COLLAGEN STEWARDSHIP ALLIANCE

COLLAGEN 101 GUIDE

Developed by the Collagen Stewardship Alliance

collagenalliance.org

info@collagenalliance.org

TABLE OF CONTENTS

WHAT IS COLLAGEN?

A group of abundant, fibrous proteins found in vertebrates, and is the primary building block of skin, connective tissue, cartilage, tendons, and bones. Supplemental collagen, comes in a variety of forms and is found as an ingredient for both cosmetic and dietary applications.

WHEN IS THE IDEAL TIME TO TAKE COLLAGEN?

Determining the ideal time to take supplements is a common concern, as the absorption and effectiveness of dietary supplements are often influenced by whether they are taken with food or on an empty stomach. However, collagen supplementation is less about the specific timing and more about consistency; it should be taken daily over the course of weeks or months for optimal results. Therefore, collagen products can be taken orally or mixed into any beverage of your choice, at a time that is most convenient for you.

COLLAGEN SOURCES:

Bovine Collagen

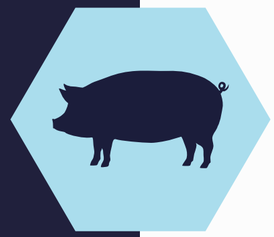
Source: Extracted from the hides, bones, and cartilage of cows[1]

Features:

- Composed of type I and type III collagen, known for supporting skin, bone, and joint health.
- Widely used in dietary supplements, cosmetics, and medical products.

Applications:

- Promotes skin elasticity and hydration.
- Supports joint health and cartilage integrity.
- Often used in protein supplements for muscle repair and recovery.



Porcine Collagen

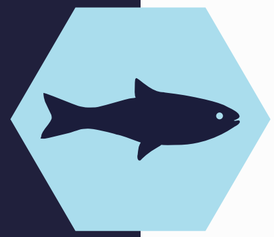
Source: Extracted primarily from pig skin[1]

Features:

- Rich in type I and type III collagen, with similar structural and functional properties to bovine collagen.

Applications:

- Enhances skin health and hydration.
- Supports joint health and cartilage integrity.



Marine Collagen

Source: Extracted from fish skin and scales[1, 2, 28]

Features:

- Known for its high bioavailability due to smaller peptide sizes.
- Primarily composed of type I collagen, beneficial for skin, hair, and nails.
- Thought of as a more sustainable and environmentally friendly option.

Applications:

- Formulations for skincare.
- Nutritional supplements designed to support healthy skin and hair.

COLLAGEN SOURCES: (CONTINUED)

Chicken Collagen

Source: Extracted from chicken cartilage[1, 3, 29]

Features:

- Contains type II collagen, which supports joint and cartilage health, as well as skin, hair, and nails.
- Often included in supplements targeting arthritis and joint pain relief.

Applications:

- Joint support and cartilage repair.
- Supports skin elasticity and hydration.
- Used to alleviate symptoms of osteoarthritis.

Eggshell Membrane Collagen

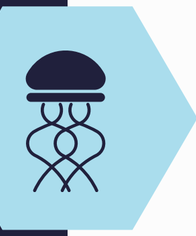
Source: From the thin membrane lining eggshells[4]

Features:

- Contains a mix of collagen types along with other beneficial compounds like glycosaminoglycans.
- Recognized for its ability to support both skin and joint health.

Applications:

- Improves joint flexibility and reduces pain.
- Promotes smoother, healthier skin.
- Possible concern due to egg allergy.



Emerging Collagen Sources[2]

While less common, research is exploring other collagen sources:

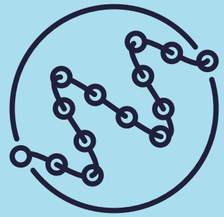
- Jellyfish, starfish and Marine Sponges: Valued for their bioactive potential and eco-friendly harvesting.

VEGAN COLLAGEN CONUNDRUM

We support the position as expressed by New Hope Informa:

We have set a precedent with companies making collagen, whey, or other animal-identical molecules, that does not allow the use of a vegan claim in reference to those products. We do this to protect the integrity of the term for vegans who avoid animal products in the interest of their health. While it may be fair to call products vegan in terms of the processing, it is misleading to call it vegan in terms of the actual physical properties of the product itself because, by definition, collagen is an animal protein. Such products should be revised to “animal-free collagen”.

HOW DOES COLLAGEN WORK?



Stimulates Collagen Synthesis

Supplementation of collagen products may increase the internal production of collagen.[5]

Supports Essential Amino Acids Status

While collagen is not a complete source of protein, supplementing collagen offers high levels of the non-essential amino acids, glycine and proline.[6]

Extra Cellular Matrix (ETC) Support

Collagen plays a role in maintaining ETC remodeling, which is critical for elasticity in muscles and connective tissue.[6, 7]

Oral Tolerance Mechanism

Native (undenatured) collagen, particularly type II may exhibit more immune-related effects, influencing inflammation in conditions such as such as autoimmune rheumatoid arthritis and osteoarthritis.[8]

TYPES & FORMS OF COLLAGEN

The human body naturally produces various types of collagen, each with distinct roles in different tissues. Type I collagen is predominantly found in skin and bones, providing structural support. Type II collagen is a key component of cartilage in joints. Type III collagen is naturally present in blood vessels and plays a role in the body's healing processes. These different collagen types work together to maintain the integrity and function of various bodily structures.

Available forms on the market include collagen peptides, hydrolyzed collagen, gelatin, and undenatured collagen, each offering distinct applications for health and wellness.

TYPES OF COLLAGEN:

TYPE I COLLAGEN:

Type I collagen is a fibrillar type collagen, is the most abundant collagen and is expressed in almost all connective tissues and is the predominant component of the interstitial membrane.

It forms large, eosinophilic fibers known as collagen fibers. It is present in scar tissue, the end product when tissue heals by repair, as well as tendons, ligaments, the endomysium of myofibrils, the organic part of bone, the dermis, the dentin, and organ capsules. Often paired with Type III.

TYPE IV COLLAGEN:

Found in the basal lamina, the layer of extracellular matrix supporting the epithelium.

TYPE II COLLAGEN:

As a protein, fibrillar collagen is composed of three identical polypeptide chains that represent the main components of the cartilage and other types of connective tissues in animals and humans, usually provided from chicken, sometimes bovine sources. As an oral ingredient, it appears as native type II collagen.

TYPE V COLLAGEN:

Found within the dermal/epidermal junction as well as in most interstitial (the space between structures) and in placental tissues. Frequently found in association with Type-I collagen.

TYPE III COLLAGEN:

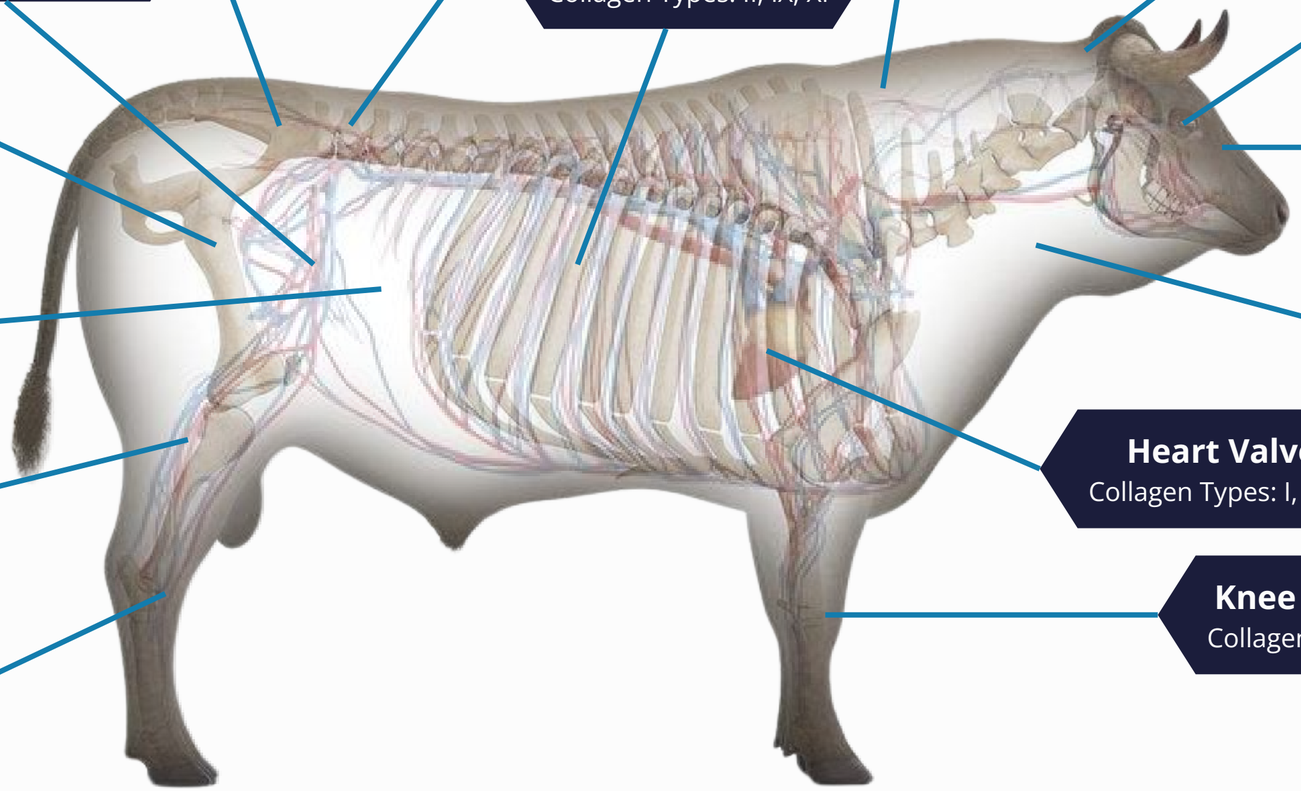
Type III collagen, one of the major fibrillar collagens, is found as a major structural component in hollow organs such as large blood vessels, uterus and bowel.

Other functions of type III collagen include interaction with platelets in the blood clotting cascade and it is also an important signaling molecule in wound healing. It constitutes between 5-20% of the entire collagen content of the human body. Often paired with Type I. [9]

TYPE X COLLAGEN:

Rare type of collagen that is involved in the growth, mineralization and remodeling of articular cartilage.

TYPES OF COLLAGEN:[10]



Interverbal Disc
Collagen Types: I, II, III

Fecet Joint Cartilage
Collagen Types: II, IX, XI

Skeletal Muscle
Collagen Types: I, III, VI

Articular Cartilage
Collagen Types: I, II, III

Blood Vessels
Collagen Types: I, III, IV

Costal Cartilage
Collagen Types: II, IX, XI

Cornea
Collagen Types: I, V, VI

Bone
Collagen Types: I, III, V

TMJ Disc
Collagen Types: I, III, V

Adipose Tissue
Collagen Types: I, V, VI

Skin
Collagen Types: I, III, VI

Tendons & Ligaments
Collagen Types: I, III, V

Heart Valve
Collagen Types: I, III, V

Knee Meniscus
Collagen Types: I, II, III

Articular Cartilage
Collagen Types: II, IX, XI

COLLAGEN FORMS:

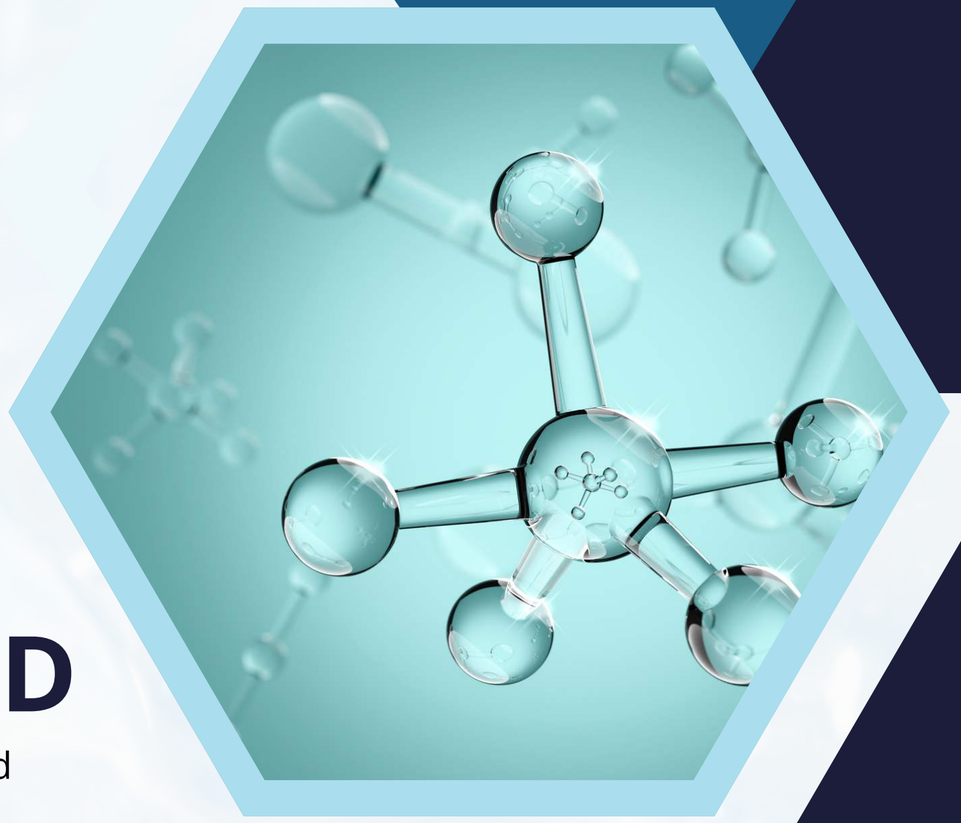
Gelatin	Produced by controlled thermal hydrolysis of animal bones, cartilage, and skin in water. Usually sourced from cows or pigs. High protein ingredient that can enhance the flavor, texture, and nutritional value of certain foods, such as mousses, stews, and gelled desserts.[11]	Typical dosage range: No current consensus on dosage[12]
Hydrolyzed Collagen/ Collagen Peptides	Hydrolyzed collagen (HC) is a group of collagen peptides with low molecular weight (0.3 and 8 kDa) and average molecular weight of 2-3kDa, that can be obtained by enzymatic action in acid or alkaline media at a specific incubation temperature. HC can be extracted from different sources such as bovine, porcine, or chicken. Intake of collagen hydrolysates has been reported to exert various beneficial effects, mainly at skin and joint levels.[13, 14]	Typical dosage range: 1 - 15 g/day[12, 29, 30]
Undenatured/Native Type II Collagen	Not broken down or hydrolyzed (into peptides), undenatured in its original form, with a triple helix structure.	Typical dosage range: 2-40 mg per day[12, 15]

COLLAGEN FORMS: (CONTINUED)

Collagen Matrix	Commonly associated to scaffolds, dressings and grafts, the extracellular matrix represents a complex alloy of variable members of diverse protein families defining structural integrity and various physiological functions. The most abundant family is the collagens with more than 20 different collagen types identified so far. [16]	Typical dosage range: • Chondroitan sulfate - 800-1200 mg/day [17] • Hyaluronic acid - 100-200 mg/day [18]
Collagen Boosters	Collagen boosters are often vegan products, that contain a number of amino acids derived from other sources, as well as vitamins and other nutrients intended to support or boost the body's ability to make (and retain) collagen. Common ingredients used in this way include hyaluronic acid, vitamin C and various antioxidants.	Typical Glycine dosage range - 10 g/day [19] Typical vitamin C dosage range: [20] • 15–75 mg for children • 75 mg for adult women • 90 mg for adult men • 85–120 mg for pregnant or breastfeeding women

NATIVE/UNDENATURED VERSUS HYDROLYZED/DENATURED

The two primary forms available on the market are native/undenatured and hydrolyzed/denatured collagen. These differ significantly in structure, production processes, mechanisms of action, as well as clinical applications.

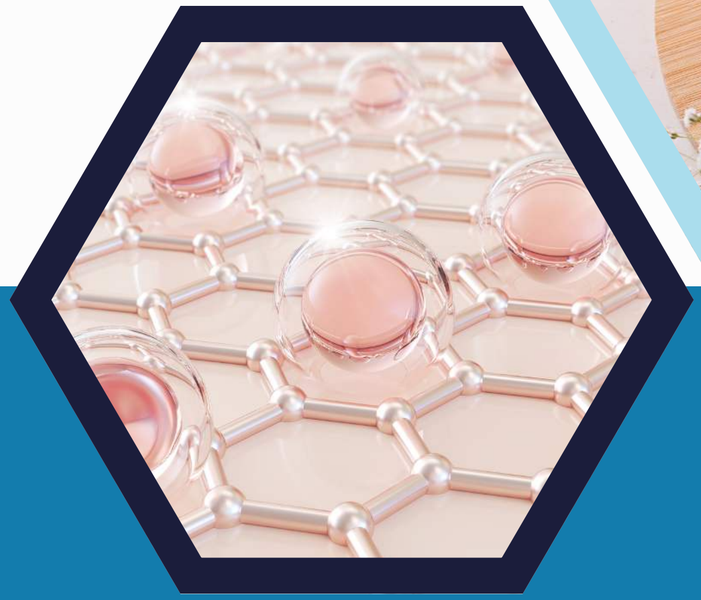


STRUCTURE AND PRODUCTION

Native/Undenatured Collagen:
Native collagen retains the original triple-helix structure and large molecular size, which is approximately 300 kDa. This form utilizes low temperatures and without denaturation agents to maintain its natural configuration.[21]

The Two Types of Native Collagen:

1. **Soluble Native Collagen:** Maintains the triple helix but has fewer crosslinks, which increases solubility. This is done by destabilizing the covalent bonds contained within its structure.[8]
2. **Insoluble Undenatured Collagen:** Retains its triple helix and natural crosslinks, making it water-insoluble.[8]



Hydrolyzed/Denatured Collagen:
Hydrolyzed collagen is produced by enzymatically or chemically breaking down native collagen. This process reduces molecular size to 2–9 kDa by breaking the original triple-helix structure, allowing for enhanced bioavailability.[21, 22]

MECHANISMS OF ACTION

Native/Undenatured Collagen

Native collagen, particularly undenatured type II collagen, is thought to work through oral tolerance, an immune-mediated process involving gut-associated lymphoid tissues. Preserved antigenic epitopes within the triple-helix structure may help modulate the immune response, potentially reducing inflammation in conditions like osteoarthritis.[8, 21]

Hydrolyzed/Denatured Collagen

Hydrolyzed collagen, due to its smaller peptide size, has different mechanisms:

1. **Enhanced Absorption:** These smaller peptides are absorbed in the small intestine, increasing bioavailability.
2. **Cartilage Support:** After absorption, collagen peptides may stimulate chondrocytes to synthesize cartilage components, as well as modulate osteoblast and osteoclast activity[8, 22]

BIOAVAILABILITY

Native/Undenatured Collagen [8]
Bioavailability: Lower due to its large size.

Hydrolyzed/Denatured Collagen [8, 23]
Bioavailability: Higher, due to its smaller peptides.

CLINICAL EVIDENCE AND APPLICATIONS

Native/Undenatured Collagen
Evidence on joint pain, specifically in subjects with osteoarthritis have shown promise, which is thought to be from an immune response, triggered in the gut.

Hydrolyzed/Denatured Collagen
Research has shown significant improvements in hair, nails, and skin, attributed to increased collagen production resulting from higher bioavailability. This heightened availability of collagen not only enhances the appearance and health of these structures but also seems to contribute to improvements in pain and joint pain. The mechanisms behind these benefits appear to stem from hydrolyzed collagen stimulating a greater repair and recovery response.

Initial data shows promise, but there will always be a need for more robust long-term studies to substantiate these findings. Offering opportunities in the market to grow brand awareness through clinical research. [24]

WHO SHOULD TAKE COLLAGEN?

Everyone may benefit from collagen supplementation. Many individuals do so to make up for lower intake of collagen through dietary sources. Others may want to increase their collagen intake through supplementation to support an area of concern. Collagen supplementation has been shown to be beneficial for:

Skin Health:

Significant benefits for skin health:

- Improved skin hydration and elasticity
- Reduced wrinkles and improved skin texture
- Enhanced dermal collagen density [5]

Joint Health:

Potential benefits for joint health:

- Improved recovery from exercise-induced joint stress [7]
- Potential reduction in osteoarthritis symptoms
- Supports joint comfort and mobility [8]

Muscle Recovery and Performance:

Supplementation may support:

- Faster recovery
- Improved markers of muscular recovery [5]

Bone Health:

Research suggests:

- Increased bone mineral density
- Enhanced calcium absorption
- Potential support for osteoporosis [25]

MISPERCEPTIONS/MISUNDERSTANDINGS:

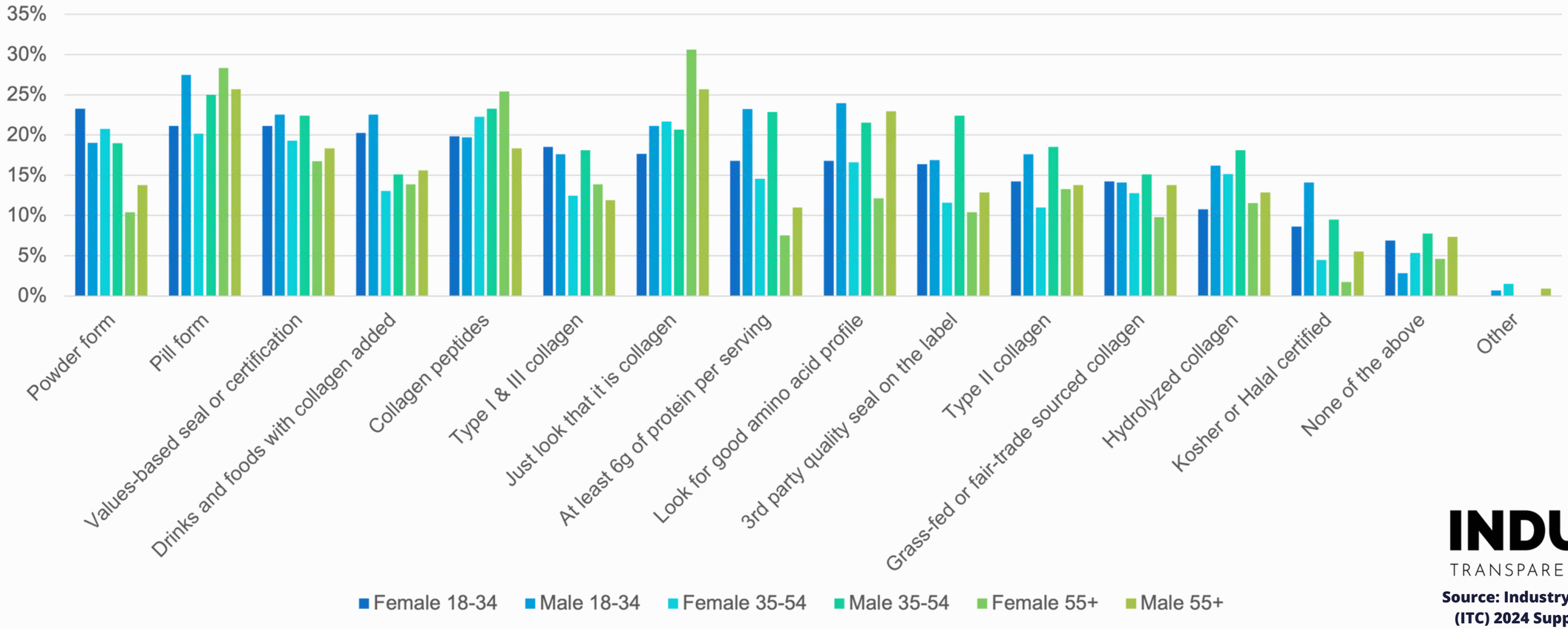
“All collagen supplements are the same.”	This is a prevalent misconception. In reality, collagen supplements differ significantly in several ways: type (e.g., Type I, II, III), source, form (powder, capsule, liquid), processing methods, and molecular weight (hydrolyzed vs. native). These differences can significantly impact the effectiveness.[5, 23]
“Collagen source doesn’t matter.”	While more research is necessary, evidence indicates that different types and sources of collagen may be more, or less effective for specific health concerns, such as skin health, or osteoarthritis pain. Furthermore, factors such as stability, bioavailability, and individual dietary restrictions, whether due to allergies or religious beliefs, can influence the choice of collagen source. [23, 26]
“Since our bodies make collagen, supplementation is not necessary.”	Although our bodies do produce collagen, this process tends to decline with age, starting in the late 20s to early 30s. Collagen supplementation can be beneficial in this context, helping support skin elasticity, hydration, and wrinkle reduction while also promoting joint health and function.[23, 27]
“Dietary protein vs. collagen supplements: Do we need supplementation in the context of sufficient protein.”	It’s true that our diet provides amino acids—such as glycine, proline, and hydroxyproline—that are essential for collagen production. However, when collagen is consumed as a supplement, it delivers unique bioactive peptide sequences that offer benefits not found in single amino acids or through simply increasing overall protein intake. [5]

COLLAGEN CONSUMER RESEARCH

Source: Industry Transparency Center (ITC) 2024 Supplement User Survey

COLLAGEN LABEL CHARACTERISTICS: AGE & GENDER

When looking at age and gender, there is a similar pattern shown, with most responses close to the 10%-20% range. There are a few characteristics that skew male, such as 6g of protein, while powder form shifts slightly towards females.

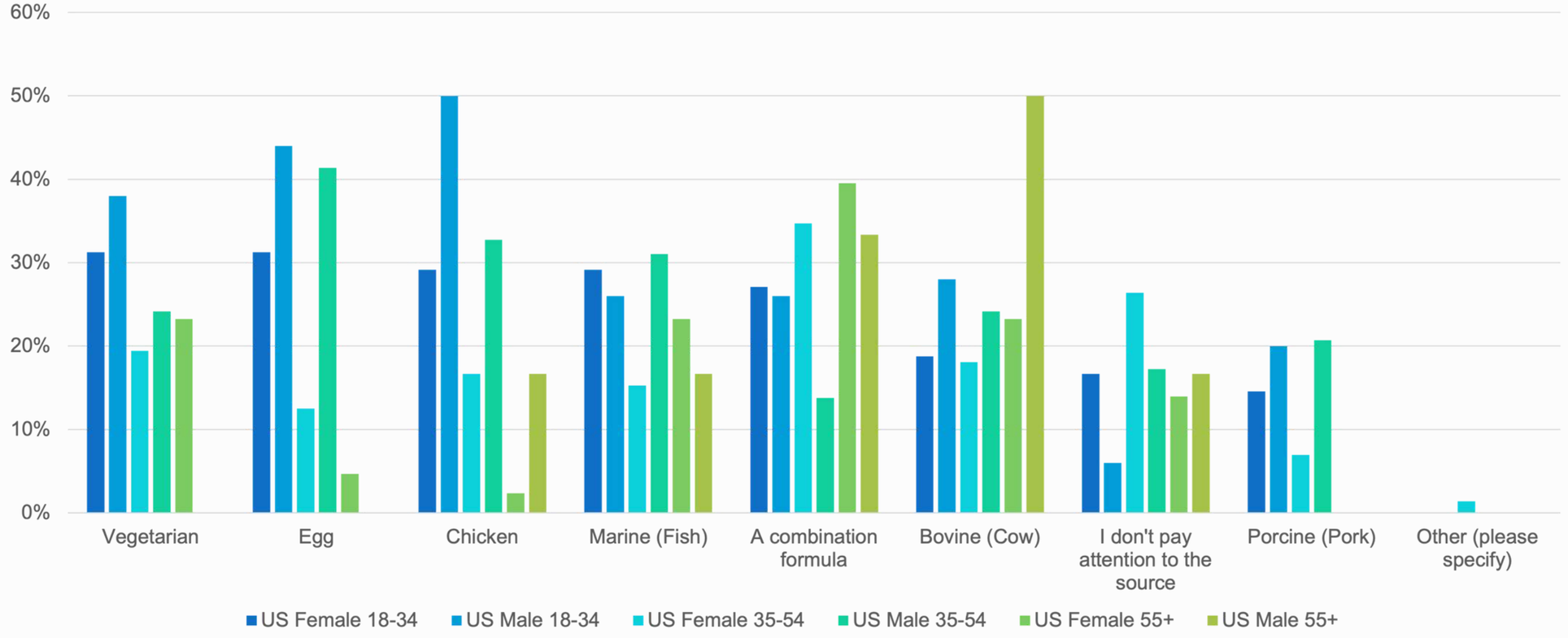


INDUSTRY TRANSPARENCY CENTER

Source: Industry Transparency Center (ITC) 2024 Supplement User Survey

PREFERRED SOURCE OF COLLAGEN: US, AGE & GENDER

Egg and chicken sources are most popular among younger demographics, including those who prefer vegetarian options. In contrast, older demographic groups, both males and females, tend to favor combination formulas. Porcine sources remain the least popular.

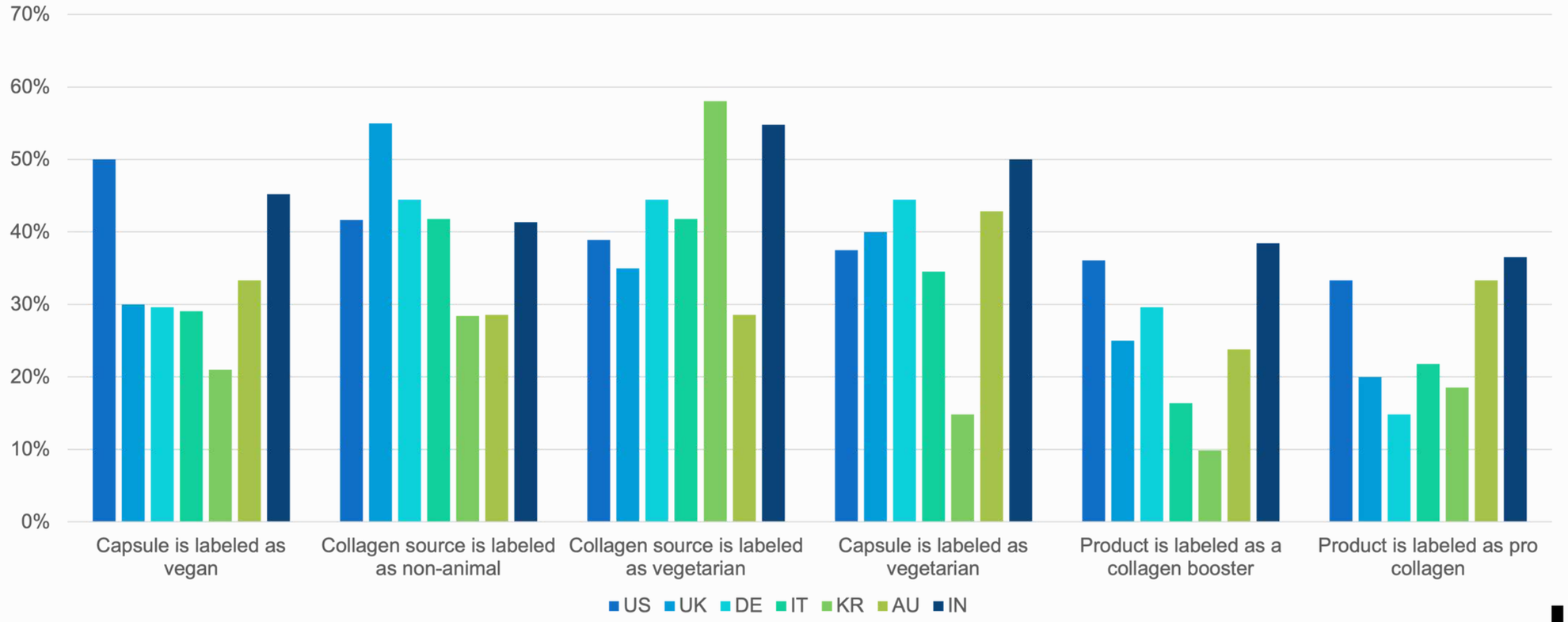


INDUSTRY TRANSPARENCY CENTER

Source: Industry Transparency Center (ITC) 2024 Supplement User Survey

VEGETARIAN COLLAGEN: COUNTRY

Vegetarian collagen is controversial but increasingly in demand, particularly in the US and India, which rank as the top two countries in almost all categories. On average, collagen boosters and pro-collagen products tend to have lower demand.



INDUSTRY TRANSPARENCY CENTER

Source: Industry Transparency Center (ITC) 2024 Supplement User Survey

COLLAGEN VERIFIED DISCUSSION

NutraStrong™ Collagen Verified (Collagen Verified) is a certification program for ingredient providers, manufacturers and brands designed to provide consumers with freely available third-party verified information regarding product quality to increase confidence and improve/facilitate purchasing decision making in the collagen market.

The Collagen Verified program reviews and evaluates collagen products to ensure purity, source, absence of contamination, manufacturing quality and claim substantiation so that customers receive what is claimed on the label. The program also seeks to protect the category by excluding claims including but not limited to “Vegan Collagen,” or similar.

Obtaining and displaying the Collagen Verified certification on your product will communicate to your customers that your ingredients/products are of the **highest quality** and that **transparency** is a core value of your company. You will be able to differentiate your products on quality, source and company values allowing for improved consumer evaluation and perception of your brand.

NUTRA STRONG™

PROCEDURE:

The **Collagen Verified program** is in place to outline the procedure for certification of dietary supplement products & ingredients containing collagen to ensure that all certified products have the following information in place: manner.

1. **Testing:** Accredited testing program in place to verify the contents of the product.

2. **Quality System:** Quality system in place to ensure that product is manufactured, handled, tested, stored, shipped, and treated in a consistent and repeatable manner.

3. **Labeling:** Product label should be clear and accurate in the description of the content including source and comply with current regulatory standards in the jurisdictions sold.

SCOPE:

The **Collagen Verified program** applies to companies whose purpose is, but not limited to, production, manufacturing, and/or processing of collagen, as well as companies which sell collagen containing foods, beverages, dietary supplements and/or natural health products directly to the public (e.g. major brands, private label brands, e-commerce brands, etc.).

The **Collagen Verified program** may apply to any food, dietary supplement and/or natural health product containing collagen as an input provided the applicant is either a member in good standing with the Collagen Stewardship Alliance or sourcing their collagen materials from an ingredient provider member of the Collagen Stewardship Alliance in good standing.

COLLAGEN STEWARDSHIP ALLIANCE | NUTRA STRONG™

COLLAGEN STEWARDSHIP ALLIANCE

CONNECT WITH US

Len Monheit
Executive Director, CSA
len@itcstrategy.com

Steve Imgrund
Communications Director, CSA
steve@itcstrategy.com

REFERENCES:

1. Matinong AME, Chisti Y, Pickering KL, Haverkamp RG. Collagen Extraction from Animal Skin. Biology. 2022;11(6):905. doi:https://doi.org/10.3390/biology11060905

2. Rahman A, Rehmani R, Pirvu DG, Huang SM, Puri S, Arcos M. Unlocking the Therapeutic Potential of Marine Collagen: A Scientific Exploration for Delaying Skin Aging. Marine Drugs. 2024;22(4):159. doi:https://doi.org/10.3390/md22040159

3. CORDEIRO ARR de A, BEZERRA TKA, QUEIROZ ALM de, et al. Collagen production from chicken keel bone using acid and enzymatic treatment at a temperature of 30 °C. Food Science and Technology. 2020;40(2):491-497. doi:https://doi.org/10.1590/fst.43118

4. Mensah RA, Salim K, Peszko K, Diop S, Ting HR Wong, David Y.S. Chau. The chicken eggshell membrane: a versatile, sustainable, biological material for translational biomedical applications. 2023;18(4):042001-042001. doi:https://doi.org/10.1088/1748-605x/acd316

5. Pu SY, Huang YL, Pu CM, et al. Effects of Oral Collagen for Skin Anti-Aging: A Systematic Review and Meta-Analysis. Nutrients. 2023;15(9):2080. doi:https://doi.org/10.3390/nu15092080

6. Holwerda AM, van Loon LJC. The impact of collagen protein ingestion on musculoskeletal connective tissue remodeling: a narrative review. Nutrition Reviews. 2021;80(6). doi:https://doi.org/10.1093/nutrit/nuab083

7. Bischof K, Stafilidis S, Bundschuh L, Oesser S, Baca A, König D. Influence of specific collagen peptides and 12-week concurrent training on recovery-related biomechanical characteristics following exercise-induced muscle damage—A randomized controlled trial. Frontiers in Nutrition. 2023;10:1266056. doi:https://doi.org/10.3389/fnut.2023.1266056

Zhang L, Wei W, Xiao F, et al. A randomized, double-blind, multicenter, controlled clinical trial of chicken type II collagen in patients with rheumatoid arthritis. Arthritis & Rheumatism. 2008;59(7):905-910. doi:https://doi.org/10.1002/art.23824

9. Kuivaniemi H, Tromp G. Type III collagen (COL3A1): Gene and protein structure, tissue distribution, and associated diseases. Gene. 2019;707:151-171. doi:https://doi.org/10.1016/j.gene.2019.05.003

10. UCI researchers quantify, characterize and identify functions of collagen, its subtypes. UC Irvine News. Published 2020. Accessed February 3, 2025. https://news.uci.edu/2020/07/24/uci-researchers-delve-into-collagen-a-ubiquitous-mammalian-biomaterial/

11. De Pietro M. Gelatin: Amino acids, uses, and benefits. www.medicalnewstoday.com. Published November 6, 2019. https://www.medicalnewstoday.com/articles/319124

12. Snyder C. How Much Collagen Should You Take per Day? Healthline. Published September 18, 2020. Accessed February 3, 2025. https://www.healthline.com/nutrition/how-much-collagen-per-day#_noHeaderPrefixedContent

13. Bakilan F, Armagan O, Ozgen M, Tascioglu F, Bolluk O, Alatas O. Effects of Native Type II Collagen Treatment on Knee Osteoarthritis: A Randomized Controlled Trial. The Eurasian Journal of Medicine. 2016;48(2):95-101. doi:https://doi.org/10.5152/eurasianjmed.2015.15030

14. León-López A, Morales-Peñaloza A, Martínez-Juárez VM, Vargas-Torres A, Zeugolis DI, Aguirre-Álvarez G. Hydrolyzed Collagen—Sources and Applications. Molecules. 2019;24(22):4031. doi:https://doi.org/10.3390/molecules24224031

15. COLLAGEN TYPE II (NATIVE): Overview, Uses, Side Effects, Precautions, Interactions, Dosing and Reviews. www.webmd.com. https://www.webmd.com/vitamins/ai/ingredientmono-714/collagen-type-ii-native

16. Gelse K, Pöschl E, Aigner T. Collagens—structure, function, and biosynthesis. Advanced Drug Delivery Reviews. 2003;55(12):1531-1546. doi:https://doi.org/10.1016/j.addr.2003.08.002

17. Bourgeois P, Chales G, Dehais J, Delcambre B, Kuntz JL, Rozenberg S. Efficacy and tolerability of chondroitin sulfate 1200 mg/day vs chondroitin sulfate 3×400 mg/day vs placebo. Osteoarthritis and Cartilage. 1998;6:25-30. doi:https://doi.org/10.1016/s1063-4584(98)80008-3

18. Gao YR, Wang RP, Zhang L, et al. Oral administration of hyaluronic acid to improve skin conditions via a randomized double-blind clinical test. Skin research and technology : official journal of International Society for Bioengineering and the Skin (ISBS) [and] International Society for Digital Imaging of Skin (ISDIS) [and] International Society for Skin Imaging (ISSI). 2023;29(11):e13531. doi:https://doi.org/10.1111/srt.13531

19. de Paz-Lugo P, Lupiáñez JA, Meléndez-Hevia E. High glycine concentration increases collagen synthesis by articular chondrocytes in vitro: acute glycine deficiency could be an important cause of osteoarthritis. Amino Acids. 2018;50(10):1357-1365. doi:https://doi.org/10.1007/s00726-018-2611-x

20. National Institutes of Health. Vitamin C. National Institutes of Health. Published March 26, 2021. https://ods.od.nih.gov/factsheets/VitaminC-HealthProfessional/

21. Harris RB, Fonseca FLA, Sharp MH, Ottinger CR. Functional Characterization of Undenatured Type II Collagen Supplements: Are They Interchangeable? Journal of Dietary Supplements. Published online June 1, 2021:1-16. doi:https://doi.org/10.1080/19390211.2021.1931621

22. Mobasheri A, Mahmoudian A, Kalvaityte U, et al. A White Paper on Collagen Hydrolyzates and Ultrahydrolyzates: Potential Supplements to Support Joint Health in Osteoarthritis? Current Rheumatology Reports. 2021;23(11). doi:https://doi.org/10.1007/s11926-021-01042-6

23. Wang H. A Review of the Effects of Collagen Treatment in Clinical Studies. Polymers. 2021;13(22):3868. doi:https://doi.org/10.3390/polym13223868

24. Honvo G, Lengelé L, Charles A, Reginster JY, Bruyère O. Role of Collagen Derivatives in Osteoarthritis and Cartilage Repair: A Systematic Scoping Review With Evidence Mapping. Rheumatology and Therapy. 2020;7(4):703-740. doi:https://doi.org/10.1007/s40744-020-00240-5

25. Geahchan S, Baharlouei P, Rahman A. Marine Collagen: A Promising Biomaterial for Wound Healing, Skin Anti-Aging, and Bone Regeneration. Marine Drugs. 2022;20(1):61. doi:https://doi.org/10.3390/md20010061

26. Collagen: A Review of Clinical Use and Efficacy | Nutritional Medicine Institute. https://www.nmi.health/collagen-a-review-of-clinical-use-and-efficacy/

27. Do. Boston Derm Advocate. Boston Derm Advocate. Published October 4, 2023. Accessed February 3, 2025. https://www.bostondermadvocate.com/science-of-skincare/do-collagen-supplements-really-work

28. BH;, H. S. H. (n.d.). Hair-growth-promoting effects of the fish collagen peptide in human dermal papilla cells and C57BL/6 mice modulating Wnt/β-catenin and BMP signaling pathways. International journal of molecular sciences. https://pubmed.ncbi.nlm.nih.gov/36233206/

29. Schwartz. (2019). Novel Hydrolyzed Chicken Sternal Cartilage Extract Improves Facial Epidermis and Connective Tissue in Healthy Adult Females: A Randomized, Double-Blind, Placebo-Controlled Trial. Alternative Therapies in Health and Medicine, 25(5). https://pubmed.ncbi.nlm.nih.gov/31221944

30. Park, J., & Schwartz. (2012). Ingestion of BioCell Collagen®, a novel hydrolyzed chicken sternal cartilage extract; enhanced blood microcirculation and reduced facial aging signs. Clinical Interventions in Aging, 267. https://doi.org/10.2147/cia.s32836