peptides into a new or existing recipe, email peptan@rousselot.com or visit www.peptan.com




**Rousselot Headquarters:**

Rousselot B.V. Kanaaldijk Noord 20-21 5691 NM Son The Netherlands

Phone: +31 499 364 100 Fax: +31 499 364 972 peptan@rousselot.com

peptan.com PeptanbyRousselot @Peptan_Global Collagen Peptides

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