Science Review: Collagen

Metagenics®

What is collagen?

The most abundant structural protein in the body, collagen is responsible for the structure of skin, connective tissue, tendons, bones, and teeth. The major collagen types are I, II, and III, which form the structural fibrils of tissues.

Function

As the main group of structural proteins of the extracellular matrix, collagen proteins form elastic molecular networks to strengthen tendons and elastic sheets that support skin and internal organs. They also function as biologically active components of tissues including skin, bone, and cartilage.

Sources for supplementation

Collagen is extracted from animal byproducts, including both land (e.g., bovine, porcine, and chicken) and marine sources, such as skin, bones, connective tissue, fish heads, guts, fins, and scales. Marine collagen, however, contains a lower amount of the amino acids proline and hydroxyproline—resulting in lower denaturation temperatures (lower melting point), which indicate their lower stability (weaker gel strength). Additionally, biological properties of marine collagen can be highly variable depending on biochemical composition.

Collagen forms

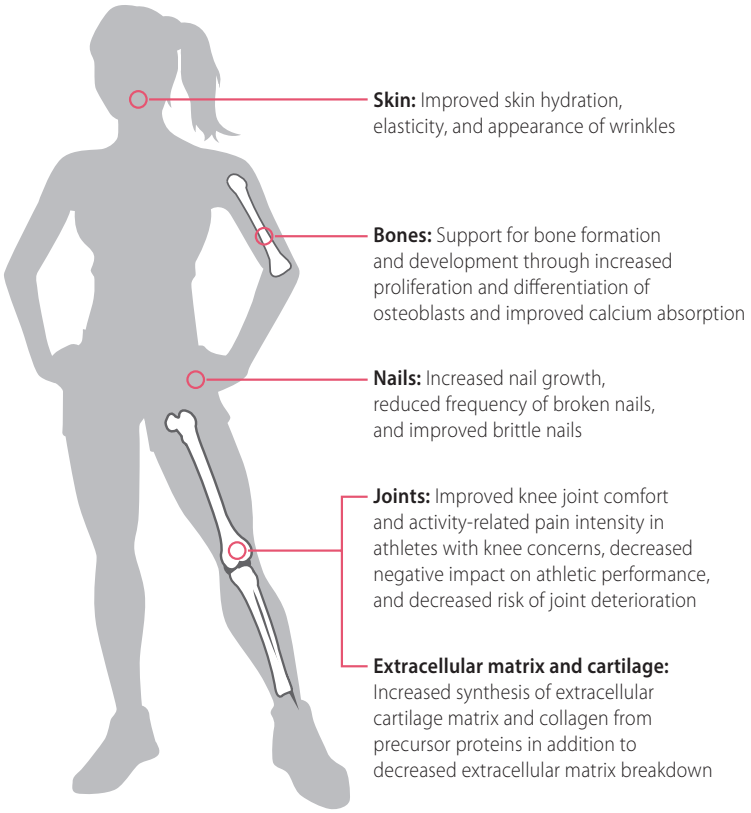
Due to its highly preserved sequence and structure, collagen and its derivatives (hydrolysates, peptides, and gelatin) are highly biocompatible and safe.

- **Protein:** Approximately 25-35% of all vertebrate proteins mainly consist of three nearly identical α-chains of the amino acids glycine, proline, and hydroxyproline. The unique amino acid composition and structure confer collagen proteins with excellent stability.
- **Hydrolyzed:** A result of the enzymatic breakdown (hydrolysis) of collagen, the byproduct is extracted and dehydrated into a white powder (hydrolyzed collagen or collagen hydrolysate) that is easier to digest and use.
- **Peptides:** These water-soluble peptide fragments (2-20 amino acids) originate from the breakdown of the full-length collagen protein. Due to their smaller size, collagen peptides show higher bioavailability and are better absorbed into the bloodstream.
- **Gelatin:** This denatured form of collagen is obtained by partial hydrolysis of the protein. Depending on the pH, temperature, and extraction process used, gelatin may vary in functional properties despite having amino acid content similar to collagen.

Research Highlights

- ✓ Collagen is the most abundant type of structural protein in the body.
- ✓ Supplement sources are extracted from animal byproducts.
- ✓ Marine collagen contains a lower amount of proline and hydroxyproline as compared to bovine collagen—resulting in lower stability and shelf-life.
- ✓ Collagen protein and its derivatives (hydrolysates, peptides, and gelatin) are highly biocompatible and safe.
- ✓ Preclinical and clinical studies show that supplementation with collagen may support skin, nail, bone, and joint health.

How Collagen Works in the Body



Health benefits

An increasing number of both animal and human studies have identified a variety of bioactivities for collagen hydrolysates or peptides. Sustainable sources, good bioavailability, and neutral taste render collagen hydrolysates and peptides a promising approach for biomedical applications.

- **Extracellular matrix and cartilage**
  - Preclinical studies show stimulation of chondrocytes to synthesize extracellular cartilage matrix and changes in serum biomarkers associated with increased collagen synthesis and decreased extracellular matrix disruption.
  - Adults with mild knee osteoarthritis showed improved extracellular matrix and cartilage support following daily supplementation with 10 g of collagen hydrolysate for 48 weeks.
- **Skin and nails**

  Several clinical trials have highlighted the benefits of collagen peptides on skin properties, such as hydration, elasticity, and reduction of wrinkles.
  - Collagen peptides can stimulate the growth of fibroblasts in the skin and the synthesis of hyaluronic acid as well as improve skin barrier dysfunction.
  - Daily consumption of 2.5 g of hydrolyzed collagen containing peptides types I and III for 4 weeks increased skin elasticity in healthy female subjects compared to placebo.
  - After 8 weeks of consuming 2.5 g per day of collagen peptides, increased content of procollagen type I and elastin was observed as compared to placebo-treated patients.
  - 2.5 g of collagen peptides consumed daily for 24 weeks showed increased nail growth and improved brittle nails in conjunction with decreased frequency of broken nails.
- **Joint and bone health**

  Collagen has been associated with improvements in joint and bone health.
  - Collagen peptides can stimulate the proliferation and differentiation of osteoblasts and improve calcium absorption in addition to up-regulating expression of bone-related genes in osteoblasts, suggesting that collagen supports bone formation and development.
  - 5 g of collagen peptides per day for 12 weeks improved activity-related pain intensity in athletes with knee problems compared to placebo-treated subjects.
  - Osteoarthritis patients who supplemented daily with 10 g of collagen hydrolysate for 24 weeks showed improvement in knee joint comfort.
  - Enhanced collagen synthesis as a result of daily supplementation with 10 g of collagen hydrolysate from 12 to 24 weeks may reduce the risk of joint deterioration—indicating that the use of collagen supports joint health and may reduce parameters that have a negative impact on athletic performance (such as pain).
  - Postmenopausal women with age-related reduction in bone mineral density supplemented with 5 g of collagen peptides per day for 12 months and showed increased bone mineral density and favorable changes in bone markers compared to the control group.
- **Other applications**

  Collagen proteins are being considered in regenerative medicine for tissue engineering and regeneration purposes, such as the production of hydrogels or scaffold for wound healing. Collagen-based materials can be used to prevent moisture and heat loss from wounded tissue, while providing a barrier against microbial infiltration.