The ingestion of collagen hydrolysate has been reported to improve skin and joint conditions. However, critics have pointed out a lack of scientific evidence about the molecule's mechanism of action. Our research group has demonstrated that the ingestion of collagen hydrolysate increases blood plasma levels of bioactive collagen peptides, such as Pro-Hyp, in humans. Pro-Hyp increases fibroblast numbers in collaboration with growth factors and the production of extracellular components, which could be associated with the beneficial effects of collagen hydrolysate consumption.

How collagen hydrolysate works on your skin and joints

Collagen is the main protein compound in the extracellular matrix. The collagen molecule consists of three subunit chains and has a triple helical structure. Collagen forms a family of proteins with different gene products. Type I collagen is the main constituent of non-cartilage connective tissues, while other collagen types are present in cartilage, bone, and skin.

Collagen hydrolysate, or hydrolyzed collagen, is a food supplement that can improve skin and joint conditions. It is rich in bioactive collagen peptides, which can be digested by proteases to form collagen peptides. These peptides increase fibroblast numbers in collaboration with growth factors and the production of extracellular components, which could be associated with the beneficial effects of collagen hydrolysate consumption.
A few human clinical trials using placebo controls have demonstrated that the ingestion of collagen peptides increases skin moisture [1] and elasticity [1], decreases wrinkle volume [1,2], and attenuates joint pain, compared to the placebo controls [3]. Furthermore, animal studies also have confirmed these beneficial effects. Currently, the other functions of collagen hydrolysate are under investigation.

FOOD-DERIVED COLLAGEN PEPTIDES IN HUMAN BLOOD

Most scientists believe that orally administered peptides are degraded into amino acids during the digestion and absorption processes. It has been speculated that the ingestion of collagen peptide could not show specific responses beyond those of its constituent amino acids. However, observation of the presence of high levels of hydroxyproline (Hyp)-containing peptide in human blood after the ingestion of collagen hydrolysate changed this conventional view. Collagen consists of a unique amino acid, Hyp, while most other proteins lack it. Thus, a Hyp-containing peptide can be considered to be a collagen peptide. Unexpectedly, high levels of collagen peptide were observed in human blood plasma after the ingestion of collagen hydrolysate [4]. Collagen peptide levels in human blood increase in a dose-dependent manner. After ingestion of 5–10 g collagen hydrolysate, which is the commonly used amount in supplements, a concentration of approximately 10–50 μM of collagen peptides are observed in human blood plasma, depending on the preparation method and source of collagen hydrolysate.

The main constituent of collagen peptides in plasma is Pro-Hyp, which has been confirmed by precolumn derivatization, followed by high-performance liquid chromatography (HPLC) separation and liquid chromatography–tandem mass spectrometry (LC-MS/MS). Animal experiments demonstrate that Pro-Hyp is deposited in tissue after its clearance from blood. In addition, Pro-Hyp is also generated from endogenous collagen in inflamed tissues and wound healing sites.

BIOLOGICAL ACTIVITIES OF PRO-HYP

To elucidate the biological significance of Pro-Hyp, effects of Pro-Hyp on fibroblasts were first examined. Mouse skin discs were cultured in the presence of Pro-Hyp or constituent amino acids (200 μM). The number of fibroblasts migrating from the skin significantly increased in the presence of Pro-Hyp, compared to that in the presence of free Pro and Hyp (Fig. 1) [5]. This effect was abolished by the addition of mitomycin C, which does not affect cell migration but inhibits cell division. Furthermore, Pro-Hyp triggered the growth of fibroblasts attached to the collagen gel (Fig. 2) [5].

Fibroblasts attached to the collagen gel stop growing even in the presence of growth factors, while fibroblasts grow rapidly on plastic and glass plates (Fig. 2). These observations indicate that Pro-Hyp stimulates the growth of fibroblasts in tissues in collaboration with growth factors. In addition, Pro-Hyp increases the production of hyaluronic acid and glycosaminoglycan by fibroblasts and chondrocytes, respectively. Pro-Hyp also increases the production of keratin-associated proteins from keratinocytes by affecting the excretion of some biological substances from fibroblasts.

The in vitro activities of Pro-Hyp could be associated with the in vivo responses of the ingestion of collagen hydrolysate, such as the increase of collagen content in skin, improvement of epidermis barrier function, and increase of glycosaminoglycan in the joints.
References


In conclusion, the ingestion of collagen hydrolysate increases the levels of bioactive collagen peptides such as Pro-Hyp in the blood and tissues. Pro-Hyp affects the growth of fibroblasts and stimulates the production of extracellular matrix compounds by fibroblasts, keratinocytes, and chondrocytes, which are associated with the beneficial effects of collagen hydrolysate ingestion on skin conditions.