Worldwide Biopolymers Market Overview

Apr 2025

Disclaimer and Scope of Analyzed Sources

This document represents estimates as of March 2025 is based on WINDOME BANKING PARTNERS SAS's intelligence leveraging a number of independent sources:

1/ The Mordor Intelligence Report on the Global Aesthetic Filler Market (2018-2028), with information some on the number of fillers and aesthetic procedures, performance and market shares of key players for main regions and aesthetic country markets

2/ The Worldwide Market Report by GlobalData on the Aesthetics Market by Segment, country and competitors with market share indications (2015-2028)

3/ The Worldwide Market Report by GlobalData on the Aesthetics Dermal Fillers by type, country and competitors with market share indications (2015-2028)

4/ WINDOME BANKING PARTNERS SAS's presentation held at the IMCAS Webinar on Jan 27th, 2023 on the Challenges and Repercussions of COVID-19

5/ DRG QIV 2020 update including revised volume and value projections (2020-24) for HA and non-HA Dermal Filler and Toxin Injectables, Breast Implants and EBD segments and Dermocosmeceuticals, as well as by key regions

6/ Discussions with Leading Sector Executives, IMCAS Academy Webinars and Science Masterclass Teaching Courses, Business Insider Intelligence, Frost & Sullivan and KOLs or advisers of Regulatory Agencies and SmartTrak for the PRP market as well as other online sources;

7/ The Clarivate "Global Rejuvenation: Aesthetics Market Analysis"; January 2023

8/ Updates based on information obtained as part of Mr. Coste's membership in the IMCAS Faculty (International Mastercourse of Anti-Ageing Science)

We have focused on top markets to project the consequences on the medical aesthetics, regenerative medicine and dermocosmetics market.

The situation surrounding COVID-19 is dynamic and rapidly evolving, on a daily basis. Although we have taken great care prior to producing this presentation, it represents WINDOME BANKING PARTNERS SAS 's view at a particular point in time.

We cautiously advise our customers to make their own assessment as to the appropriate course of action to take, use this presentation as guidance. Please carefully consider local regulatory and guidance relevant for your area of operation, particularly the most recent advice issued by your local (and national) health authorities, before making any decision.

Glossary Of Selected Key Terminology

- **Type I :** 1,4-butanediol diglycidyl ether, a chemical which is most commonly used cross-linker in HA dermal filler to slow the rate at which the body breaks them down. BDDE has certain biological toxicity and potential carcinogenicity, and risk of lumps or nodules.
- **FACIT:** Fibril Associated Collagens with Interrupted Triple Helices (Type IX, XII, XIV, XIX, XXI)
- **Multiplexin** : Multiple Triple Helix domains with Interruptions(Type XV, XVIII)
- **PMMA:** Polymethyl methacrylate, a synthetic resin produced from the polymerization of methyl methacrylate. A transparent and rigid plastic, PMMA has been used as an injectable filler to treat hollows and reduce rhytids. PMMA fillers contain about 20 percent of tiny PMMA microspheres that are suspended in 80 percent purified collagen gel. The FDA approved PMMA in 2006 to treat nasolabial fold
- **Telopeptide:** The C-terminal telopeptide (H-Glu-Lys-Ala-His-Asp-Gly-Gly-Arg-OH), also known as carboxy-terminal collagen crosslinks, is the C-terminal telopeptide of fibrillar collagens such as collagen type I and type II. It is used as a biomarker in the serum to measure the rate of bone turnover.
- **PDLA:** Polymer D-lactic acid an ubiquitous biodegradable polymer. It is typically used to fabricate medical devices that predictably degrade over months in physiological conditions. The well-researched release profile also allows for drug-release functionalization with calculable results.1 Owing to its extensive history, PDLLA is one of the most understood and affordable biodegradable polymers for medical devices today.
- **Recombinant Human Collagen III:** The combination of the core functional regions of human type III collagen prepared through DNA recombinant technology. The repeating units of its amino acid sequence are the same as the specific functional regions of the amino acid sequence of human collagen. Its functional region has a 164.88° flexible triple helix structure.
- **PGPR:** Polyglycerol polyricinoleatem, is an emulsifier made from glycerol and fatty acids to help improve the texture and consistency of the product. In dermal fillers, PGPR is often used as a stabilizing agent, which helps to keep the filler from breaking down or separating over time.
- **HA:** Hyaluronic Acid, a naturally occurring substance that is found in the body, particularly in the skin, eyes, and joints. It is a glycosaminoglycan, which is a type of carbohydrate molecule that helps to maintain the structure and hydration of tissues in the body. HA is commonly used in the medical aesthetics and dermocosmetics
- **PLLA**: Polylactic Acid, a synthetic, biocompatible, biodegradable polymer. For soft-tissue augmentation, the size and chemical attributes of the PLLA microparticles are central to this agent's ability to promote a subclinical inflammatory response that stimulates deposition of collagen in the extracellular matrix.

Table of contents

Table of contents

Purpose of the Report and Methodology

- **Purpose**

This report aims to provide comprehensive insights into the global biopolymers market, especially in healthcare and aesthetics, assessing its current status, growth potential, and future trends. Collagen, a pivotal structural protein found in the connective tissues of animals, Chitosan, derived from chitin and found in large amounts in the carapace of marine arthropods (shrimps, crabs) and other forms of shellfish and crustaceans have witnessed escalating demand across various industries such as healthcare, pharmaceuticals, cosmetics, and food and beverages. The multifaceted applications of collagen, ranging from medical products to beauty enhancers, have driven its market to evolve continuously, adapting to varying consumer needs and technological advancements.

The primary purpose of this study is to furnish stakeholders, including industry leaders, investors, and policymakers, with an in-depth analysis of the biopolymers market. It seeks to uncover the driving forces behind the market's expansion, understand the challenges and constraints faced by the sector, and identify the opportunities for future growth. By evaluating market dynamics, consumer behavior, and competitive strategies, the report intends to aid in strategic decision-making and offer forecasts that help in planning long-term growth strategies in the biopolymers industry.

- **Methodology**

The methodology of this report encompasses a combination of primary and secondary research to ensure comprehensive and accurate results. The approach is outlined as follows:

- **Secondary Research:** Initially, an extensive review of existing literature was conducted. This included analyzing industry reports, scholarly articles, company annual reports, and market analysis publications to gather historical data and understand the current trends. Secondary research helped in identifying the market segmentation and key players, forming a solid foundation for the report.
- **Primary Research:** Interviews were carried out with industry experts, including CEOs, marketing managers from leading collagen-producing firms and KOLs from the industry including: plastic surgeons, owner of medical beauty spas. Insights from these interactions provided a real-time understanding of market dynamics and expert opinions on future trends.
- **Quantitative and Qualitative Analysis:** Both quantitative data (market size, growth rates, and revenue forecasts) and qualitative insights (market trends, growth drivers, and challenges) were analyzed.
- **Market Forecasting:** Using time-series analysis, regression models, and market forecasting techniques, the report predicts future market trends. This section provides stakeholders with expected market developments and potential investment opportunities.

The methodology adopted in this study ensures that the report provides a holistic view of the global collagen market, supported by reliable data and expert opinions, facilitating strategic decision-making for stakeholders involved.

Executive Summary of Key Findings

Total Collagen market size 2023	Total Collagen market CAGR2023-2030	Asia Pacific 2023 Market Revenue share	US 2023 Market Revenue share	Total Chitosan market size 2023	Total Collagen market CAGR2023-2030	Asia Pacific 2023 Market Revenue share
$10.8bn	9.1%			$90.5m	7.8%	

Market segmentation

- Global Aesthetic Collagen Filler reaches
- Collagen Wound Dressing market reaches
- Chitosan raw materials market reaches

Geographical distribution

- Asia Pacific takes dominant share in 2023 market Revenue share of with the following of Market share of that of US, In the projected period(2024-2023), North America and Asia Pacific will take lead of the growth
- Asia Pacific takes dominant share in 2023 market Revenue share of

Key opportunities

- Explore the potential for applications in healthcare, food industry, etc.
- Increasing Consumer Awareness
- Sustainability and Ethical Sourcing

Growing trend

- Expanding Applications in Healthcare
- Growing application of human recombinant collagen in Aesthetics and skincare,Marine Collagen Powder Market Growth, Increase in production of natural collagen
- Chitosan Demand rises in wound healing, drug delivery, and eco-friendly materials, driven by sustainability trends and regulatory support.

Source

- **Collagen:** Animal are the main source, especially bovine, porcine, poultry, marine
- **Chitosan:** Primarily derived from chitin, which is found in the exoskeletons of crustaceans (shrimp, crabs, lobsters) and the cell walls of fungi.

Key Challenges

- **Regulatory Hurdles**, especially concerning food and pharmaceutical applications
- **Supply Chain Volatility**, Fluctuations in the availability of raw materials

Section I

Hyaluronic acid Market

Hyaluronic Acid Classification

Hyaluronic acid raw material can be prepared by animal tissue extraction (originally cockscomb) or microbial fermentation. The molecular weight of hyaluronic acid obtained by animal tissue extraction generally ranges **from 200,000 Dalton to 2,000,000 Dalton**, while **microbial fermentation** can obtain hyaluronic acid with a molecular weight greater than 2,000,000 Dalton, and can also obtain hyaluronic acid with a molecular weight of less than 200,000 Dalton through later chemical degradation or microbial digestion techniques. **It is also possible to obtain hyaluronic acid with a molecular weight of less than 200,000 Dalton by subsequent chemical degradation** or microbial digestion. Hyaluronic acid can be categorized as large, medium, or small depending on the molecular weight range

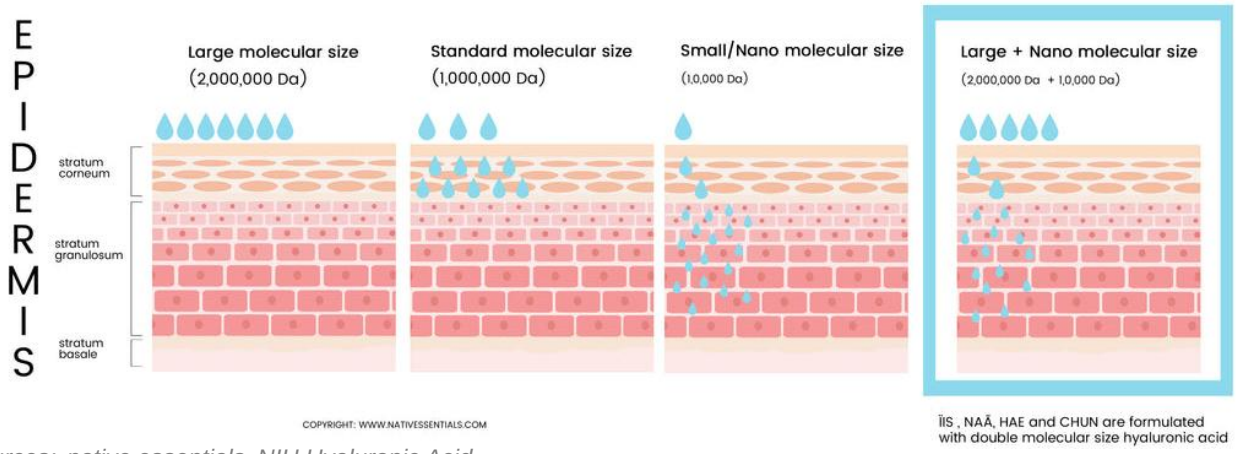
Large molecule hyaluronic acid, which typically has a molecular weight range of **1,800,000 to 2,200,000 Dalton**, is more viscous in aqueous solution and takes longer to metabolize in the body

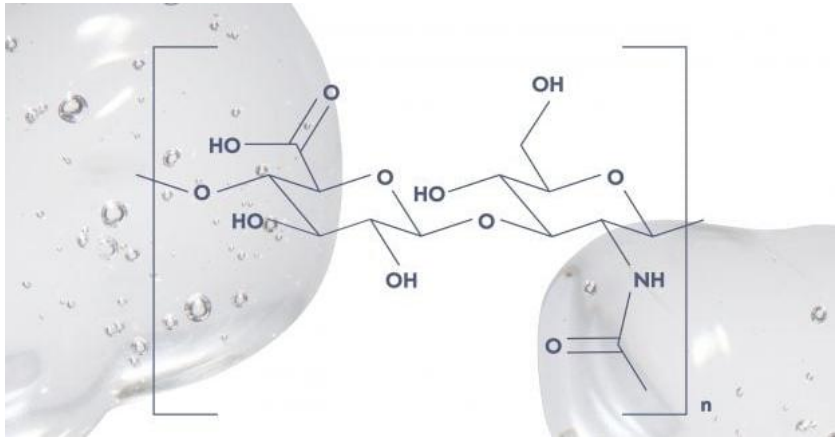
Medium molecular hyaluronic acid has a molecular weight between large and small molecules.

Small molecule hyaluronic acid is usually in the molecular weight range of **200,000~1,000,000 Dalton** and is metabolized more quickly in the body.

The difference in molecular weight makes hyaluronic acid show different physical and biological properties, with a wide range of applications. Hyaluronic acid with larger molecular weight has stronger support, resistance to degradation and viscoelasticity, so it is often used as a molding filler material in medical aesthetics. Smaller molecular weight hyaluronic acid is able to penetrate the epidermis and achieve deep skin absorption, so it is often used in moisturizing skin care products.

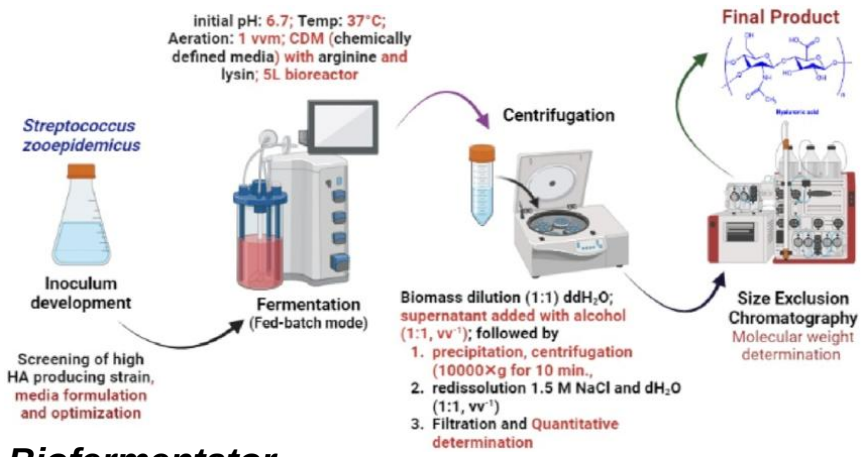
HYALURONIC ACID ABSORPTION





Sources: native essentials, NIH Hyaluronic Acid

Hyaluronic Acid Production uses - Biofermentation



Biofermentator

1. Strain Selection & Genetic Engineering (optional)

- *Use of Streptococcus zooepidemicus*
- *Or genetically engineered strains (e.g., Bacillus subtilis, E. coli, Zoo Equi) for better control and safety*

2. Fermentation

- *The bacteria are grown in a bioreactor, fed with nutrients:*
  - *Glucose (carbon source)*
  - *Peptones / yeast extract (nitrogen)*
  - *Salts, trace elements*
- *Under aerobic conditions and tightly controlled pH/temp*
- *Bacteria secrete HA into the culture medium*

3. Recovery

- *The culture broth is filtered to separate bacterial cells from the HA-rich supernatant*

4. Purification

- *Steps include:*
  - *Centrifugation*
  - *Precipitation (often with ethanol or isopropanol)*
  - *Dialysis or ultrafiltration to remove proteins, nucleic acids, endotoxins*
  - *Multiple Sterile filtration Passages*

5. Drying and Formulation

- *Purified HA is lyophilized (freeze-dried) into a powder*
- *Later rehydrated via pre-mixing with aqueous solutions for use in:*
  - *Dermal fillers*
  - *Eye drops*
  - *Joint injections*
  - *Skin creams*

Streptococcus zooepidemicus

- ✓ *The bacteria convert glucose into **UDP-glucuronic acid** and **UDP-N-acetylglucosamine***
- ✓ *These are polymerized by **hyaluronan synthase enzymes** → into high molecular weight*

Hyaluronic Acid Production uses - Biofermentation

- **Key Enzymes in HA Biosynthesis:**
- 1. **The main precursors are:**
    - UDP-glucuronic acid (UDP-GlcA)
    - UDP-N-acetylglucosamine (UDP-GlcNAc)
    - These are linked together by the enzyme hyaluronan synthase, which catalyzes the polymerization into HA.
- **2. Purification**
    - After fermentation, the broth contains HA along with bacterial cells and by-products.
    - Cell separation (filtration/centrifugation)
    - Enzymatic treatments (remove proteins/DNA)
    - Ultrafiltration to concentrate and purify HA, Drying (e.g., spray drying) to get HA powder
- 3. **Advantages of Biofermentation:**
    - Vegan-friendly (no animal origin)
    - Consistent molecular weight control
    - Scalable and sustainable
    - **High purity level** Lower contamination risk compared to animal extraction
    - Ability to comply with the most stringent requirements in purity levels (beyond the pharmacopoeia): Ions, Proteins, Nucleic acids, Bacterial endotoxins, heavy metal residue elimination
    - **Batch to batch consistency**

      Low variability with low polydispersity
- **High stability , R**esulting in long-lasting functionality in the end products.

Section II
The Global HA Market

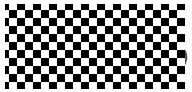
The Global HA Market reached $11.1bn in 2024 and is well-poised for breakout growth in the next years

HA market size 2024
$11.1bn

CAGR2024-2034
6.0%

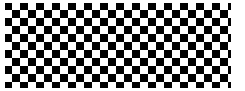
HA market size 2034
$19.9bn

Dermal filler(biggest application share)



Asia Pacific 2024 Market Revenue share

North America 2024 Market Revenue share



- In terms of revenues, the **dermal filler product segment dominated the market with the biggest revenue share of**  in 2024
- Hyaluronic Acid was first discovered 90 years ago, back in 1934, by Columbia University researchers Karl Meyer and John Palmer. They extracted the vitreous humor from the eyeballs of a cow and characterized it as a highly hygroscopic, high-molecular-weight polysaccharide acid. In the 1970s, scientists realized they could extract hyaluronic acid from the combs of roosters and its use became more popular. The companies that tended to extract and utilize it mostly had connections to the poultry or egg industries due to their easy access to roosters.
- **Hyaluronic acid (HA),** is a sulfur-free straight-chain mucopolysaccharide composed of the disaccharide units **D-glucuronic acid and N-acetylglucosamine**, which is widely distributed in connective tissues, epithelial tissues and neural tissues of the human body. Its unique molecular structure and physicochemical properties in the body show a variety of important physiological functions, such as lubrication via viscosupplementation of joints to regulate the permeability of the blood vessel wall, regulating the diffusion of proteins and electrolytes and the maintenance of sufficient hydration, anti-inflammation and promote wound healing.while protecting the epidermal layers of the skin against external aggressions from free radicals ,exposure to ultraviolet rays and the consequences of oxidative stress. Particularly important is that the hyaluronic acid molecule can absorb up to 1000 times its weight in water, so it can be used as a high-quality moisturizing ingredient to reduce Transepidermal Water Loss (TEWL) with high clinical value, known as the natural moisturizing factor.
- **Key Characteristics:**
  - **Hydrophilic:** Can hold up to 1,000 times its weight in water.
  - **Biocompatible and biodegradable:** Safe for medical and cosmetic applications.
  - **Viscoelastic:** Acts as both a lubricant and a shock absorber in joints.

Notes: CAGR: Compound Annual Growth Rate / average growth rate per year.
Sources: precedenceresearch, Mordor Intelligence

HA's Characterization, Mode of Delivery and Main Applications

Category	Mode of Delivery	Main Applications
PHARMACEUTICAL GRADE (▓▓)*	Injectable Transparent Hyaluronic Acid	lubricant or shock absorber to treat osteoarthritis pain
		lubricant to prevent post-surgical adhesions
		viscous adhesive for ophthalmic surgery
		plastic surgery filler to prevent skin aging
	Eye Drop Transparent Hyaluronic Acid	carrier for ophthalmic drugs to reduce drug irritation and prolong drug efficacy
COSMETIC GRADE (▓▓)*	Topical Transparent Hyaluronic Acid	Used in various moisturizing skincare products
FOOD GRADE(▓▓)*	Food-Grade Transparent Hyaluronic Acid	nutritional supplements and food products

Notes: CAGR: Compound Annual Growth Rate / average growth rate per year. % referes to revenue breakdown
Sources: precedenceresearch, Mordor Intelligence

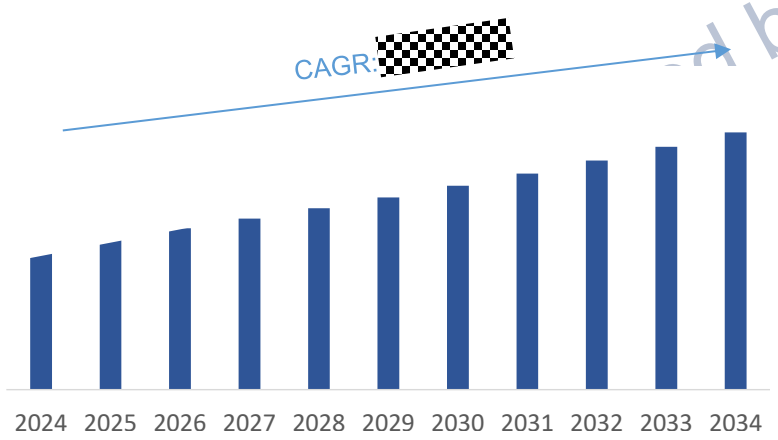
Global Hyaluronic Acid Market Growth & Trends

GLOBAL Hyaluronic Acid MARKET OVERVIEW

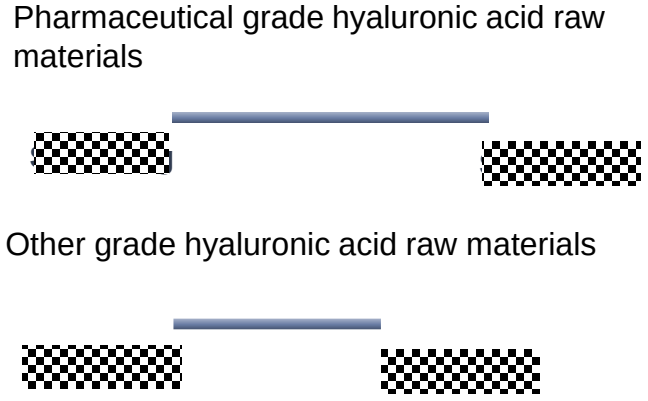
HIGH DEMAND FROM THE MEDICAL AESTHETICS DERMO-COSMETICS AND REGENERATIVE MEDICINE SECTORS ACCELERATES GLOBAL GROWTH

- The global Hyaluronic Acid market size is expected to reach **USD 19.9 billion by 2034**, expanding at a revenue-based **CAGR of 6.0 %** from 2024 to 2034, according to a report by Grand View Research (March 2025). The global Hyaluronic Acid volume sales is [redacted] in 2023, of which, pharmaceutical-grade hyaluronic acid raw materials sales is the fewest, but its unit price is much higher than other grades.
- Because of its hydrating and anti-aging characteristics, hyaluronic acid is frequently used in skincare products. It contributes to moisture retention, which keeps the skin hydrated and plump. Hyaluronic acid has become more and more in demand in cosmetics and personal care items, including serums, lotions, and moisturizers. As a result, new products have entered the hyaluronic acid market, further accelerating its expansion. Furthermore, the aging population and the frequency of joint problems are driving the need for hyaluronic acid in the healthcare industry.
- The market for natural and organic skincare products is expanding as people become more aware of the components in the goods they use. Because hyaluronic acid is a naturally occurring substance in the body, it fits nicely with this trend and will continue to develop in the hyaluronic acid market.

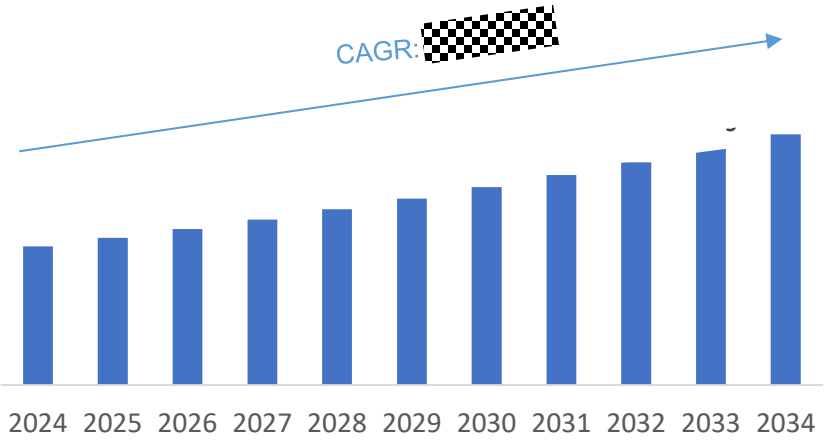
Global Hyaluronic Acid Market Size Evolution
Revenue in USD billions, 2024-2034



Hyaluronic acid raw material price(2024)
(Based on Frost & Sullivan)



US HA market Size (2024)
Revenue in USD billions, 2024-2034



Sources: Grand View Research, Huatai Research

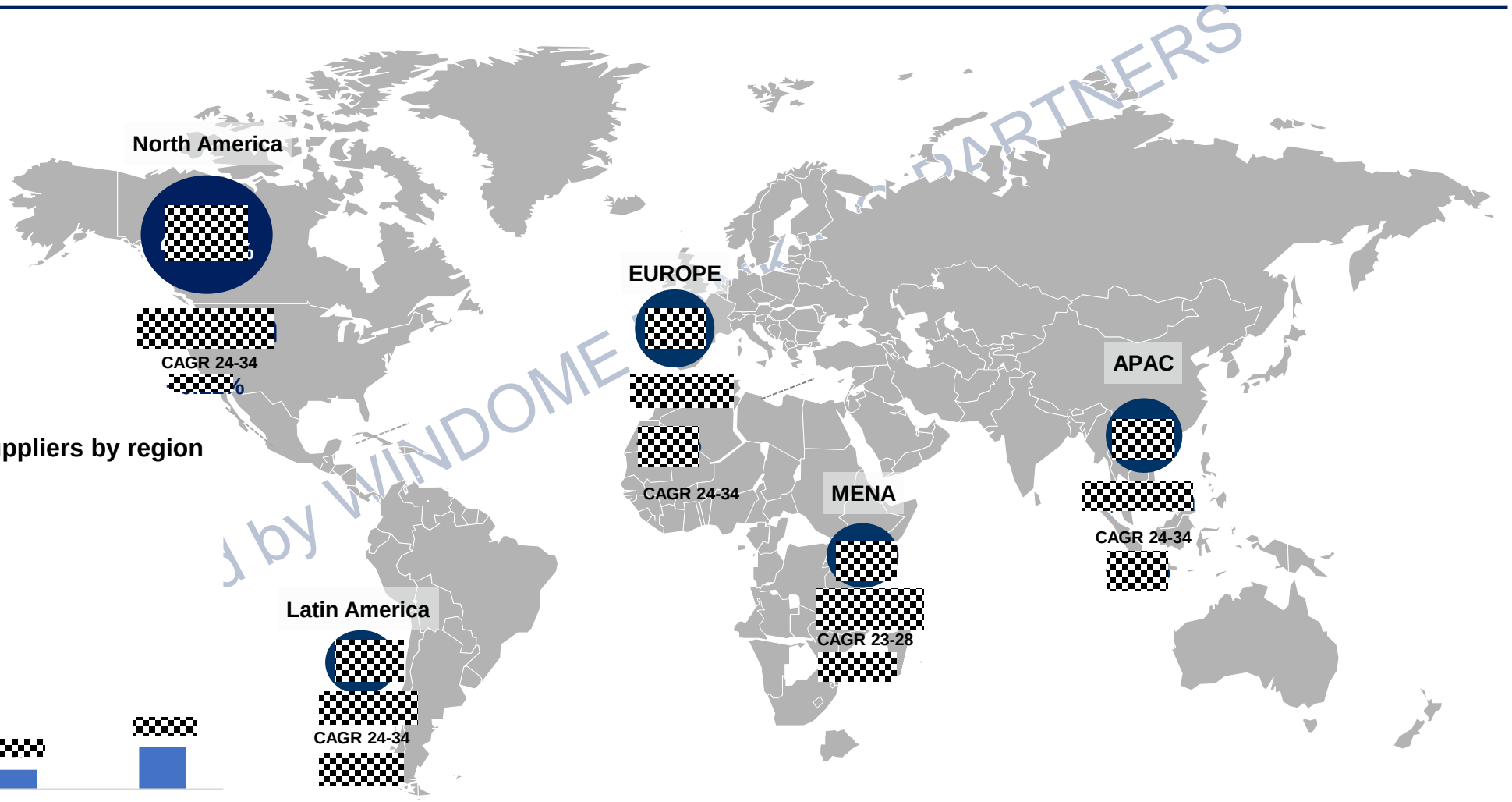
Global Hyaluronic Acid Market Evolution from 2024

Global Market of Hyaluronic Acid

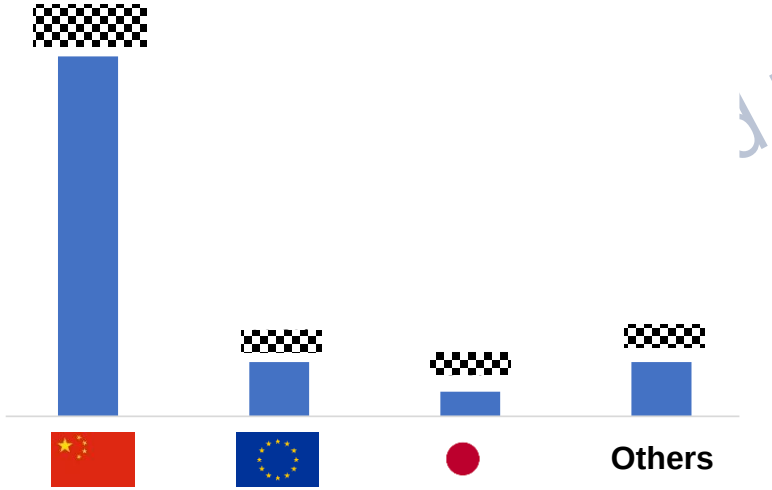
$11.1bn in 2024

$19.9bn in 2034

+6.0% CAGR 2024-2034



Hyaluronic acid Ingredient Suppliers by region

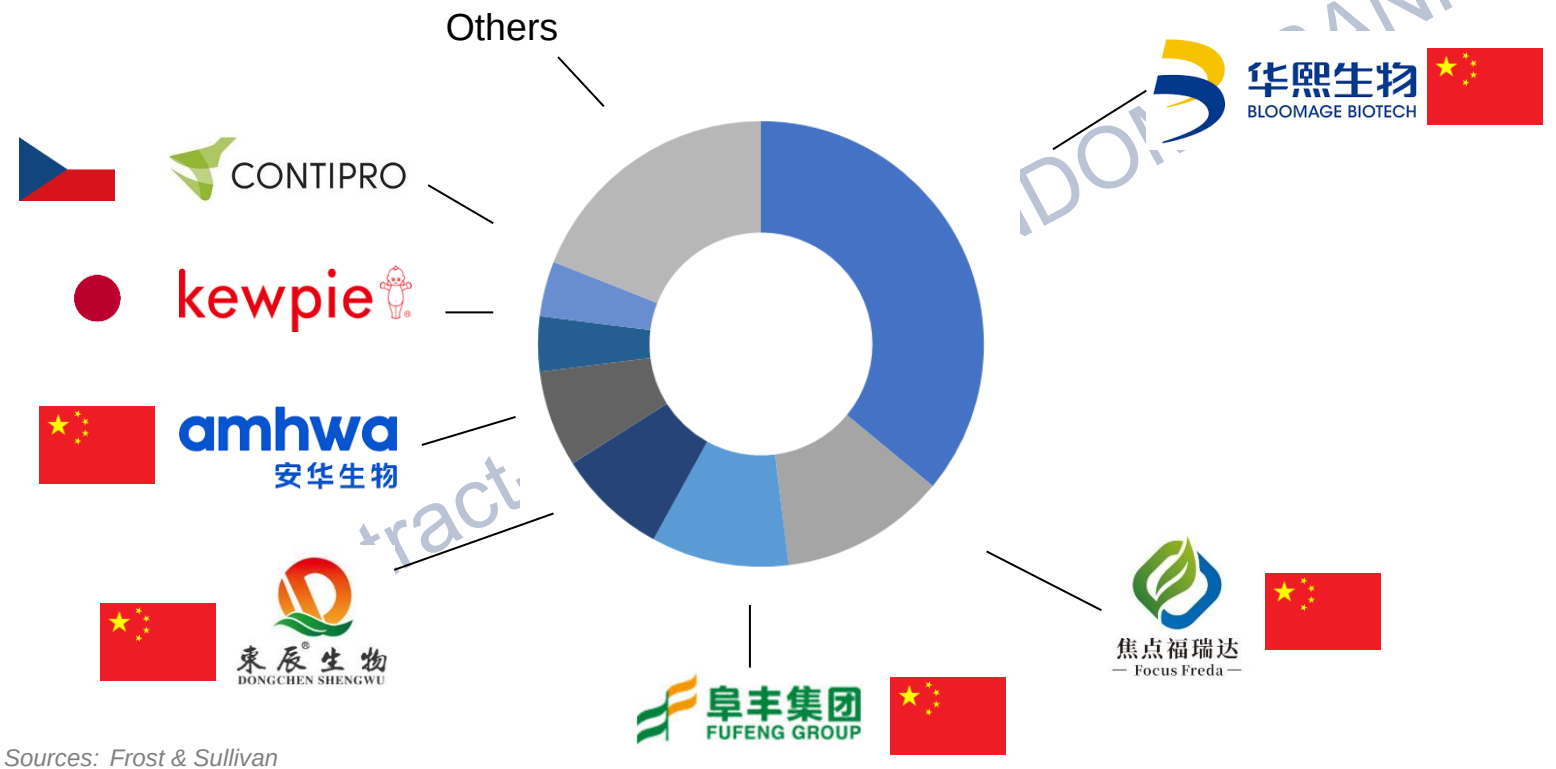


Sources: Global newswire, Mordor Intelligence

Global Hyaluronic Acid Ingredients Market Competitive Landscape

Hyaluronic acid Ingredient volume led by Chinese company, of which volume accounted for [redacted]

China is the world's largest hyaluronic acid raw materials production and sales country, the total sales volume of hyaluronic acid raw materials in China in 2023 accounted for [redacted] of the global total sales volume of the world's top five hyaluronic acid raw materials sales volume of the top five companies, all of which are Chinese companies. Among them, **Bloomage is the world's largest hyaluronic acid production and sales enterprise, accounting for [redacted]% of the sales volume in 2023.**



Global Hyaluronic Acid Ingredients

CONTIPRO kewpie amhwa 安华生物

東辰生物 DONGCHEN SHENGWU 阜丰集团 FUFENG GROUP 华熙生物 BLOOMAGE BIOTECH

焦点福瑞达 Focus Freda Givaudan Human by nature htl BIOTECHNOLOGY

Lifecore BIOMEDICAL DSM BAODING FAITHFUL A RELIABLE RAW MATERIAL SUPPLIER FOR HEALTH PRODUCTS

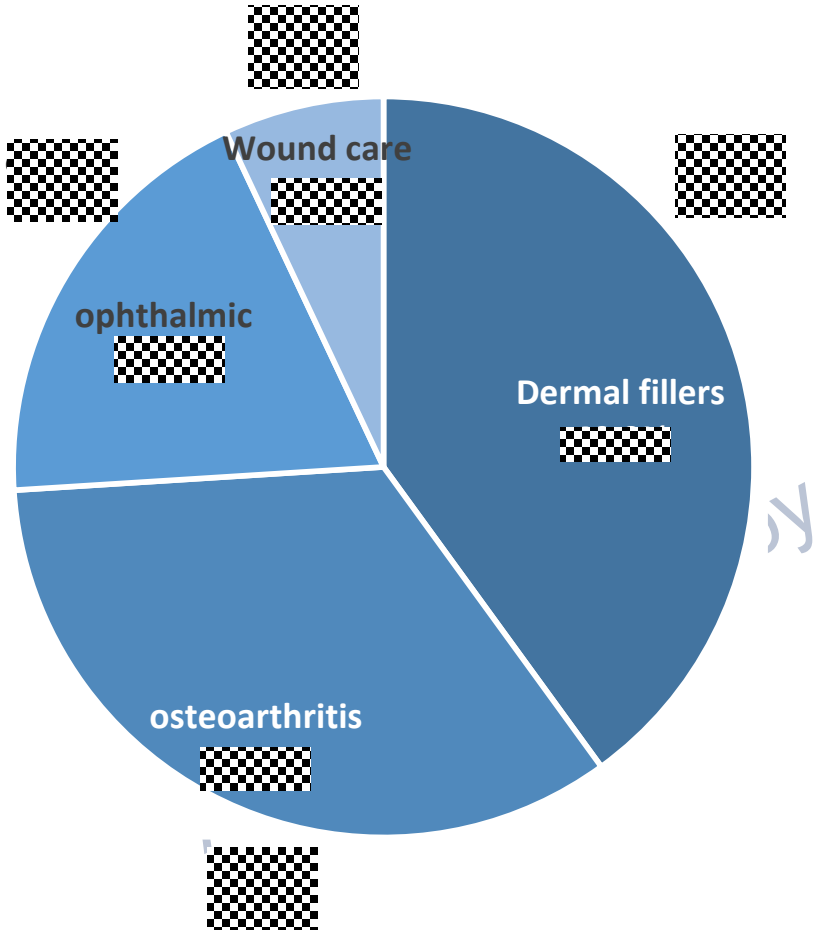
PLAMED 绿天生物 EVONIK Leading Beyond Chemistry

Sources: Frost & Sullivan

Breakdown of Application of Pharma-Grade Hyaluronic Acid

The dermal fillers segment held the largest share of the hyaluronic acid market in 2024

Application of Hyaluronic Acid



- **Hyaluronic acid-containing dermal fillers** have been in high demand due to a number of variables, including an aging population, rising public awareness of cosmetic procedures, and developments in aesthetic medicine, exposure to inflammatory agents such as oxidative stress, pollution and endocrinological disruptors, global warming, ultraviolet sunrays following depletion of ozone layers. Customers are looking for more natural-looking outcomes that accentuate their features without coming across as excessive.
- Hyaluronic acid is the material of choice for dermal fillers since it is a naturally occurring component in the body and is generally well-tolerated. These filters are renowned for their ability to produce outcomes that look natural with little chance of problems or negative responses. Hyaluronic acid-based fillers have witnessed constant innovation in the hyaluronic acid market, including changes in formulation, cross-linking strategies, and delivery systems. The fillers now perform and last longer because of these advances. The quest for minor changes and faster recovery times has fueled a growing trend towards less invasive cosmetic procedures, such as dermal fillers.
- **The osteoarthritis segment is expected to witness the fastest growth in the hyaluronic acid market** by application. In the medical field, hyaluronic acid is also utilized, especially in the treatment of osteoarthritis. It is injected into the joints to act as a cushion and lubricant, decreasing discomfort and increasing joint range of motion. New uses for hyaluronic acid are being investigated through ongoing research and development. In order to increase the effectiveness of hyaluronic acid-based medicines, manufacturers are concentrating on creating cutting-edge formulations and delivery methods.

Sources: Grand View Research

Section III
The Global HA Policies Overview

National policies on Hyaluronic Acid

United States Food and Drug Administration (FDA) Labeled Indications

Intraarticular injection
For pain relief in patients with mild to moderate osteoarthritis (OA) of the knees, who have not responded to conservative non-pharmacological measures and/or analgesics. The FDA has not evaluated nor approved this treatment for any other joints.

Intradermal injection
Injection into the mid-to-deep dermis for correction of facial wrinkles or folds and perioral rhytids. Patients must be over the age of 21.

Subcutaneous injection
Volume deficit correction for dorsal hands in patients over the age of 21. Correction of age-related volume loss and for cheek augmentation in mid-face in patients over the age of 21.

Subperiosteal injection
Correction of age-related volume loss and for cheek augmentation in mid-face in patients over the age of 21.

Submucosal injection
Correction of age-related volume loss and for cheek augmentation in mid-face in patients over the age of 21.

Topical cream/gel
Management of wounds, skin ulcers, Relief of symptoms (burning, itching, and pain) in dermatoses such as atopic dermatitis, radiodermatitis, and allergic contact dermatitis.

Ophthalmic
Surgical aid cataract extraction, intraocular lens implantation, corneal transplant, glaucoma filtration, retinal attachment surgery, and anterior segment surgery.

Non-FDA-Labeled Indications

•Injection to provide a scaffold for regenerative endodontic procedures, Injection into vocal folds to treat glottal insufficiency, Injection into the areola to enhance nipple projection after breast reconstructive surgery, Refractory interstitial cystitis

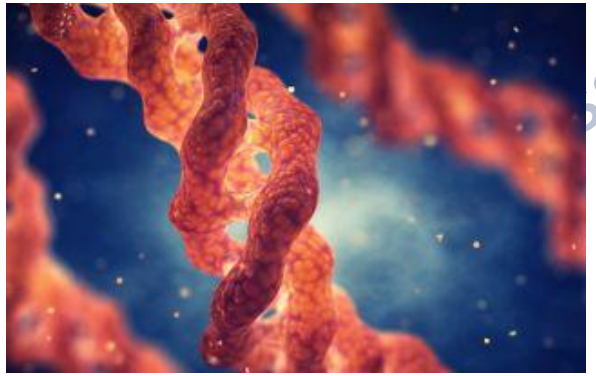
Sources: native essentials, NIH Hyaluronic Acid

Section II
The Global Collagen Market

The Global Collagen Market reached $10.8bn in 2023 and is well-poised for breakout growth in the next years

Collagen market size 2023	CAGR2023-2030	Collagen market size 2030	Gelatin (biggest product share)	Food and beverage (biggest application share)	Asia Pacific 2023 Market Revenue share	US 2023 Market Revenue share
$10.8bn	9.1%	[redacted]	[redacted]	[redacted]	[redacted]	21.4%

- In terms of revenues, the **gelatin product segment dominated the market with the biggest revenue share of** [redacted]
- **With regards to animal-source collagen, the main sources are bovine, porcine, poultry, marine (fish), plankton and jellyfish. Despite an accelerating diversification, the bovine source still** dominated the market with the highest revenue share of [redacted]. The marine source segment is projected to ascend at a CAGR of [redacted] over the forecast period.
- Dry form dominated the market with a revenue share of more than [redacted] in 2023.
- Type I dominated the market with a revenue share of more than [redacted] in 2023. This is attributed to the growing inclusion of the product in tissue engineering **as the induction of collagen subsequently orchestrated a cascade of processes that underpin fibroblasts secretion, reconstruction of the dermal-epidermal juncture and the regenerative capabilities of the body.,** drug delivery systems via vectorization of collagen, and cosmetic surgery.
- In terms of volumes, cosmetic surgery and wound healing emerged as the largest healthcare application segments in 2023, owing to its ability to treat chronic wounds as they inhibit the action of metalloproteinase
- Key factors that are driving the collagen market growth include increasing demand for collagen-based cosmetics, skincare, regenerative and reconstructive medicine as well as wellbeing, fitness and wellness products as part of an holistic therapeutic routine due to their superior anti-aging and cell repair and tissular induction properties

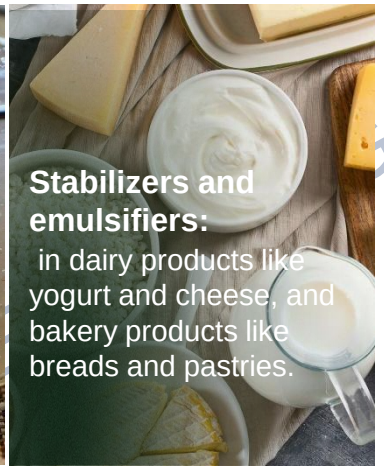


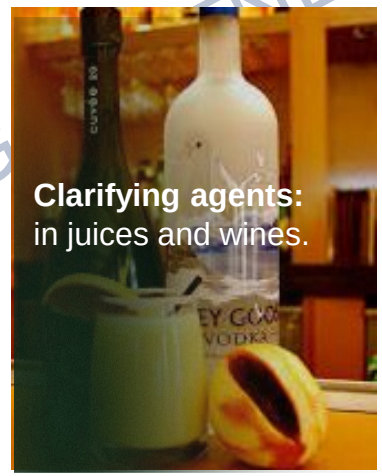

Notes: CAGR: Compound Annual Growth Rate / average growth rate per year.
Sources: Grand View Research, precedenceresearch, Mordor Intelligence

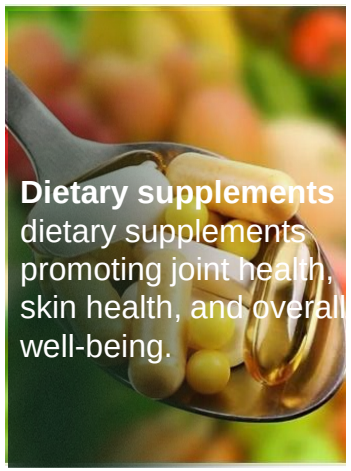
Breakdown of Industrial use of Collagen

The biggest industrial use of collagen is currently in the food and beverage industry

Primary Usage







Secondary Usage

- **Wound healing and tissue regeneration:** Collagen-based biomaterials are used in medical devices and implants for skin grafts, bone fillers, and cartilage repair.
- **Drug delivery systems:** Collagen can be used to create matrices for controlled release of drugs and bioactive molecules
- **Cosmetics:** Hydrolyzed collagen is an ingredient in some anti-aging creams and lotions, although its effectiveness in topical applications is debated.

- **Adhesives:** Collagen-based adhesives are used in various industries, including wood and paper products.
- **Filtration materials:** Collagen membranes are used in water purification and other filtration applications.
- **Packaging materials:** Collagen can be used to create edible and biodegradable packaging films.

Sources: Grand View Research

Collagen: The Foundational Building Block of The Body

Collagen is the **most abundant protein in the body**, accounting for about **30% of the total protein content**. It's a crucial component of the connective tissues, which are the

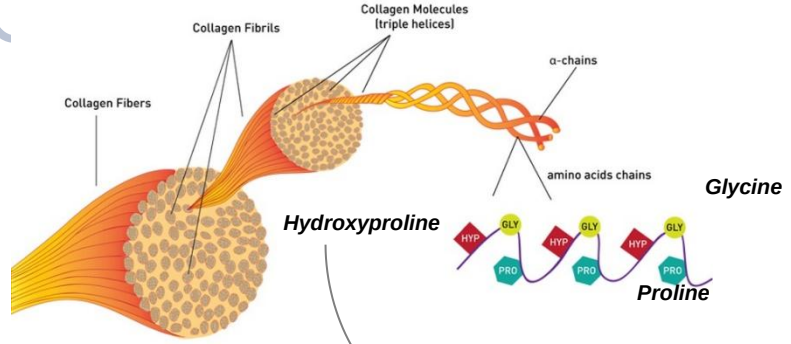
Functions of Collagen:

Forms the framework of the skin, bones, muscles, tendons, and ligaments: Imagine collagen as a strong, flexible mesh that provides structure and support to your tissues.

Provides cushioning and shock absorption: Collagen in your joints helps protect your bones from impact and wear and tear.

Maintains skin elasticity, cohesivity and firmness: Collagen production naturally decreases with age, leading to wrinkles and sagging skin

Contributes to wound healing: Collagen plays a key role in repairing damaged tissues, the dermal-epidermal juncture and promoting wound healing.



There are 28 different types of collagen in the human body, each with its own specific function and location. The most common types:

Type I

90% of Vertebrates collagen - Found in skin, tendons, and organs.

Type II

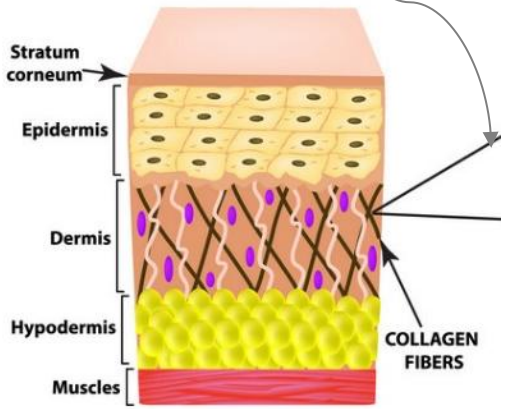
Found in **cartilage** and provides cushioning for joints

Type III

Muscles, **blood vessels and internal organs**

forms basal lamina

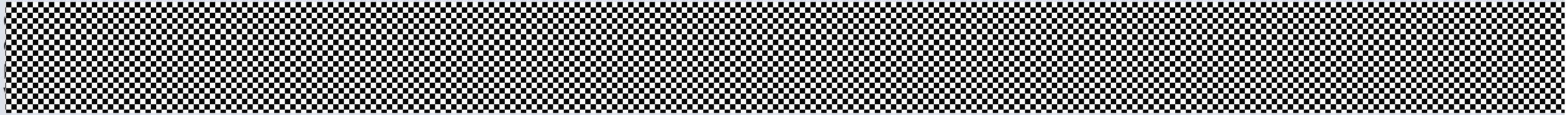
cell surfaces, hair, and placenta

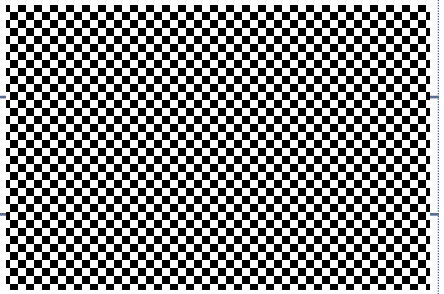


TYPE 1 90% of collagen in humans

They are several factors that can affect collagen production, including **Age, Diet**, **Sun damage**, exposure to oxidative stress as well as pollution, **Smoking** and de-hydration (amongst others from alcohol consumption). This can provoke accelerated collagen degradation and premature signs of ageing.

Collagen, Collagen types, Peptides and Gelatin

- **There are 28 types of types of collagen of which 12 are expressed in the skin at the dermis, epidermis, dermal-epidermal junction as well as hypodermis levels** , but the main ones in typical health discussions are Types 1, 2, and 3. Collagen Types 1 and 3 are the most abundant and can be sourced from bovine (Type 1 can come from marine collagen as well). They make up 90% of the total collagen in our body, and are important for the health of our bones, muscles, skin and hair. Type 2 collagen can only be found in cartilage and is important to the joints. Collagen XIII is expressed at the surface of the epidermal cells (keratinocytes), connecting the cellular compartments enabling a constant intra-cellular dialogue, particularly during embryonic development and tissue remodeling.
- Collagen decays with ageing, structurally and biologically at a rate of 1% per year from the age of 20 and 3-4% post menopause in women, such degradation being accelerated by extrinsic factors such as skin oxidation triggered by sun exposure, air pollution, air conditioning, inflammation, stress…
- 
- **Gelatin** is another type of collagen, but instead of going through full hydrolysis, **gelatin collagen has undergone only partial hydrolysis.** This is where its gel appearance comes from. To produce gelatin, animal bones, skin, and other connective tissues are boiled in water for an extended period. This process extracts the collagen from the tissues, and as the solution cools, the collagen molecules reorganize and form a gel-like substance. This is then dried and ground into a powder, resulting in the final gelatin, commonly used to thicken foods for desserts, stews, and gummies.

	Form & Molecular Weight	Solubility	Absorption & Digestibility	Applications	Global Market Size (2023)
Native Collagen	 MW: >300K Da	Insoluble	None	Medical materials, collagen casings, healthcare (wound dressing, tissue regeneration, medical implants, cardiology), etc.	
Gelatin	 MW: 50K - 100K Da	Medium	Medium	Gelatin desserts, confectionery cooking, food production, cosmetics, pharmaceuticals, drug delivery, industrial applications, etc.	
Collagen Peptides	 MW: 300 - 8K Da	High	High	Dietary supplements, functional foods and beverages, biomaterials, nutraceutical industries, etc	

Sources: Further Food, Grand View Research, MarketsandMarkets,

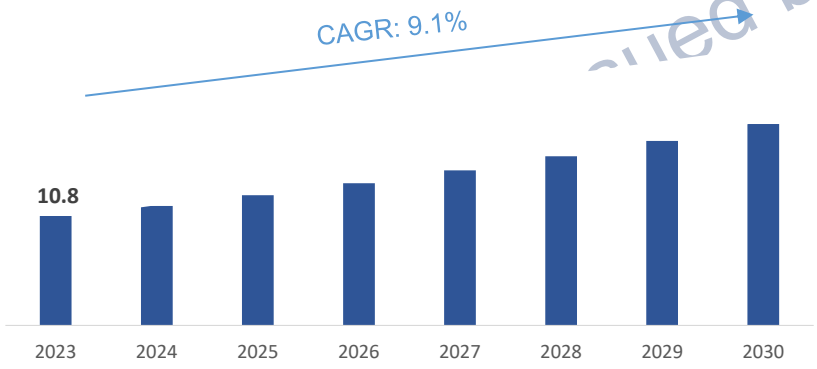
Global Collagen Market Growth & Trends (1/6)

GLOBAL COLLAGEN MARKET OVERVIEW

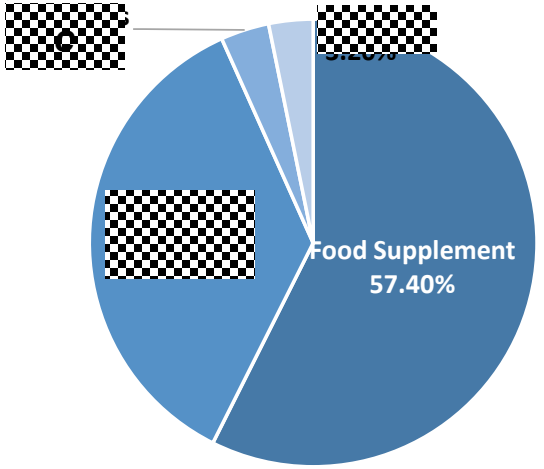
HIGH DEMAND FROM THE MEDICAL AESTHETICS DERMO-COSMETICS AND REGENERATIVE MEDICINE SECTORS ACCELERATES GLOBAL GROWTH

- The global collagen market size is expected to reach **USD 19.9 billion by 2030**, expanding at a revenue-based **CAGR of 9.1%** from 2023 to 2030, according to a report by Grand View Research (January 2024)
- The growth in the market can be attributed to **high demand for collagen in cosmetic surgeries and wound healing, regenerative and reconstructive medicine treatments, ageing of demographics now also taking place in emerging economiesthe, and prejuvenation trend particularly prevalent in the Millennials and GenZ generations. Increasing consumer spending capacities** coupled with the **innovation-led growing relevance of skin surgeries** has propelled product demand across the world.
- The growing end-use applications, changing consumer preference for their skin rejuvenation daily skincare protocols and lifestyles, increasing disposable income, and rising awareness regarding health and personal care as well as continuous ageing of the world population and increasing exposure to skin oxidation drivers will promote the surge of demand. Developing economies of Asia Pacific, including China, India, and Malaysia, are anticipated to experience robust market growth over the next few years.

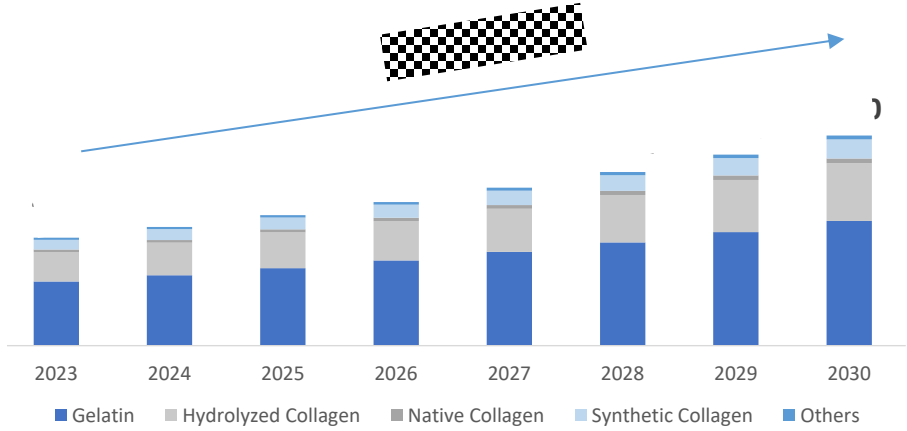
Global Collagen Market Size Evolution
Revenue in USD billions, 2023-2030



Global Collagen Applications Breakdown (2023)



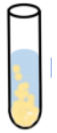
US collagen market Size, by Product(2023)



Sources: Grand View Research, Huatai Research

Global Collagen Market Growth & Trends (2/6)

COMPARISON OF DIFFERENT PREPARATION METHODS OF COLLAGEN

Preparation method	Illustration	Pros	Cons
Acid-based extraction 	After degreasing and removing protein, the sample is placed in an acidic medium with low ionic strength. The salt bond and Schiff base between the collagen molecules are destroyed, so that the collagen is dissolved, and acid-soluble collagen is obtained through procedures like salting out and dialysis	Low processing temperature, complete triple helix structure, good fiber-forming performance, and good biological characteristics; low cost and high economic value	Long extraction time, low yield, the telopeptide and other areas of collagen are retained, and collagen thus produced has a higher risk of immunogenicity
Enzymatic extraction 	Protease is used to cut the terminal peptide of collagen, and the remaining main part can be dissolved in a neutral or acidic solution, to finally extract the enzyme-soluble collagen	The complete triple helix structure and unique biological activity of acid-soluble collagen are retained, and reaction time is shortened. The collagen obtained has high purity and good physical and chemical properties.	The control of various enzymatic hydrolysis conditions has a significant impact on the structural integrity, stability, and extraction yield of the collagen prepared
Genetic Engineering 	Recombinant human collagen produced by genetic engineering is a technology in which human collagen gene undergoes specific sequence design, enzyme digestion and splicing, and ligation of vectors, and then transfer into engineered cells, and produces collagen and its analogues through fermentation.	Recombinant collagen fermented by microorganisms has better processability (such as water solubility and emulsification properties), can better control the risk of pathogenic virus transmission, and can reduce immunogenicity as much as possible through sequence design	There is currently no evidence to prove that the recombinant collagen fermented by microorganisms has a stable, protease-tolerant triple helix structure similar to natural collagen, and the biological activity of recombinant collagen is questionable.

Sources: Grand View Research, Huatei Research and Corporate Filings.

Global Collagen Market Growth & Trends (3/6)

SOURCE INSIGHTS

BOVINE ACCOUNTS THE MOST WHILE MARINE IS GROWING FAST

- **Bovine, porcine, poultry and marine** are the four main sources required to manufacture collagen.
- Collagen from bovine source accounted for a substantial revenue share of [redacted] in 2023, due to easy availability of bovine based raw material and comparatively lower prices than porcine and marine (fish or plankton based).

1.Residual concerns regarding the transfer of diseases such as bovine spongiform encephalopathy (BSE) to humans ,despite the presence of advanced purification techniques that enable the neutralization of such risk such as Affinity Chromatography: Commonly used for purifying recombinant collagen, which has been genetically modified and tagged with affinity tags. This method exploits specific interactions between the tagged collagen and a ligand immobilized on a solid support1. or simple Conventional Purification: Preferable for purifying non-recombinant collagen from mammalian and marine sources. It involves steps like extraction, precipitation, and dialysis1. Such concerns are anticipated to restrain the growth of bovine based collagen over the forecast period.

- Marine-based sources are expected to witness growth over the forecast period(2023-2030) a CAGR of 7.9%. Marine collagen is used in a variety of health supplements to improve bone health, treat arthritis, and protect the mucosa of the gastrointestinal tract. It is increasingly being used in cosmetics as a moisturizer and natural humectant. The properties, configuration structure, species, and catching origin of marine collagen-based cosmetic formulations vary. Cosmetics manufacturers are now focusing on developing marine sourced cosmetic formulations
- Marine collagen is also subject to purification processes: Acid Soluble Collagen (ASC) Extraction: A method used for marine collagen purification. It involves solubilizing collagen using acid2 or via Pepsin-Solubilized (PSC) Extraction: Another technique for marine collagen purification. Pepsin is used to solubilize marine collagen
- Marine collagen is superior to bovine or porcine sources, owing to its high absorption rate and bioavailability (smaller molecular weight). However, marine collagen costs are higher than bovine and porcine variants (from 1.5 to 3 times) due to lower scalability of production, which is expected to restrain segment growth.
- **Tech-based collagen** refers to collagen that is produced **using advanced biotechnology methods rather than traditional extraction from animal sources.** This innovative approach involves **bioengineering collagen** using **recombinant DNA technology** or fermentation processes with microorganisms. Tech-based collagen ensures potential advantages such as increased purity, sustainability, and customization of collagen properties for various applications in food, cosmetics, and biomedical industries.

35%

31%

Sources: Grand View Research, Mordor Intelligence

Global Collagen Market Growth & Trends (4/6)

PRODUCT & APPLICATION INSIGHTS

GELATIN DOMINATES THE MARKET, HYDROLYZED COLLAGEN GROWS [redacted]

- **The gelatin segment dominated the market in 2023** owing to the substantial demand for the product as a food stabilizer. The growth of fishing industry in India and China has attracted gelatin manufacturers in the Asia Pacific to use fish as a raw material for gelatin production.
- The market for **hydrolyzed collagen is also anticipated to register the fastest growth of 11.47%** over the forecast period, backed by its increasing use in the healthcare sector for tissue repair and redensification of dermal thickness as well as in dental applications fostering efforts by the companies for using hydrolyzed collagen in the treatment of bone related disorders, such as osteoarthritis have favored the growth of the segment.

HEALTHCARE APPLICATIONS KEEP GROWING, FOOD & BEVERAGE REMAIN IN DOMINANT POSITION [redacted]

- The food and beverages application dominated the market with the highest revenue share of [redacted]This is attributed to the increased demand for dietary supplements and functional food and beverages in North America and Europe regions. It is used to improve the stability, consistency, and elasticity of products. It is used as a food additive that helps in improving the color, texture, and flavor of food items. It is also widely used in collagen infused drinks such as cappuccino, coco, and juices and energy drinks among others.
- Healthcare is estimated to emerge as major application segment driving growth of the market. The demand for premium grade product for surgical procedures, wound dressing, and drug delivery mechanism is expected to drive the industry growth over the forecast period. Collagen is used to make wound covers, which are popular as dressing materials for severe burns and sores. These wound covers can absorb tissue secretions, resulting in faster healing of the affected area. It can be used to treat partial- and full-thickness wounds, wounds with little to, skin grafts no exudate and granulating or necrotic wounds, chronic non-healing wounds, and second-degree burns.
- **Asia Pacific region** is expected to hold the highest market for collagen supplements globally. A rising disposable income and a growing awareness of the importance of skin and hair have fueled the market for collagen supplements. The increasing purchasing power of consumers in countries such as China and India contributes to the expansion of these markets. As a result, India continues to represent a significant opportunity for new sales in the region.

Sources: Grand View Research

Global Collagen Market Growth & Trends (5/6)

REGIONAL INSIGHTS

ASIA PACIFIC BOASTS THE STRONGEST GROWTH WHILE NORTH AMERICA LEADS THE MARKET

North and Central America

- North America is projected to **dominate the global collagen market during the forecast period (2023-2030)** followed by Europe. The dominance of North America is mainly attributed to the huge consumption of **nutraceuticals and cosmeceuticals**, ubiquitous trend towards rejuvenation rise in research and development activities, and well-established food and healthcare industry.
- The regional market is expected to benefit from the presence of a strong healthcare industry coupled with high public expenditure on healthcare and for daily beauty and skincare rituals especially in the U.S.
- The demand for collagen in Mexico and Canada is expected to be driven by the ascending demand for gummy confectionery products.(Nutraceuticals for “beauty from the inside”)

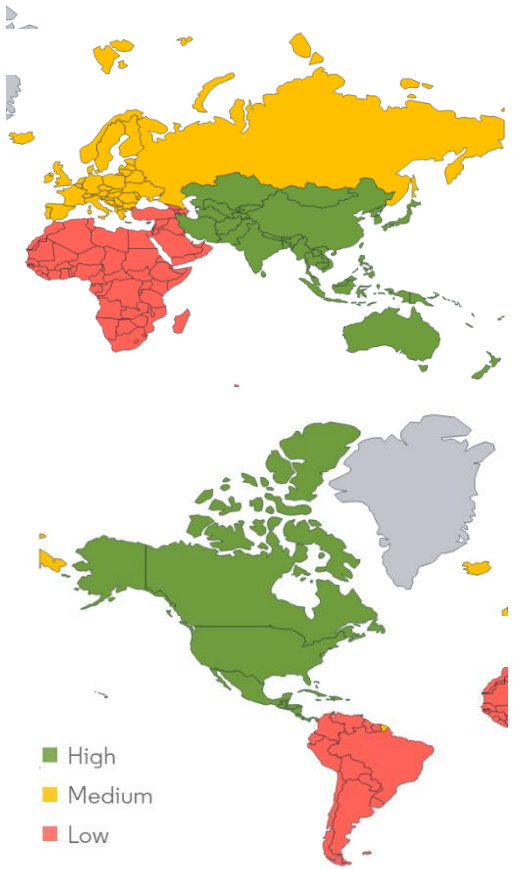
Europe

- Europe was the **largest regional segment in the market in 2019, in terms of revenue**, surpassed by US now in 2023. The regional market is likely to benefit from the presence of major sugar confectionery manufacturers such as Britannia Superfine and Astir.
- High growth of the meat processing industry in this region has also fueled product demand. The region has a sizable number of slaughterhouses, which, in turn, has encouraged product manufacturers to set up their plants in this region.

Asia Pacific

- Asia Pacific is anticipated to emerge as the **lucrative market (based on total value)(2023 market share of 22%)** over the forecast period with a volume-based **CAGR of 9.5%** through 2030. This is linked to the quick economic growth of important countries like China and India, which are predicted to boost the industry. The region boasts the presence of a well-established meat processing industry, coupled with high expenditure on industrial development by governing agencies to propel economic development. In addition, high investments in research and development activities to produce collagen-based products are expected to fuel market growth.

Market concentration



Sources: Grand View Research

Global Collagen Market Growth & Trends (6/6)

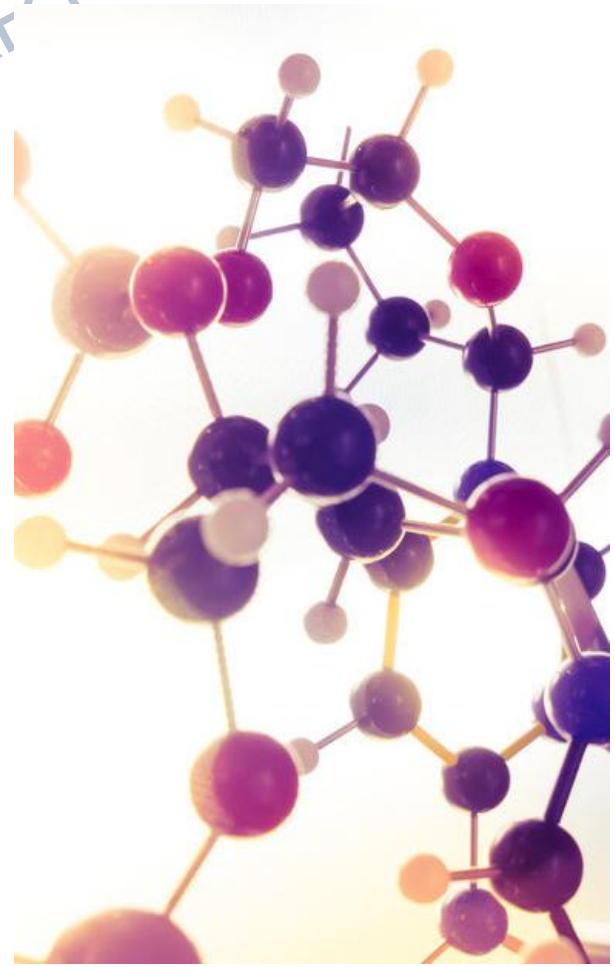
COMPETITIVE LANDSCAPE & CHALLENGES

FRAGMENTED MARKET WITH SMALL AND LARGE PLAYERS

- The global market is anticipated to continue its dynamic growth owing to the presence of prominent players with the capacity to conquer additional market share and expand the market altogether.
- These companies are actively involved in research and development of advanced products that provide additional options such as customizable emulsification and gelling with respect to product manufacturing. These players operate in multiple locations and market their products through numerous sales networks across the globe, including third-party distribution channels.
- Industry players operate in multiple locations with manufacturing facilities situated near abundant sources of raw materials to secure sustainability of supply and carry out distribution through several sales locations across the area of operation. Therefore, most of the leading vendors are focusing on strengthening their market position in emerging and local markets, especially in Asia Pacific and the Middle East and Africa, through geographic expansions and strategic alliances.

CHALLENGES FROM REGULATIONS AND CERTAIN CONCERNS ASSOCIATED WITH RAW MATERIALS

- However, concerns regarding the contagion of diseases from certain raw material sources have overshadowed market growth. The industry is regulated by laws and regulations governing animal-based raw materials and ingredients used in collagen production.
- The European Parliament has been instrumental in framing such regulations. Collagen manufacturers as well as end users in Europe are required to comply with specifications and requirements notified by the regulations.
- Specifications associated with the procurement and testing as well as detoxification of raw materials of animal origin for human consumption might make the process of raw material procurement slightly cumbersome and complexify the manufacturing process.



Sources: Grand View Research

Collagen market is fragmented and multifaceted

Players are split between highly innovative , synthetic recombinant collagen companies with non-animal production and animal-based collagen companies using purification technologies

Very few to none players as market is more towards volume than real technological innovation

Most innovative companies / technologies with the lowest player concentration:

Brauer 创尔生物 · Jinbo 锦波 · YEK · JY-RAN 匯源 · CollPlant Pioneering Regenerative Medicine

Tech based

Cosmetic oriented but scientifically proven →

INNÉIS

Highest players concentration where Collagen derivatives such as Gelatin and Collagen peptides are dedicated to food, pharma coating and skincare

Nitta Gelatin AND VYSE GELATIN · JUNCÀ GELATINES · 汉德森 Handeson

Highest Pharmaceutical collagen players where the key driver is purifying technologies / Regenerative Orthopedics

NIBEC Nano Intelligent Biomedical Engineering Corporation · EternoGen · KYERON · Geistlich Pharma

Animal based

Food — ***Medical & skincare Use***

Note: Not all the players are represented in all sections

Collagen Pharma-oriented Players Comparison(1/4)

	Abiel					
Company's Key Facts and figures	• 2023 Revenues: n.a. • Employees: 2-10 • Palermo, Italy					
Type of collagen	• I & II	• n.a.	• I	• n.a.	• I	• III
Sourcing	• Recombinant	• Synthetic / recombinant collagen	• Plant derived	• "native"	• Porcine	• Gene recombination and fermentation engineering
Applications	• Research/Cell Extraction	• Pharma oriented for bleeding & Cosmetics (INNEIS)	• Medical Aesthetic (Injectable & Implant) & Wound	• Orthopedics	• Regenerative Biomaterials	• Skincare, Anti-HPV bioprotein dressing; Gynecology
Products			• Rhcollagen		• Eqimatrix • GuidOss Collagen membrane Matrix • OCS-B Collagen • Regenomer	• Lingzhiling • Ultrapep • Weirun

Sources: Public Resource

Section II
Medical Aesthetic Applications of Native Collagen

Benefits and Risks of Collagen Injections

BENEFITS AND RISKS

- **Collagen injections are a cosmetic procedure that is done by injecting collagen - normally made up of bovine collagen - under the skin.**
- **Collagen injections include the following brands: Bellafill®, CosmoDerm®, CosmoPlast®, Zyderm® and Zyplast®, as well as the implant Fibrel®.**

COLLAGEN INJECTIONS BENEFITS

Replace the skin's natural collagen

- With the breakdown of collagen occurring in the body after a certain age, collagen injections can replace the body's original supply of collagen.
- As collagen is largely responsible for the skin's elasticity, plasticity and tissues cohesivity and firming this enhances skin fitness with a more youthful replumped, lifted, revolumized, retightened, redensified, retexturization and radiant appearance.

Reduce the appearance of scars

- Soft-tissue fillers such as collagen are ideal for improving the appearance of depressed (sunken) or resurfacing hollow scars.
- Bovine collagen is injected under the scar to stimulate collagen growth and to elevate the skin depression caused by the scar.

Re-plump the lips

- Collagen lip fillers plump up the lips, adding fullness, density, texture and volume.
- While these were once some of the most commonly used fillers for lips, fillers that contain hyaluronic acid (HA) have since become more popular. HA is a naturally occurring gel-like molecule in the body that keeps the skin moisturized. Like collagen, it plumps the lips and can be used to smooth out the vertical lines above the lips (nasolabial folds). Unlike collagen, however, HA is temporary and is broken down by the body over time.

RISKS AND POSSIBLE COMPLICATIONS

- Collagen injections, although not considered surgical procedures, carry some of the same risks as cosmetic surgery. Risks include:
  - Bacterial /microbial/fungal infection
  - A reaction to the anesthesia - liquid collagen injections contain a local anesthetic (lidocaine).
  - Allergic reaction - collagen injections are derived from bovine collagen, so anyone who is allergic to bovine-derived products should not receive this treatment.
  - Redness Swelling or bruising, granuloma or indurations
  - Itching
  - Abscesses
  - Open sores
  - Peeling
  - Scarring
  - Lumpiness

Sources: Grand View Research, Web-med.com

Collagen Filler Products

SELECTED TYPES OF COLLAGEN FILLER PRODUCTS

- **The collagen filler products include 2 main types: Collagen with PMMA and Collagen without PMMA.**
- **They are developed in a wide range of applications, including Face Rejuvenation, Wrinkles, Scar Treatment, Lip Treatment, Cellulite Reduction, and Others.**

PMMA IMPLANTATION

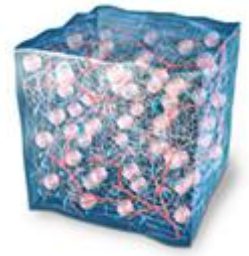
- Polymethyl-methacrylate (PMMA) is a suspension of microscopic synthetic polymer beads (microspheres) in a vehicle such as bovine collagen, hyaluronic acid, or some other colloidal suspending agent. The resin has long been used by orthopedic surgeons in bone cement for joint replacement or to replace a skull bone defect.
- PMMA implantation can be used to improve the skin's contour and reduce depressions in the skin due to scars, injury, or lines. They are used to correct facial lines and features that could have been treated with collagen replacement therapy or hyaluronic therapy, but where a more permanent solution is wanted.
- The microspheres containing PMMA induce the skin to produce its own collagen, which can last up to 5 years. It also contains collagen for immediate improvement.

- Gel immediately after injection

Collagen gel and PMMA microspheres in a certain proportion

COLLAGEN WITH PMMA

- PMMA is used in dermal filler by many aesthetics players, such as:
- **Bellafill®** from Suneva Medical, is composed of injectable polymethylmethacrylate (PMMA) with bovine collagen. It is the only FDA approved injectable filler for acne scars. It also received the FDA approval for treatment of nasolabial folds, “smile lines”, in 2006.
- **Ellansé®** from Sinclair consists of a unique and patented composition – 70% Carboxymethyl Cellulose (CMC) based gel carrier and 30% PolyCaproLactone (PCL) microspheres. It has dual benefits of immediate aesthetic correction and long-lasting results by new collagen formation.
- **Artecoll®** (PMMA suspended in bovine collagen) and **MetaCrill®** (PMMA suspended in a chemical colloid) are two brands of PMMA injectable augmentation products from Dermnet NZ.



- 4 months after injection

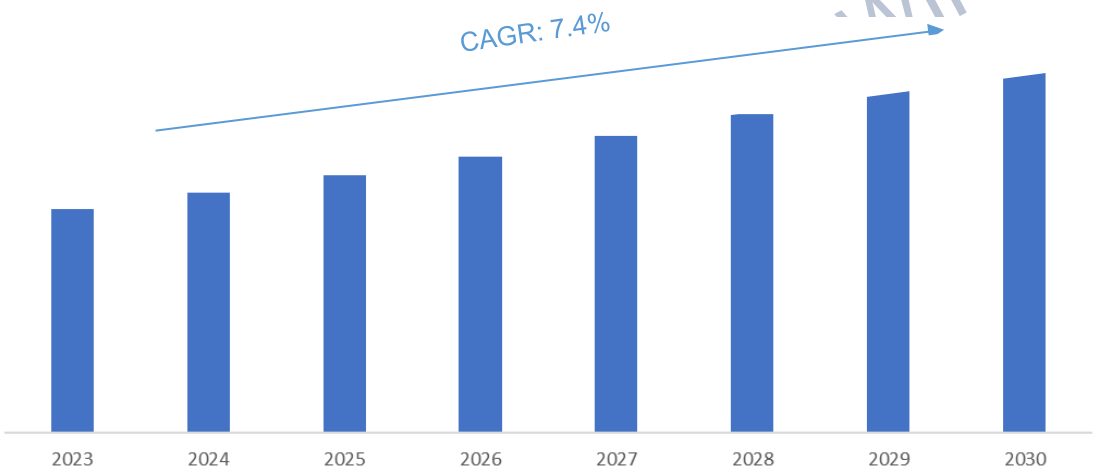
Collagen tissue matrix and blood vessels have formed around PMMA

Sources: Grand View Research, Company website

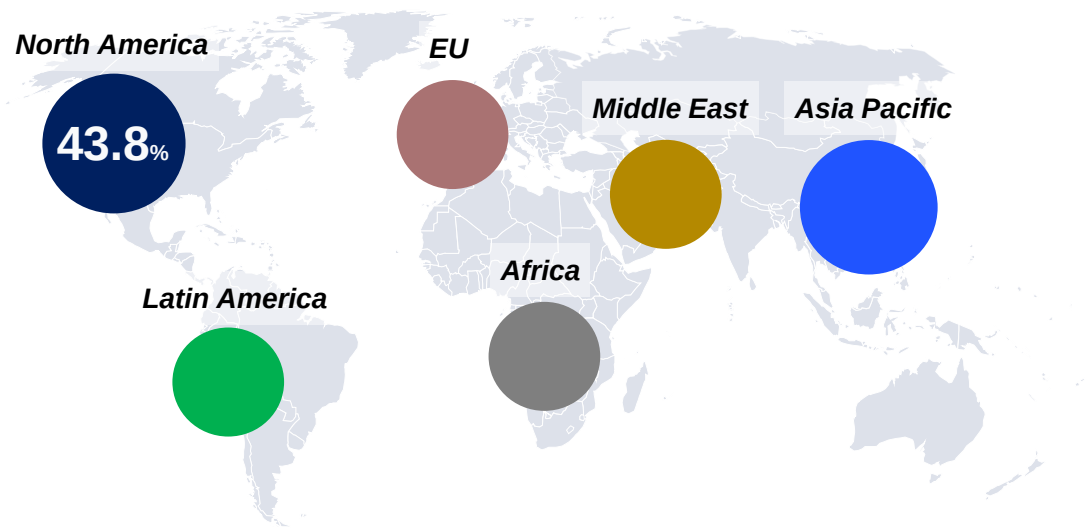
Global Collagen Filler Market

- Collagen injections have been used for decades to treat minor imperfections in facial skin, including laugh lines, wrinkles, crevasses, lipodystrophies, skin laxity and sagging, crow's feet, and acne scars.
- Collagen is also used to re-volumize lips and replenish wrinkles on the cheeks and to treat areas by re-firming and re-tightening the skin on the chest, back, and neck. However, facial collagen injections are by far the most common.
- In many cases, the collagen treatment is combined with other procedures, such as mesotherapy, radiofrequency with microneedling, HA-based dermal filler a facelift procedure or laser skin resurfacing treatment, as part of an integrative medical aesthetic protocol to leverage complementary mechanisms of action.
- In general, people who choose collagen treatment are looking to "refresh" or rejuvenate their skin with an instant effect to enhance their appearance, rather than treat more advanced signs of aging. Because collagen is a natural substance and requires no surgery to achieve results, collagen treatment is one of the safest minimally invasive ways for people to enhance their appearance.

Global Aesthetic Collagen Filler Market
Revenue in USD million, 2017-2023



Global Collagen Filler Market Share (%), By Region, 2023



Sources: Mordor Intelligence Analysis, Coherent Market Insight

Key Trends of the Global Collagen Filler Market

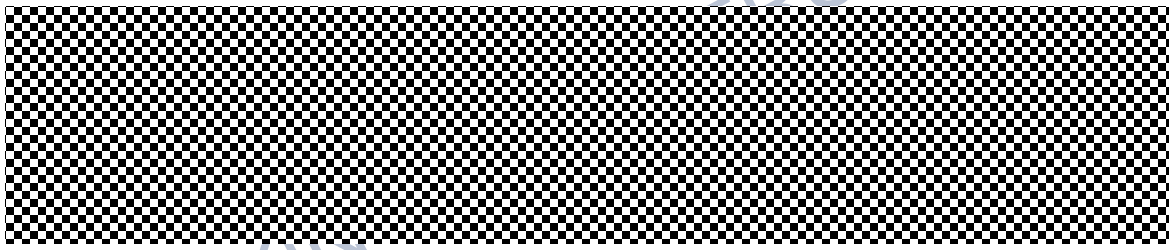
Global Collagen filler market size 2023

$801M

About **9.0%** of Global filler market

Global filler market size 2023

$8.9bn



- Key companies are focusing on research and development activity and incremental technological advancement in collagen filler is expected to drive the global collagen filler market growth.
- Moreover, increasing cosmetic procedures such as face lifts, facial revolumization or skin retexturization and redensification, wrinkle removal, breast augmentation, body sculpting and reshaping, and lip treatments are expected to drive the global collagen filler market growth. For instance, according to the American Society of Plastic Surgeons Report 2020, in 2019, [redacted] were used for treatment of various skin conditions such as skin ageing, wrinkles, lip re-volumization and face lift procedures across the globe.
- Furthermore, various initiatives have been taken by regulatory bodies to ensure efficient use to synthetic and cosmetics products for safer use of dermal fillers and to avoid side effects. For instance, in 2018, the US Food Drug and Administration approved temporary/absorbable dermal fillers for correction of moderate to severe face wrinkles, skin folds and unapproved dermal fillers for breast augmentation, size of buttocks, enhance fullness of feet and dermal implants into the bone, tendon, ligament and muscle.
- Among regions, the North America market is expected to register highest market share owing to an increase in plastic surgery procedures such as facial rejuvenations, lip treatments and temporary procedures such as face line corrections.

Potential advantages of Collagen Dermal filler vs HA dermal fillers:

- **Longer-lasting results**: While requiring initial patience for full effects to show (2-4 weeks), collagen fillers can last 1-2 years compared to HA's 6-18 months.
- May be suitable for **deeper lines and wrinkles**: Collagen fillers can be effective for addressing deeper facial lines and folds
- **Stimulation of collagen production**:
  - Collagen fillers often introduce collagen directly into the skin or contain agents that promote its production. This provides the skin with a **building block** for new collagen creation
  - The presence of collagen, as well as materials like PMMA often included in collagen fillers, can trigger a **wound-healing response** within the skin. This response prompts fibroblasts to produce more collagen, reconstruct the dermal-epidermal juncture and stimulate neo-elastogenesis.

Sources: Coherent Market Insights (CMI), Galderma website

Section VI
Recombinant Collagen markets

The Fast-emerging Global Recombinant Collagen Market

The global synthetic/recombinant collagen market is thriving, driven by diverse applications and increasing consumer awareness about safety issues as well as clean, vegan and cruelty-free treatments and industry players' focus on scalability, reproducibility, batch to batch consistency and predictability of collagen production.

Recombinant Collagen market size 2023

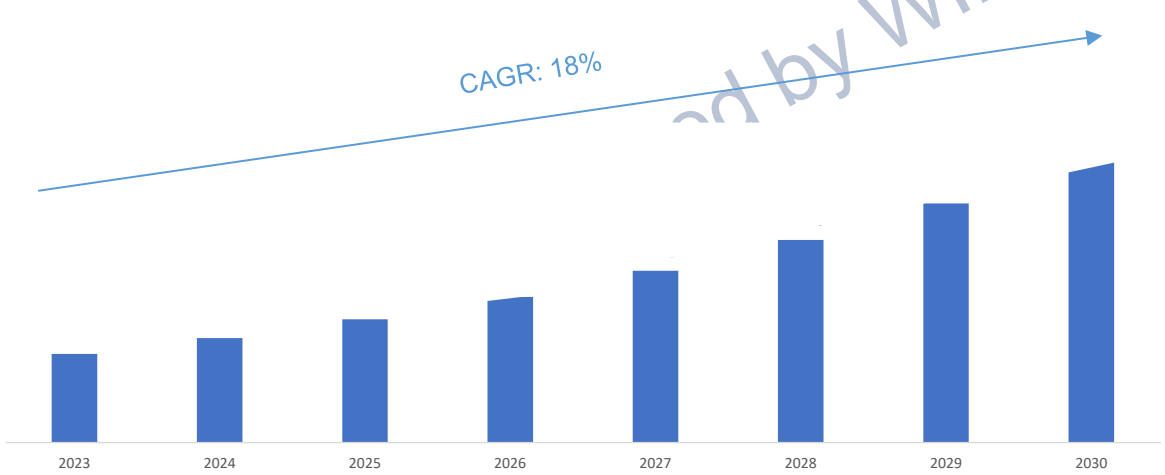
$1.0bn

Recombinant Collagen Revenue share of the whole collagen market 2023

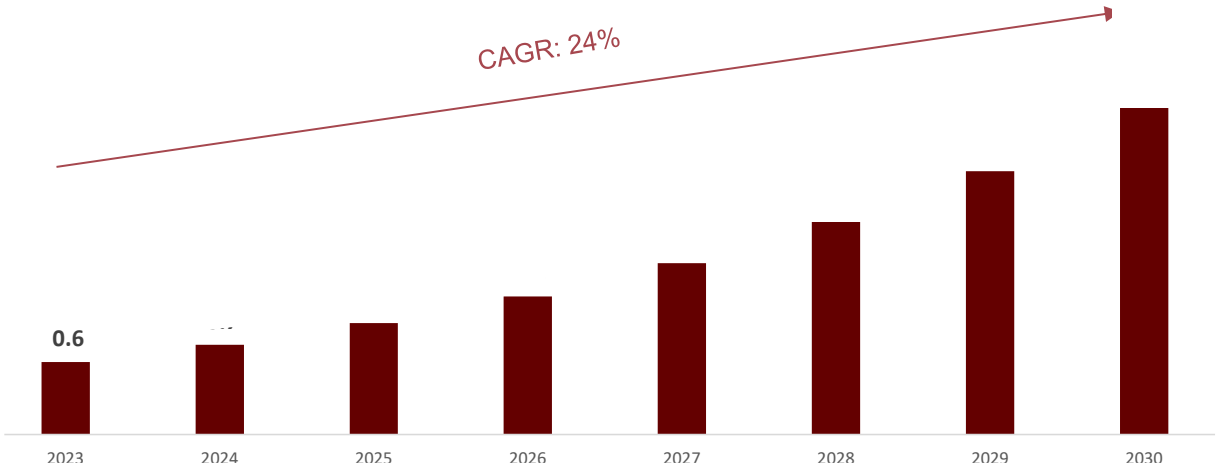
9%

The Chinese Recombinant Synthetic Collagen Market is driven by a much stronger growth momentum due to the sheer magnitude of demand for clean collagen products and the accumulated expertise and track-record of a number of established key players such as Juyou, Trautec, Jinbo , Trauer Biotechnology, Giant Biogene, Bloomage-YEK Bioengineering etc

Global Recombinant Collagen Market Size Evolution
Revenue in USD billions, 2023-2030



China's Recombinant Collagen Market Size Evolution
Revenue in USD billions, 2023-2030



Sources: SYNBIO Technologies, Frost & Sullivan

Expected to take **82%** whole China's collagen Market in 2030

Recombinant Collagen Sees Significant Growth in China's Cosmetic Market

Major collagen companies are actively expanding production, and an increase in supply is expected.

Company	Product	Original production capacity	Production capacity under construction
Sunmax Biotech			
Trauer Biotech			
Giant Biogene			
Jinbo Biotech			
Jland Biotech			
Trautec			

Sources: SYNBIO Technologies, Frost & Sullivan

Recombinant Collagen Sees Significant Growth in China's Cosmetic Market

Approved China's collagen functional skincare brand(by Jul 2023)

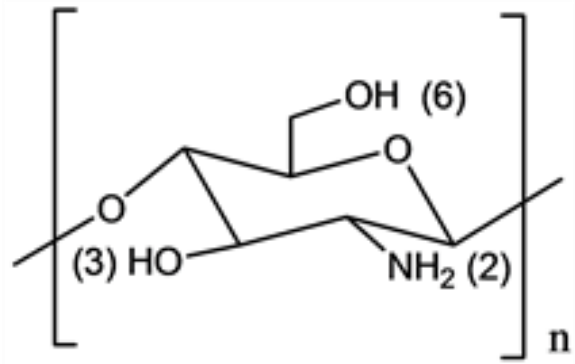
	Company	Brand	Brand Overview	Year Founded	Star Products	Price range	Average Price
Animal source collagen	Trauer Biotech						
Recombinant collagen	Giant Biogene						
	Jinbo Biotech						
	Voolga						
	Marubi Biotech						

Sources: SYNBIO Technologies, Frost & Sullivan, 1 USD = 7.2 RMB as of Mar 4, 2023

Section VII

Chitosan Market

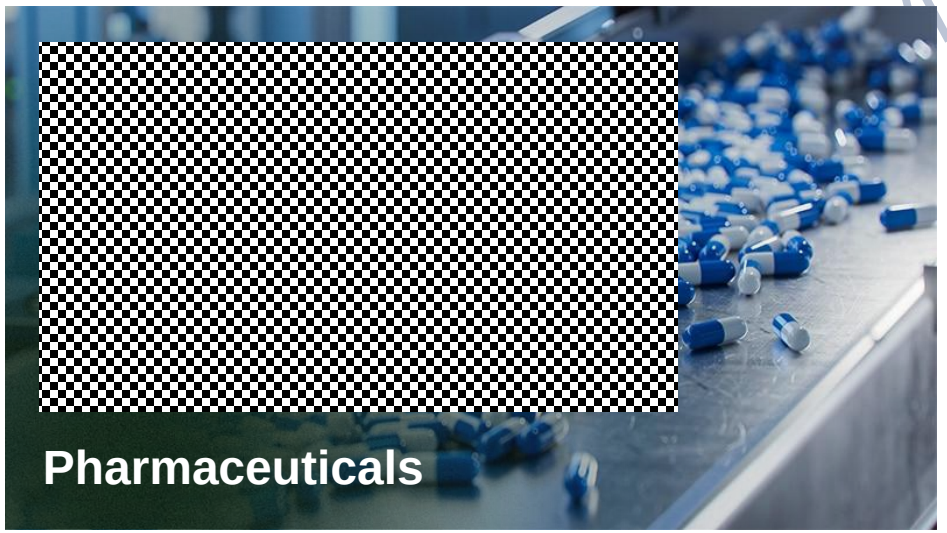
Overview of the Chitosan

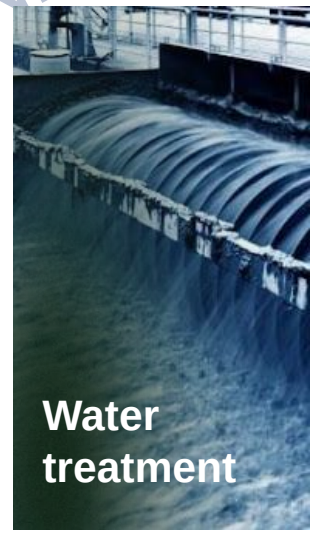


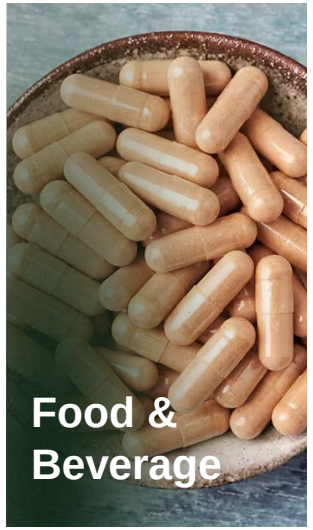
Chitosan is derived from chitin. Chitin is a cationic, biodegradable, and widely distributed polymer material that exists in nature. It is found in large amounts in the carapace of marine arthropods (shrimps, crabs) and other forms of shellfish and crustaceans. It also exists in the cell membranes of lower animal fungi, insects, and algae. Chitosan a partially crystalline biopolymer, the only alkaline polysaccharide in the biological world. Chitosan is the second most abundant natural biopolymer in the world, after cellulose.

Chitosan is inactive, non-oxidative and non-inflammatory and does not produce immune reactions with body fluids and tissues in the body. It can be degraded by lysozyme into glucosamine, which is non-toxic to the human body. Chitosan is non-toxic, non-hemolytic, non-irritating, non-pyrogenic, non-mutagenic, and demonstrates good biocompatibility and biodegradability. Since chitosan has a similar structure to cellulose, it has similar uses to cellulose, and based on the characteristics of aminopolysaccharides, it features many excellent biological properties. Therefore it has a very wide range of uses in the medical field. In recent years, chitosan has been used to develop and manufacture medical sutures, artificial skin, artificial tears, bone tissue, nerve tissue repair agents and other medical materials.

Application of Chitosan





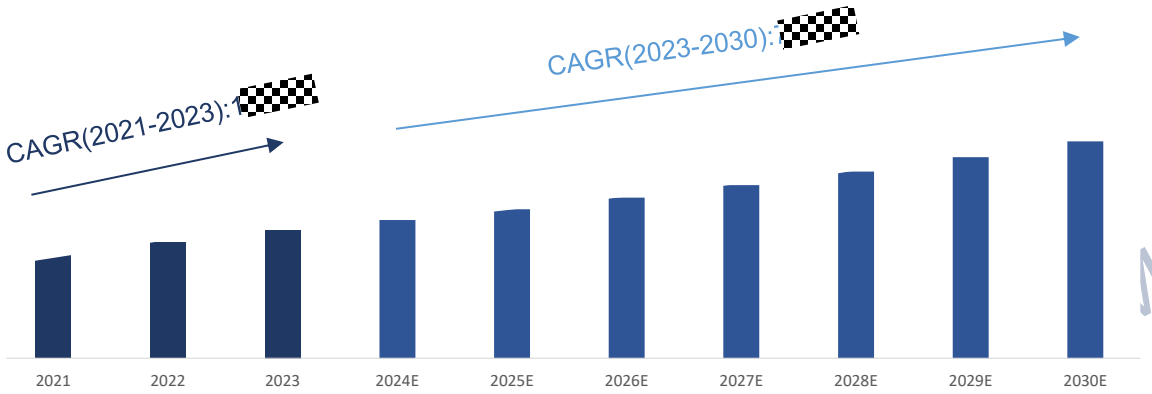


Source: QYResearch, Grandview research, Research Progress of Chitosan and Its Derivatives in Biological Medicine, market monitor

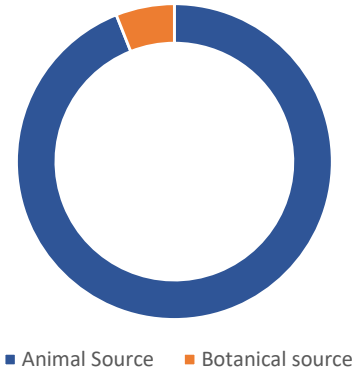
Chitosan Global Market

Global Chitosan Market Size Evolution

Revenue in USD million, 2023-2030



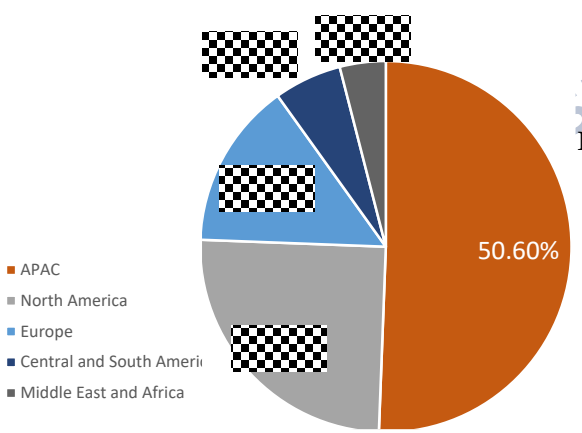
Breakdown of source of Chitosan



The pharmaceutical grade chitosan industry can be subdivided into several subdivisions such as animal-derived chitosan and plant-based chitosan.

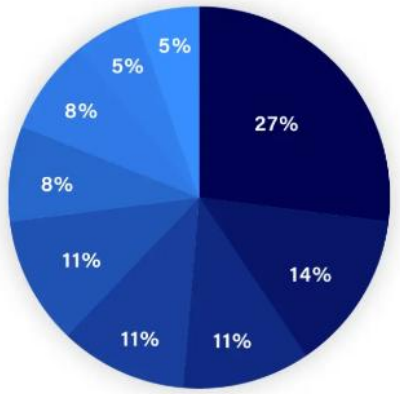
Animal-derived chitosan held the largest share in 2019, accounting for

Global Chitosan Market Breakdown



In 2022, the Asia Pacific region held the largest market share for chitosan

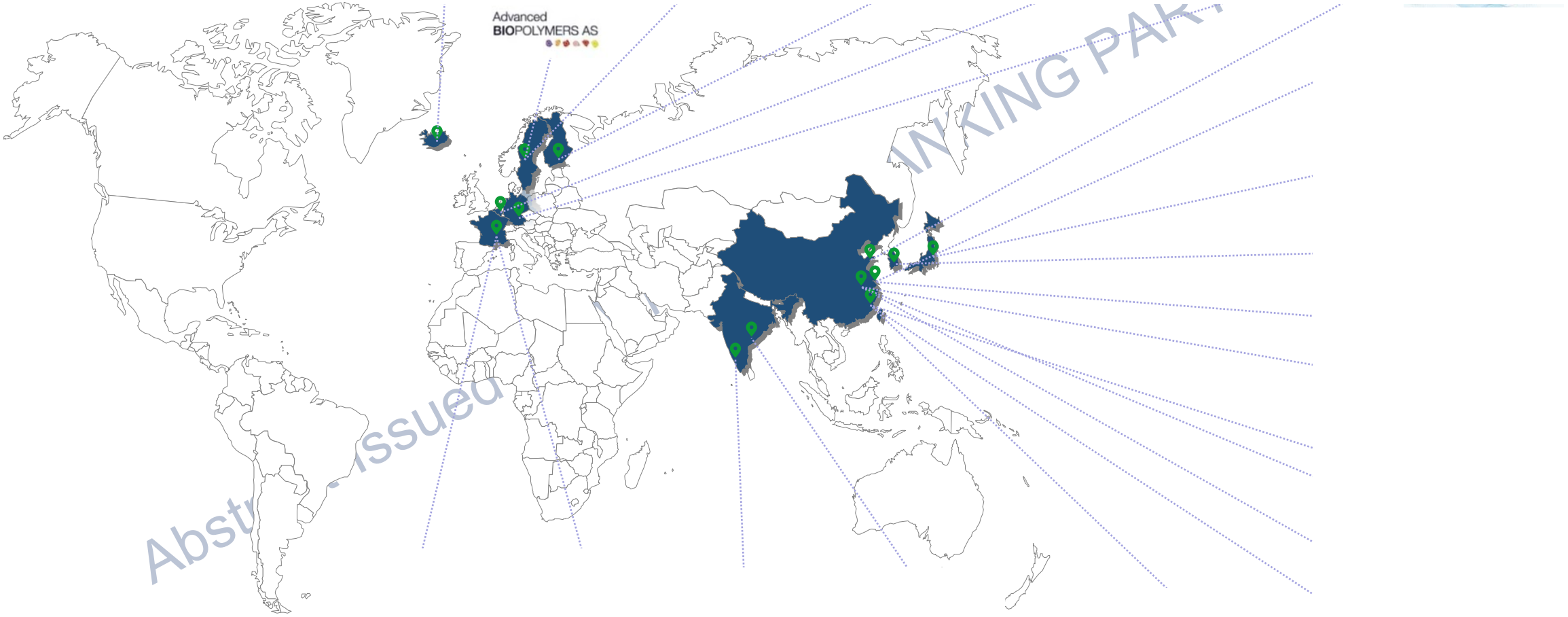
Clinical study on Chitosan



- Diabetic Foot Ulcers/wounds/ Anti-microbial effect
- Heamostasis
- Renal Disease
- Dry Eye Syndrome
- Hypercholesterolemia/Overweight/Blood Glucose Control
- Allergy
- Immunological Effects
- Analgesics
- Nerve Lesions

Source: QYResearch, Grandview research, Research Progress of Chitosan and Its Derivatives in Biological Medicine, market monitor

Chitosan Global Market



Source: QYResearch, Grandview research, Research Progress of Chitosan and Its Derivatives in Biological Medicine, market monitor

Chitosan Market Dynamics

Strengths

•**Biodegradability and Biocompatibility**: Chitosan is derived from natural sources (e.g., shrimp, crab shells) and is environmentally friendly, making it a sustainable option in various industries.

•**Wide Applications**: It is used in diverse fields, including pharmaceuticals, agriculture, water treatment, cosmetics, and food industries.

•**Health Benefits**: Chitosan has antimicrobial, antioxidant, and weight management properties, driving demand in the healthcare and nutraceutical sectors.

•**Abundant Raw Material**: Shellfish waste, the primary source of chitosan, is widely available and cost-effective.

Weaknesses

•**High Production Costs**: The extraction and purification of chitosan are complex, leading to higher production costs.

•**Allergenic Potential**: Being derived from shellfish, chitosan may cause allergic reactions in sensitive individuals, limiting its use in some products.

•**Quality Variability**: The quality of chitosan varies depending on its source and production method, affecting product consistency.

•**Regulatory Challenges**: Different regulatory frameworks in various regions can delay market entry for new applications.

Opportunities

•**Rising Demand for Biodegradable Products**: With increasing environmental awareness, industries are shifting towards sustainable materials, boosting chitosan's appeal.

•**Expanding Pharmaceutical Applications**: Chitosan's use in drug delivery systems, wound care, and tissue engineering continues to grow.

•**Water Treatment Innovations**: Chitosan is gaining traction as an eco-friendly coagulant in water purification processes.

•**Emerging Markets**: Countries like India, China, and Brazil show significant potential due to their growing healthcare and agriculture sectors.

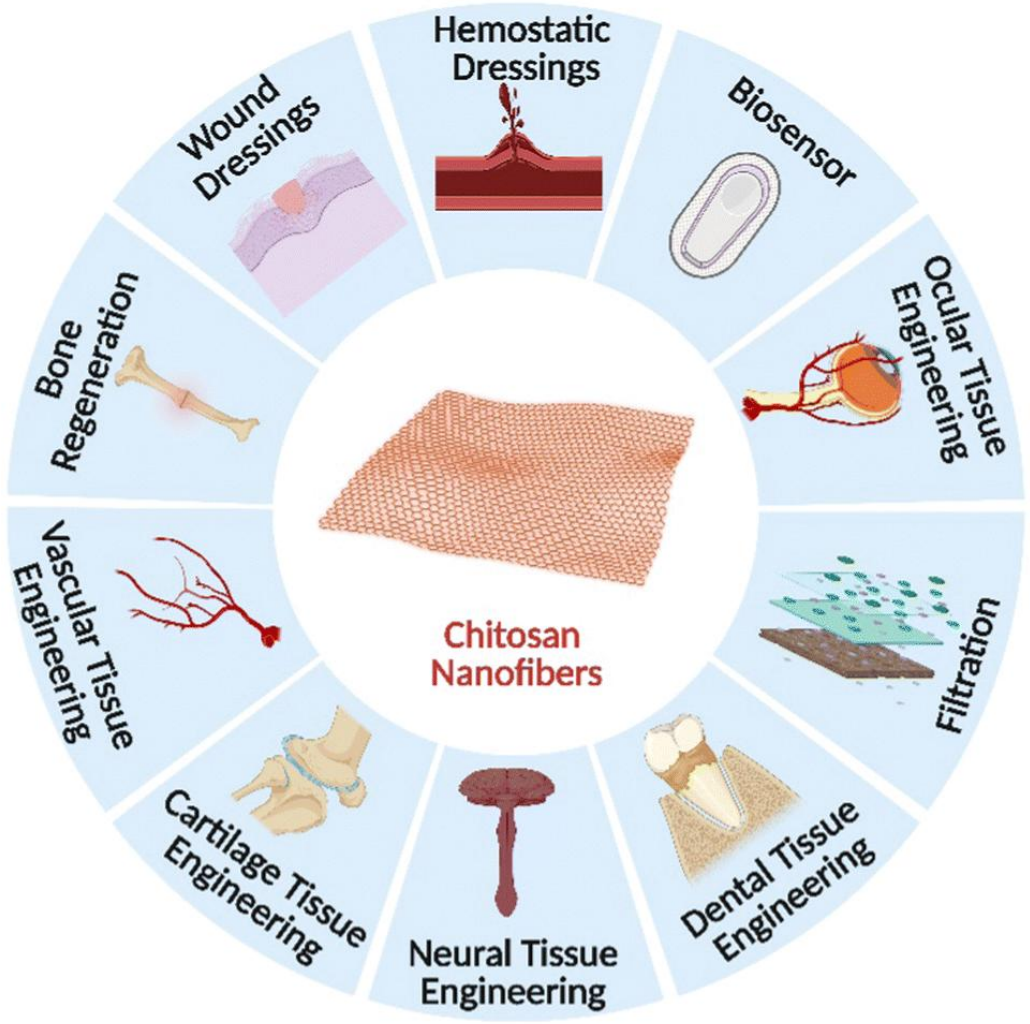
•**Research and Development**: Innovations in chitosan derivatives and applications can open new markets, such as nanotechnology and advanced biomaterials.

Threats

- **Competition from Substitutes**: Alternative biopolymers, such as alginate or cellulose, could reduce chitosan's market share.
- **Supply Chain Disruptions**: Dependence on shellfish as a raw material makes the market vulnerable to fluctuations in seafood production.
- **Economic Factors**: High production costs and pricing pressures may hinder market growth, especially in price-sensitive regions.
- **Stringent Regulations**: Regulatory restrictions on novel applications and labeling requirements for allergen-containing products could slow market expansion.
- **Environmental Concerns**: Overreliance on marine resources for raw materials could raise ecological sustainability issues.

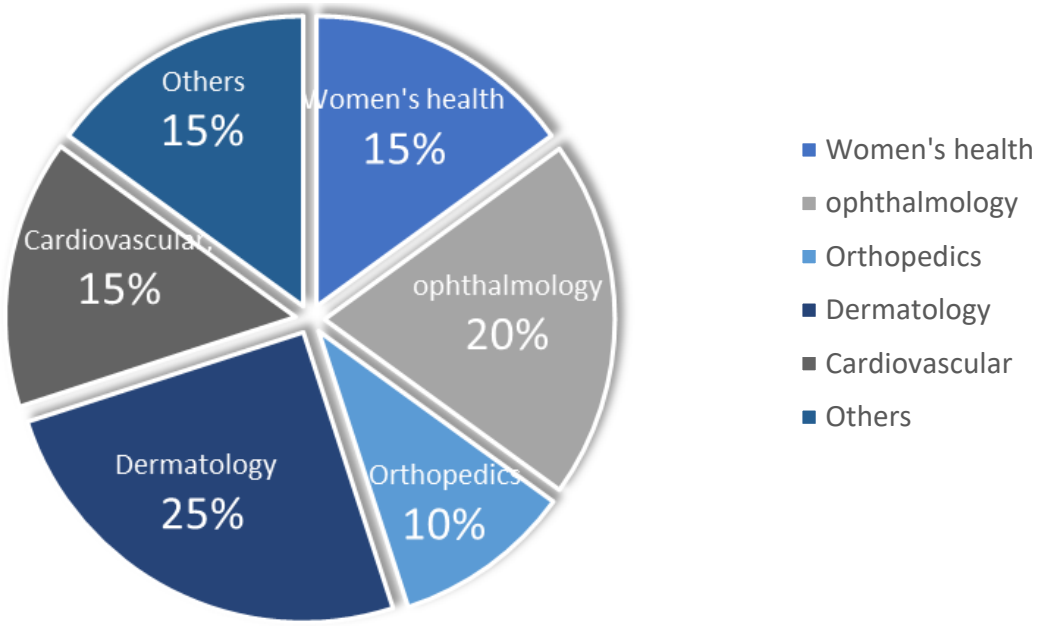
Source: QYResearch, Grandview research, Research Progress of Chitosan and Its Derivatives in Biological Medicine, market monitor

Application of Chitosan in Healthcare



Recent trends in the use of chitosan in healthcare highlight its expanding applications and growing interest across various medical and pharmaceutical areas, driven by its unique rheological physico-chemical properties such as biocompatibility, biodegradability, viscoelasticity, plasticity, cohesiveness, homogeneity and evenness as well as antimicrobial activity.

A notable recent development case of chitosan in healthcare is its application in creating advanced wound care products. **Axio Biosolutions** and their product **MaxioCel**, which can rapidly help in stopping bleeding, Enhances the healing process of wounds



Source: QYResearch, Grandview research, Research Progress of Chitosan and Its Derivatives in Biological Medicine, market monitor

WINDOME

BANKING PARTNERS

PARIS, SAN FRANCISCO

JEAN-YVES COSTE
CO-FOUNDER, CHAIRMAN AND PARTNER

JYCOSTE@WINDOME-BANKING.COM
+33 6 21 82 95 48

FLORIAN PUCHLY
CO-FOUNDER, CEO AND PARTNER

FPUCHLY@WINDOME-BANKING.COM
+33 699392010

ZHONGSHI CONG
SENIOR ASSOCIATE

ZCONG@WINDOME-BANKING.COM
+33 6 68 28 57 02