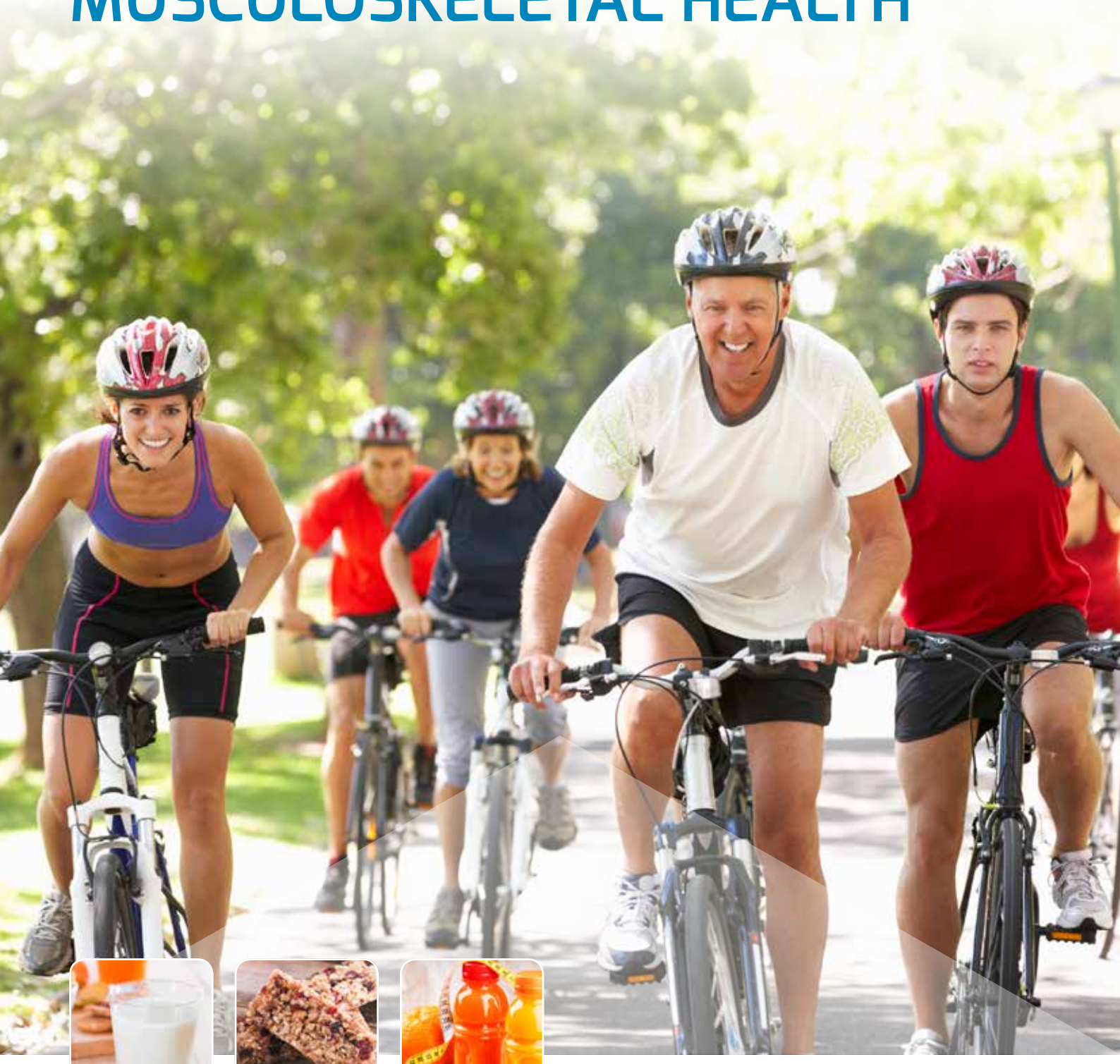
COLLAGEN PEPTIDES FOR MUSCULOSKELETAL HEALTH



Collagen Peptides for a Healthy Lifestyle

Peptan®

PRODUCED & MARKETED BY ROUSSELOT

DARLING INGREDIENTS

MAINTAINING MUSCULOSKELETAL HEALTH

MOVING FREELY AND EFFICIENTLY

As the main protein found in the body, collagen plays a vital role in a healthy musculoskeletal system. Forming the structural component in all our connective tissues including bones, cartilage, joints, tendons, ligaments and muscles, collagen supports key physical functions such as movement, posture and stability.

With age, the body's ability to naturally replenish lost collagen decreases, leading to thinning cartilage as a result of repeated joint wear; causing potential stiffness and discomfort and a gradual reduction in bone mass density. Also loss of muscle mass and strength leads to physical changes which collectively cause decreased mobility, gait problems and a higher risk of falls.

Keeping active for as long as possible is more important than ever, not only for our personal wellbeing but also to reduce pressure on health insurance and public health bodies. Equally important to consider are people of all ages who regularly take part in high intensity exercise, which can wear down connective tissue, causing joint discomfort, sports injuries and inefficient movement.

In fact, the number of people suffering from conditions relating to Musculoskeletal Disorders (MSD) is significant. In the US alone, one in four Americans has been diagnosed with some form of MSD, acknowledged as one of the leading causes of disability across the world.[1]

PEPTAN® COLLAGEN PEPTIDES

KEY TO MOBILITY

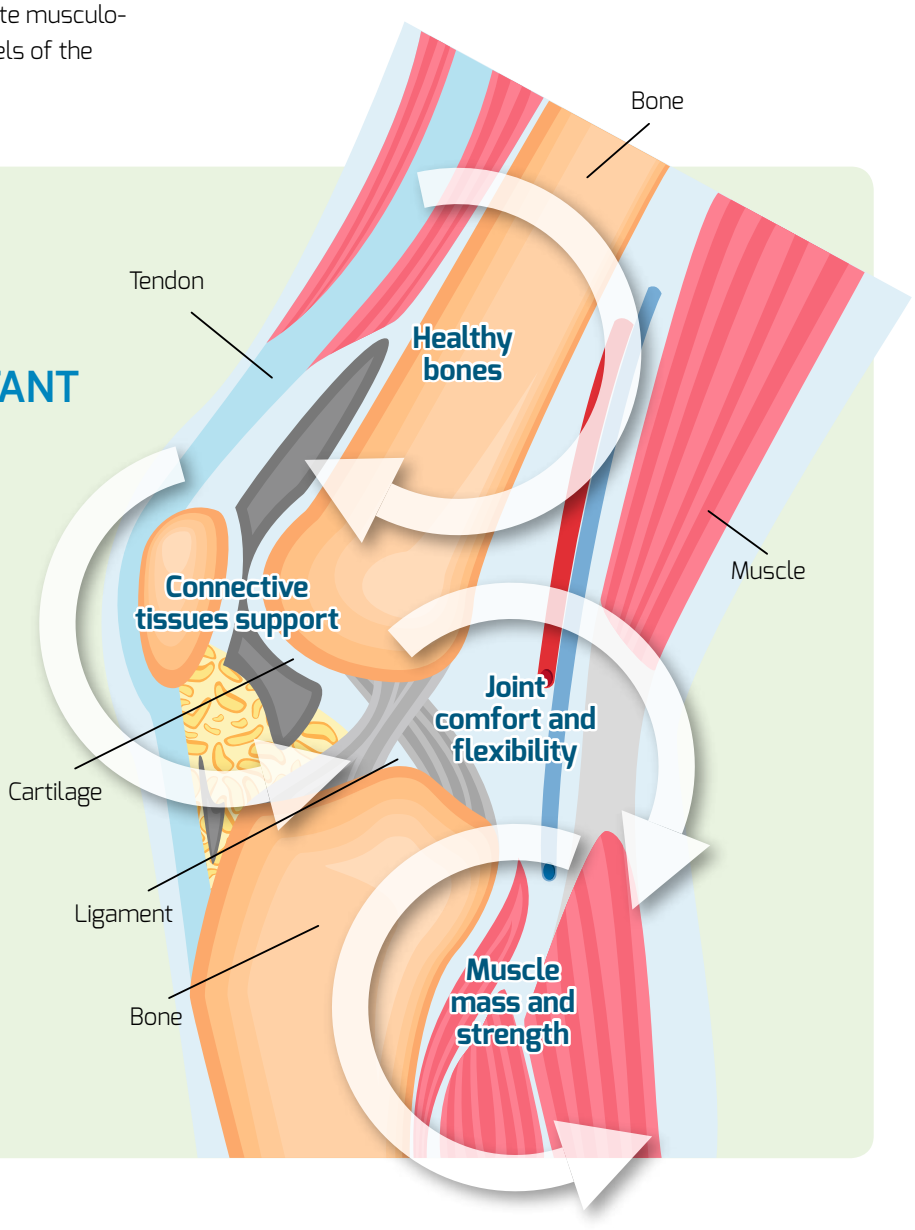
It is essential to support the entire musculoskeletal system to keep the body active. A balanced diet in combination with moderate exercise helps keep the musculoskeletal system strong and healthy. In particular, supplementation with active ingredients offers valuable additional advantages.

Leading the way in this new generation of active ingredients are collagen peptides – a unique, bioactive protein which supports collagen replenishment. Peptan is the world's leading collagen peptides brand, offering a natural solution with superior bioavailability and proven efficacy.

Peptan is a bioactive protein that offers a complete musculo-skeletal health solution. Peptan contains high levels of the amino acids Gly, Hyp, Pro and Arg which offer specific mobility benefits not found in any other proteins or single ingredients.

PEPTAN IS BACKED BY NUMEROUS SCIENTIFIC STUDIES SHOWING IMPORTANT HEALTH 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; helps prevent injury and speed up recovery of connective tissues
  - Muscle mass and strength; promotes lean muscle.



THE SCIENCE BEHIND PEPTAN®

PROMOTING JOINT HEALTH

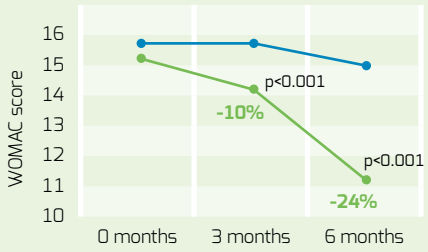
Cartilage is made up of cellular building blocks (chondrocytes) which produce a matrix consisting of collagen and proteoglycans (mainly aggrecan). Collagen fibers make up to 70% of cartilage and are responsible for its structure and strength, while proteoglycans serve as a joint lubricant.

To help maintain joint health, it is essential to ensure that this balance is protected and the necessary building blocks for collagen are available to support cartilage regeneration. Peptan has been proven to play an important role in helping to stimulate chondrocytes to produce more aggrecan and type II collagen.

A clinical study reveals that an 8g daily intake of Peptan significantly improves joint comfort and functionality.[2] During the double-blind placebo-controlled clinical trial, 94 women with diagnosed knee osteoarthritis were randomly assigned to take either 8g of Peptan or a placebo per day. The Peptan treatment resulted in a significant decrease of the WOMAC score linked to an improvement of 32% in joint pain score, 44% in stiffness score and 22% in function score.

Development of WOMAC scores

(decreased score value = improvement)

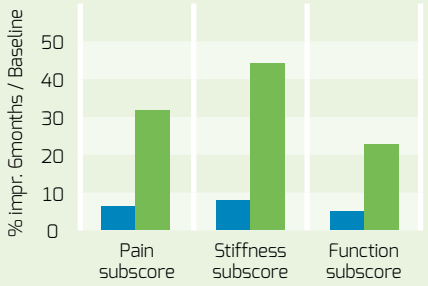


Placebo group

Peptan group

Peptan reduces joint discomfort and improves joint function

(WOMAC subscale scores)



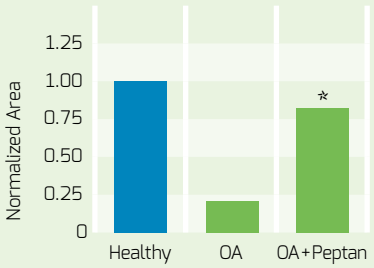
Placebo

Peptan

Jiang et al., 2014

CARTILAGE-REGENERATIVE EFFECT OF PEPTAN IN JOINTS AFTER 12 WEEKS OF TREATMENT (IN VIVO)

In vivo research conducted in an osteoarthritis mice model at the University of Rochester Medical Center (USA) confirms the unique benefits of Peptan in supporting joint health through cartilage regeneration and its significant anti-inflammatory effect.[3]



The quantification of the cartilage area 12 weeks after osteoarthritis induction in mice shows that the area decreased by 75% in osteoarthritis; Peptan treatment prevented this drastic decrease and only showed a 20% reduction in cartilage area.

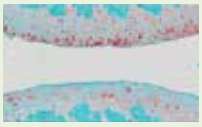
Healthy

after 3 weeks

after 12 weeks

12 weeks: Healthy cartilage has a smooth, undamaged surface, is rich in proteoglycans (red staining) and shows an abundant number of chondrocytes (dots).

Induced osteoarthritis



after 3 weeks

after 12 weeks

Early disease (3 weeks) is marked by a nearly total loss of proteoglycans. In addition, the cartilage is heavily eroded in mid-stage disease and the number of chondrocytes is strongly reduced (12 weeks).

Induced osteoarthritis + Peptan

after 3 weeks

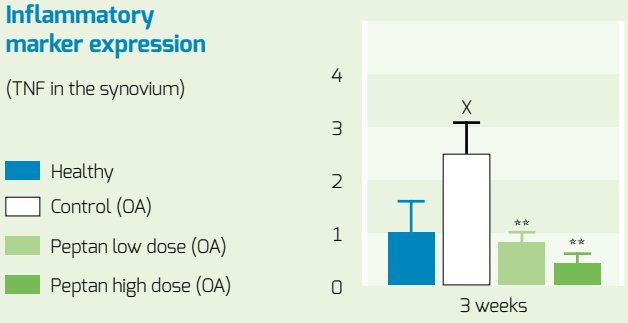
after 12 weeks

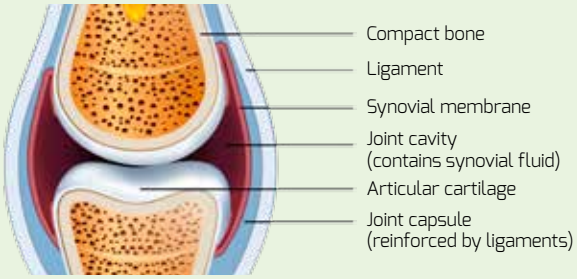
Over time, Peptan treatment has a clear cartilage regenerative effect, with drastic increase in proteoglycan production (increased staining) and cell number already at 3 weeks and a smoothening of the cartilage surface after 12 weeks.

ANTI-INFLAMMATORY EFFECT OF PEPTAN

Inflammatory marker expression

(TNF in the synovium)





- A healthy synovial membrane is very thin and with low TNF expression (blue bar).
- In induced osteoarthritis, the synovial membrane significantly thickens and is heavily inflamed (white bar).
- Peptan significantly and dose-dependently reduces the thickening and the inflammation of the synovial membrane after 3 weeks (green bars).
- The anti-inflammatory effect of Peptan is similar after 12 weeks.

Dar et al., 2016

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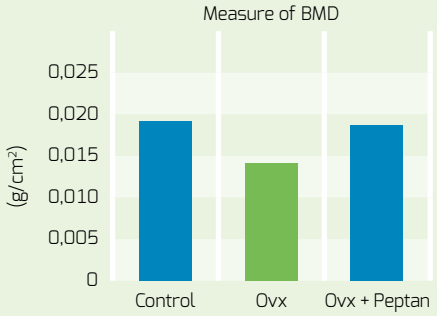
MAINTAINING HEALTHY BONES

Healthy bone is subject to a continuous cycle of bone matrix breakdown and new bone formation. An imbalance between bone resorption and bone formation results in a reduction of bone mineral density (BMD), leading to an increased risk of fractures.

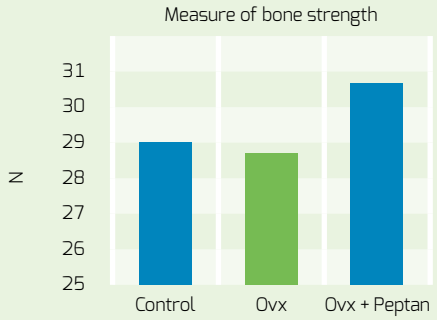
In vitro and in vivo studies have proven Peptan's efficacy in improving bone metabolism and biomechanical parameters by stimulating the endogenous production of collagen and improving bone mass density and bone strength.

An animal study indicated that Peptan collagen peptides help to restore bone mineral density and improve bone microarchitecture and solidity.[4] In a follow-up study, Peptan had the same benefit on bone health in older animals and, importantly, could exert a therapeutic and a preventive effect.[5] Peptan has been found to trigger osteoblasts (bone forming cells) and to reduce bone resorption.[6] Bone health benefits can be further strengthened when combining collagen peptides with calcium[7] and vitamin D.

Increase in bone mineral density for Ovx mice fed Peptan for 12 weeks



Increase in ultimate bone strength for Ovx mice fed Peptan for 12 weeks



Guillerminet et al., 2010, 2012

SUPPORTING TENDONS AND LIGAMENTS

High impact sports such as running and cycling often involve repetitive movements can lead to damage of cartilage, tendons and ligaments and result in excess stress on joints. Research has shown that collagen peptides can help protect these essential connective tissues.

A study involving 147 sports enthusiasts showed a statistically significant reduction in joint pain among the group that took collagen peptides.[8] Another larger scale study demonstrated that supplementation with a mix of collagen peptides, BCAA and arginine over a period of two years decreased the injury rate for tendons, ligaments, joints and muscle.[9]

Another study reported similar results for collagen hydrolysate.[10] Further studies demonstrate a significant increase in collagen fiber diameter indicating improved strength[11] and a faster return to play after injury.[12]

SUPPORTING MUSCLE MASS AND STRENGTH

Protein consumption in combination with exercise plays a vital role in supporting muscle health.

Collagen peptides are an easily digestible and bioavailable source of protein whose role goes beyond muscle regeneration. Collagen peptides contain high amounts of the amino acids glycine and arginine, which aid the natural production of creatine in the body, supporting muscular contraction during periods of high intensity exercise.[13]

Collagen peptides help support the body's natural muscle replacement process through a good nitrogen balance which helps to preserve lean muscle mass and increase muscle strength in older adults.[14] Collagen peptide supplementation in combination with resistance training has been shown to improve body composition and increase muscle strength in elderly sarcopenic men.[15]

COLLAGEN PEPTIDES

FOR A HEALTHY LIFESTYLE

Thanks to our global leadership in the production and supply of collagen peptides together with our world-wide presence and customer-centric culture, we work in close and reliable partnership with our customers.

Science: Peptan offers proven efficacy in extensive in vitro, in vivo and clinical studies.

Innovation: Global network of technical experts are available to support you in new and innovative product development.

Formulation: with application and expertise centres located across the globe, Rousselot continuously develops new product concepts and recipes to support our customers' innovation focus.

Brand: Peptan is the world's leading collagen peptides brand, a trusted, safe and globally recognised ingredient used in hundreds of successful products available in the nutrition market today.

Safe: neutral in taste, odor and color and fully traceable, Peptan powder contains more than 97% protein (dry weight basis), allowing for easy incorporation into a wide range of applications including supplements and functional foods and beverages, even at high concentration.

Quality: Peptan is manufactured in-house in state-of-the-art certified plants which meet the highest international food quality standards and ensure traceability of products and processes. A premium quality collagen peptide, Peptan is free from preservatives or additives.

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About Rousselot and Peptan:
Rousselot and Peptan are both brands of Darling Ingredients Inc. Rousselot is the global leader[1] of gelatin and collagen peptides. Rousselot's wide range of collagen peptides are marketed under the Peptan brand. We work in partnership with our customers all over the world, delivering innovative and advanced ingredient solutions manufactured through state of the art operations. We help our customers achieve their goals, enabling them to create world class pharmaceutical, food and nutritional products to inspire and excite today's demanding consumers.

[1] *Global Industry Analysts, Inc, Gelatin a Global Strategic Business report, Nov 2016*

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