MARUKYOU BIO FOODS Co.

Nano Type CHONDROITIN

It is often said, “You are what you eat”.
However, this is not exactly true.
The truth is, “You are what you absorb”.

Nano Type Chondroitin’s patented technology (JP5146733) has clinically shown it can be absorbed 200 times more by the body compared to regular Chondroitin.
Nano Type Chondroitin reaches the targeted parts of your body where you need it without fail.

Chondroitin and Proteoglycan are known to be effective for joint maintenance. However, because they are large in molecules (more than 10,000 molecules), it is unlikely it will be absorbed by the body.

Nano Type Chondroitin, with a size of 2,000 molecules, is absorbed by your body to reach the targeted areas efficiently.

10mg daily is recommended to maintain healthy joints and lifestyle. Increasing the dosage up to 100 mg daily may ease any immediate concerns.

Nano Type Chondroitin has excellent bioabsorbability, with an oral absorption rate of over 200 times that of conventionally used high-molecular-weight chondroitin sulfate. This has been published in academic papers. As a result, NanoType Chondroitin is delivered to tissues throughout the body via the bloodstream, regulating gene expression at the cellular level and bringing about better effects on the human body.

The physiological activity of NanoType Chondroitin (chondroitin sulfate oligosaccharides) includes the following.

■Activating NRF2

- ➡ Antioxidant effect
- ➡ Anti-inflammatory effect
- ➡ Improvement of locomotive syndrome
- ➡ Suppression of hypertension
- ➡ Suppression of fat droplet accumulation in adipocytes
- ➡ Down regulating the expression of creatine kinase

Nano Type Chondroitin

What is chondroitin sulfate oligosaccharides?

Nano Type Chondroitin：chondroitin sulfate oligosaccharides

Bridging Glycobiology and Healthy Longevity

■Issues with conventional chondroitin sulfate

Because chondroitin sulfate is a macromolecule, it needs to be digested in the stomach and intestines in order to be absorbed by the human body. However, because the human body does not have a digestive enzyme for chondroitin sulfate in the digestive tract, the chondroitin sulfate that is ingested is either excreted as it is or consumed by intestinal bacteria as food, and it is almost never absorbed into the body as an active ingredient.

■Solving problems with Nano Type Chondroitin

We have developed a technology for reducing the molecular weight of chondroitin sulfate through microchemical processing in joint research with a university, and have obtained a patent for it.

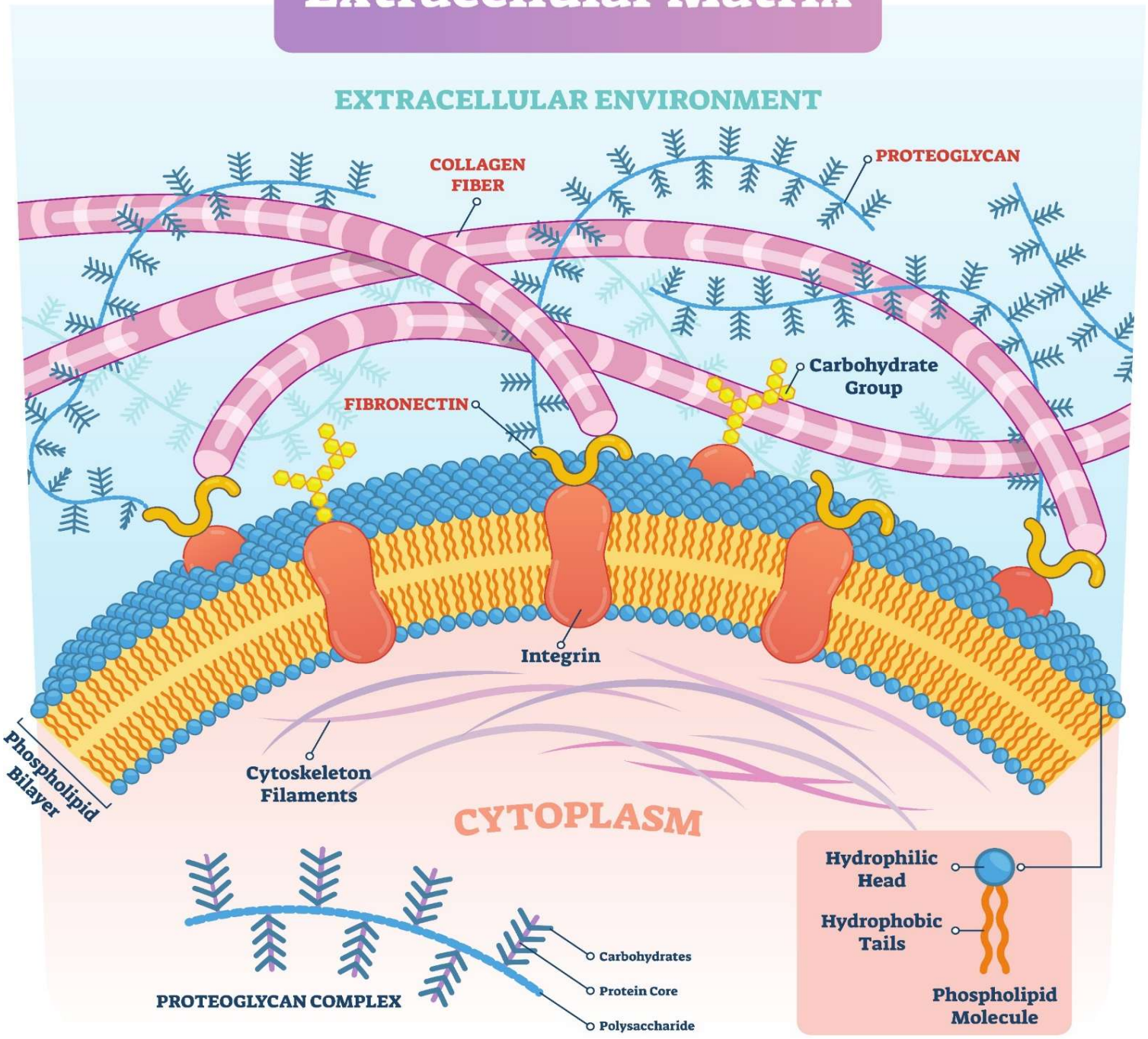
Nano Type Chondroitin are absorbed through the intestinal tract when taken orally and enter the bloodstream. They are then delivered to cells throughout the body along with the bloodstream. The amount of chondroitin sulfate delivered is more than 200 times greater than that of conventional products.

Once delivered to the tissues, Nano Type Chondroitin controls gene expression in cells and demonstrates excellent functions such as cartilage production, bone production, hypertension suppression, antioxidant stress protection, and anti-inflammation.

Nano Type Chondroitin has passed all safety tests and its safety has been confirmed through over 10 years of food experience in Japan.

Marukyou Bio foods Corporation operates the world's only plant capable of mass-producing chondroitin sulfate oligosaccharides.

Extracellular Matrix



Chondroitin sulfate is a major component of the extracellular matrix. It is present in almost all tissues. It is present in large quantities in cartilage, the aorta and tendons, and maintains the physical structure of tissues through its strong affinity with water, while also playing a variety of physiological functions necessary for life activities.

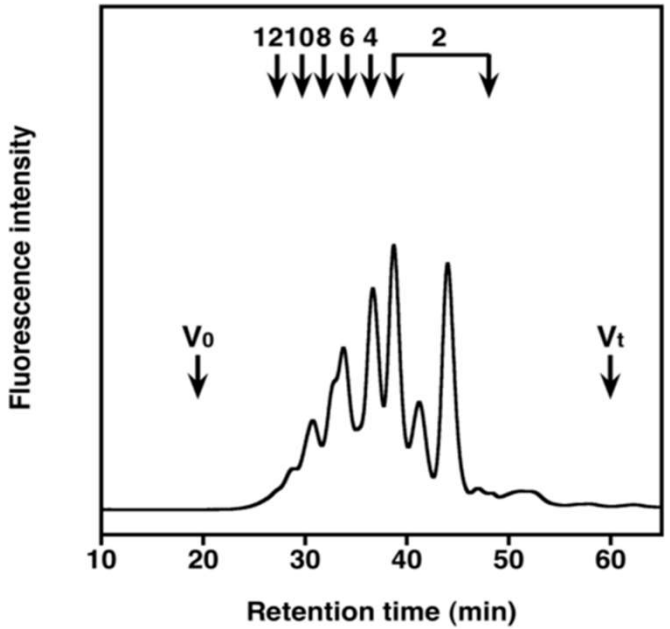
In the body, chondroitin sulfate forms proteoglycans (sugar-protein complexes) bound to proteins.
There are many types of proteoglycans, each with its own unique functionality, depending on the binding method of the core protein and sugar chain. Typical examples include aggrecan, which is abundant in cartilage, and versican, which is found in the skin.

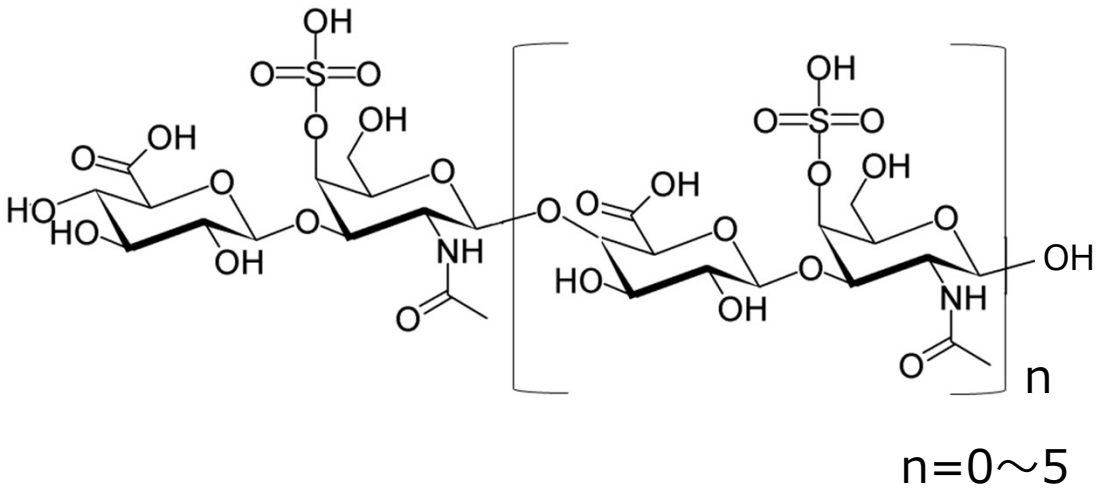
Chondroitin sulfate oligosaccharides, which are breakdown products of chondroitin sulfate, function as bioactive substances, sending various signals to cells and controlling gene expression, and work to keep tissues healthy by protecting them from injury and aging.

Structure and composition of chondroitin sulfate oligosaccharides

■ Size: Oligomers of mainly 12 to 2 sugars

■ Sugar chain structure: Mostly, oligomers of chondroitin sulfate in which the 6th position of N-acetylgalactosamine (GalNAc) is sulfated. Even-numbered and odd-numbered sugars are present. Even-numbered sugars include those with a non-reducing terminal of galacturonic acid (GlcA) as well as those with a non-reducing terminal of GalNAc. Odd-numbered sugars include those with both ends of GlcA and those with both ends of GalNAc. Our chondroitin sulfate oligosaccharides are a mixture of these four oligosaccharide chains. As they are produced by hydrolysis, none of the non-reducing terminal C4-C5 bonds have a double bond.





Kawahara, et al., *Bulletin of Applied Glycoscience*, 11(2), 94–99,2021

Chondroitin sulfate oligosaccharides are water-soluble acidic sugars with an average molecular weight of 2000.

Comparison of chondroitin sulfate oligosaccharides and general chondroitin sulfate (high-molecular-weight)

Items	Nano Type Chondroitin Chondroitin sulfate oligosaccharides	General chondroitin sulfate (high molecular weight)
Average molecular weight（kDa)	2	100～150
Solubility in water	dissolves easily	hard to dissolve
Recommended intake（mg/day/man)	10～100	1,560 (Japanese pharmaceuticals)
Absorption from the intestinal tract when administered orally	high absorbency (Type Chondroitin times)	not absorbed
Transdermal absorption when applied	high absorbency (320times)	not absorbed
anti-inflammatory	○	▲
Anti-locomotive syndrome	○	▲
hypertension suppression	○	×
Protection from cell damage through the activation of antioxidant genes	○	×

Safety of chondroitin sulfate oligosaccharides

items	Analysis Test Results
Total number of bacteria	3,000cfu／g or less
Coliform bacteria	Negative
Mold count	Negative
Yeast count	Negative
Number of heat-resistant spores	300cfu／g or less
Acute oral toxicity after a single dose	2,000m g ／ k g or more
Repeated dose toxicity test for 28 days	Less than 1,000mg／ k g
Mutagenicity (Ames TEST)	Negative
Human intervention study	(1) UMIN000023492: No abnormalities at 100mg/day/man/8week (2) UMIN000052732: No abnormalities at 100mg/day/man/12week
Cytotoxicity test(bioluminescence method)	Negative
Food Experience	No adverse events occurred

Intellectual property related to chondroitin sulfate oligosaccharides

Patent name	Registration status	Country of application
Method for producing chondroitin sulfate oligosaccharides	Patent No.6146733	JAPAN
Antiplatelet agents, platelet adhesion inhibitors, platelet aggregation inhibitors, antithrombotic agents, food compositions for inhibiting platelet adhesion and/or platelet aggregation, and food compositions for preventing or improving thrombosis	Patent pending 2021-094977	JAPAN
Blood pressure lowering agents and food compositions for lowering blood pressure	PCT/JP2023/008494	JAPAN United States
Agents and methods for regulating the expression of creatine kinase	Patent pending 2024-185215	JAPAN (International application scheduled)
Agents and methods for activating Nrf2	Patent pending 2025-22456	JAPAN (International application scheduled)
Agents and methods for suppressing melanin production	Patent pending 2025-144579	JAPAN (International application scheduled

Manufacturing process

No.	Process
1	raw materials(Fish cartilage)
2	enzyme treatment
3	clarifying filtration
4	ultra filtration
5	heat sterilization
6	subcritical water treatment
7	concentration with ultrafiltration
8	activated carbon treatment
9	spray drying
10	classification
11	metal inspection
12	measurement and packing

This product is manufactured in accordance with the health food raw materials GMP of the Japan Health and Nutrition Food Association.

Product Specifications

Item	Result	method
Appearance	White to beige powder	Visual
Chondroitin Sulfate Assay	Minimum 80.0%	HPLC method
Weight - average molecular weight (Mw)	3000 or less	HPLC method
Moisture	Maximum 10.0%	Infrared moisture meter
pH (1% solution)	3.0 - 5.0	Glass electrode
Heavy metal (as Pb)	Maximum 10ppm	Sodium sulfide colorimetric method
Viable bacteria Count	Maximum 3,000 cfu/g	Standard agar plate culture method
Escherichia coli	Not detected	BGLB method
Granularity	30 mesh pass	Sieve separation

This product is manufactured in accordance with the health food raw materials GMP of the Japan Health and Nutrition Food Association.

Nutrition Facts

Item	Result (per 100g)
Calories	323 kcal
Protein	0 g
Total Fat	0 g
Saturated Fat	0 g
Trans Fat	0 g
Total Carbohydrate	80.8 g
Sugars	0 g
Sodium	4660 mg

This product is manufactured in accordance with the health food raw materials GMP of the Japan Health and Nutrition Food Association.

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