

Review Article

Secret of Anti-Aging: Anti-Aging Food Containing Glucosamine, Hyaluronic Acid and Chondroitin

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Abstract

Glucosamine, hyaluronic acid, chondroitin are now used as health food by many persons in Japan. I will explain how hyaluronic acid, chondroitin, glucosamine are contributing to the health, anti-aging and long life. Klotho (anti-aging gene) makes disaccharide (glucuronosyl(1-3)(N-acetyl glucosamine) from hyaluronic acid. Sulfo glucuronosyl(1-3)galactoside from chondroitin sulphate. Klotho co-works with produced disaccharide on site and gives stable Ca homeostasis and consequent health, anti-aging and long life. Secret of anti-aging and long life is to eat food containing hyaluronic acid, chondroitin and glucosamine.

Introduction

People are looking for materials effective for anti-aging and long life for many years. Average life in Japan: male is 80.50 (third), female is 86.83 (top in the world). I wonder why Japanese live longer than other country. I believe that Japanese food based on fish is fit and good for long life.

I found that disaccharides and hyaluronic acid, glucosamine and chondroitin are closely related with anti-aging and long life.

Hyaluronic acid, glucosamine, chondroitin are now used as health food by many persons in Japan. Suntory sold 20 millions bottles of glucosamine and chondroitin as nutrition supporting food. Setagaya Shizenshokuhin sold 22 million bags of glucosamine, hyaluronic acid and chondroitin as health food for 11 years. Taishoseiyaku are selling glucosamine and chondroitin. Zeria Shinyaku is selling chondroitin as medicine for 60 years. Wada calcium pharmaceutical sold 10 million bags containing glucosamine, chondroitin sulfate and collagen

as nutrition supporting food. About 6 million persons are drinking and eating these materials and enjoying health, anti-aging and long life. I found the reason why glucosamine, hyaluronic acid and chondroitin are so much used.

Nabeshima found Klotho (anti-aging gene) [1]. Since then many reports about human Klotho [2], anti-aging [1-11], Ca homeostasis [12-15] and related papers [16-19] are published. Nabeshima found a sulfo disaccharide from mouse liver cell. This saccharide binds with Klotho and FGF23.

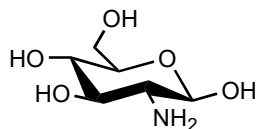
I have synthesized the sulfo disaccharide and proposed the mechanism how the disaccharide are related with hyaluronic acid and chondroitin [20-24]. I am now reporting these and show the way to get health, anti-aging and long life in detail.

Glucosamine Derivatives

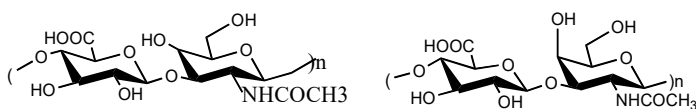
When we look at glucosamine derivative from natural products, we can find many compounds like hyaluronic acid, chondroitin, chondroitin sulfate, chitin, chitosan, keratan

sulfate, proteochonroitinsulfate (chondromucoprotein).

Hyalunoic acid is poly(glucuronosyl(1-3)glucoside) and chondroitin is polt(glucuronosyl(1-3)galactoside).

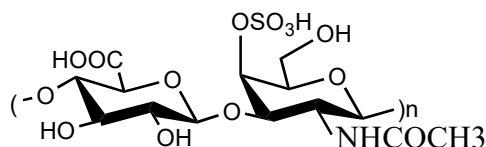


Glucosamine

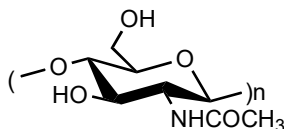


Hyaluronic Acid

Chondroitin

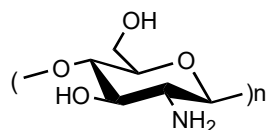


Chondroitinsulphate A

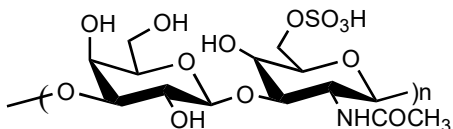


chitin

be-ta-1,4-poly-N-acetyl glucosamin



Chitosan

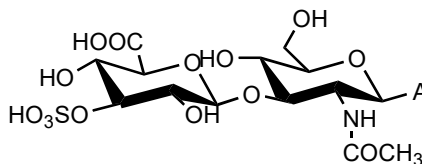


Keratan Sulfate

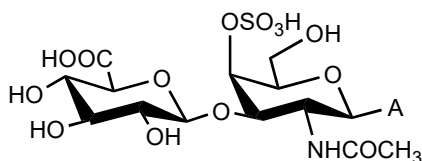
Soft bone, cartilage: Proteochonroitinsulfate is proteio-glycan aggregate composed of hyaluronic acid and core protein.

Structure of Sulfo Disaccharides

Active disaccharides have following structures. Sulfo-glucuronosyl(1-3)-glucoside, Sulfo-Glucuronosyl(1-3)-Galactoside



Sulfo-glucuronosyl(1-3)-glucoside



Sulfo-glucuronosyl(1-3)-galactoside

(A: attached molecule like estrone, p-methoxyphenyl, vitamin D, amino acid, oligo amino acid, protein). These compounds bind with Klotho and FGF23 indicating that these compound are co-working with Klotho.

Relation of Klotho, Sulfo-Disaccharide, Glucosamin, Hyaluronic Acid and Chondroitin

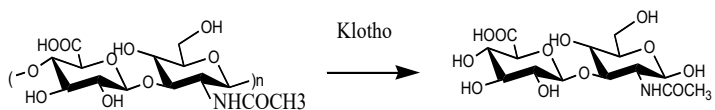
Klotho is an enzyme that in humans is encoded by the KL gene [2]

This gene encodes protein that is related to β -glucuronidases. Klotho is a novel β -glucuronidases [19]. β -Glucuronidase is a enzyme that can cleave glucuronosyl bond and can bind glucuronosyl group. Therefore Klotho can make disaccharide from hyaluronic acid and chondroitin.

Hyaluronic acid is poly(glucuronosyl(1-3)glucoside) and chondroitin is poly(glucuronosyl(1-3)galactoside)

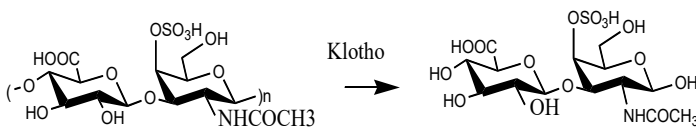
Hyaluronic acid gives glucurosyl(1-3) N-acetyl glucosamine by

Klotho



Hyaluronic cid Glucuronosyl(1-3)N-Acetyl Glucosamine

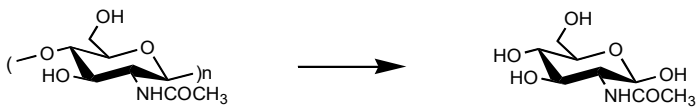
Chondroitinsulphate gives sulfo-glucronosyl(1-3)
N-acetyl galactosamine by Klotho



Chondroitin Sulphate

Sulfo-Glucronosyl(1-3)
N-Acetyl galactosamine

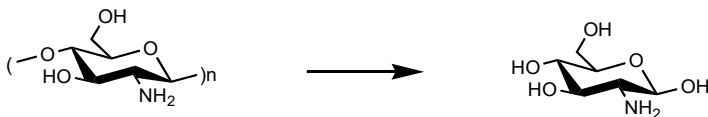
Depolymerization of Chitin gives N-acetylglucosamine.



Chitin

N- acetyl glucosamine

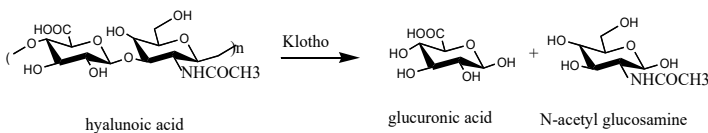
Depolymerization of Chitosan gives glucosamine



Chitosan

glucosamine

Hyaluronic acid gives glucuronic acid and N-acetyl glucosamine
by Klotho

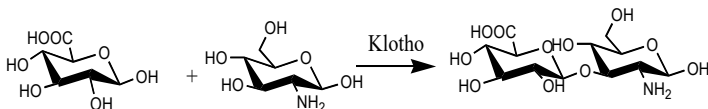


hyaluronic acid

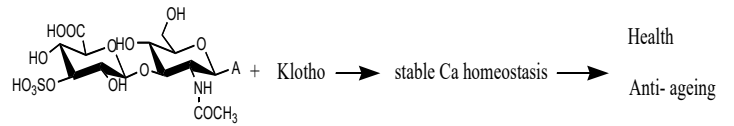
glucuronic acid

N-acetyl glucosamine

Klotho combine glucuronic acid and glucosamine to afford
disaccharide



Klotho co-work with produced disaccharide on site to afford
stable Ca homeostasis and subsequent health and anti-aging.



These schemes indicate that Klotho is playing multiple roles.

- 1) Production of disaccharide from hyaluronic acid, chondroitin by glucuronidase
- 2) Production of glucuronic acid , N-acetyl glucosamine and N-acetyl galactosamine
- 3) Production of disaccharides by combing of two sugars
- 4) Production of stable Ca homeostasis co-working with disaccharide

These schemes show that disaccharides, Klotho, hyaluronic acid, chondroitin, glucosamine are working closely related all together and giving us health , anti-aging and long life.

Klotho is a regulator of Calcium homeostasis [12,15] Klotho makes disaccharide from hyaluronic acid and chondroitin and co-works with produced disaccharide on site and gives stable Ca homeostasis and consequent health and anti-aging [20-22]. Therefore eating of hyaluronic acid and chondroitin rich food is essential for anti-aging and long life [23,24].

Anti-Aging Food

For good health, anti-aging and long life, eating of food containing hyaluronic acid, chondroitin, glucosamine and derivative is essential. Eating of fish, whole body or head of fish or eye of fishes, like sea bream(tai), house-mackerel(aji), mackerel pike(sanma), sardine(iwashi),shirasu(small sardine),iriko(boiled and dried small sardine),mezashi (dried sardine), smelt (shishamo), ayu, splendid alfonasine(kinme dai), loach(dojou), eel(unagi), carp (koi), curucian carp(funa), flat fish(hirame,karei), sand lance (ikanago), silver stripe round herring(kibinago), stone fish (okoje), black rockfish(mebaru), herring(nishin), tsumire(crashed mixture of small fish), shark fin(fukahire), tsukudani of small fish.

Among fish, clammy (nurunuru) fish like eel,anglerfish (ankou), loach, cat fish(namazu), sea cucumber(namako), octopus(tako), moray eel(utsubo), pike conger sea eel(hamo), clammy turtle (suppon) are good as anti-aging food, because main component of clammy substance at skin is chondroitin. Eating of eel (unagi no kabayaki) at hottest day of the year(doyono ushinohi) is popular as health food in Japan. Eel is served without head. But if it served with head, the efficiency

will be increased.

Anglerfish(ankou) is delicious and whole body is eaten.

Octopus is clammy and dried under sun and eaten as health food. But octopus is washed with washing machine and clammy chondroitin is washed away . These octopus is not so effective as unwashed one.

Turtle (suppon) is clammy and famous as delicious anti-aging food. Husk of shrimp and crab is composed with chitin and chitosan. Depolymerization of chitin gives N-acetylglucosamine. Depolymerization of chitosan gives glucosamine. Eating of shrimp and crab with head and husk is recommended.

Eating of nebaneba(stringy and sticky) vegetable like sea tangle, kelp, sea weed (mozuku), yam (yamaimo), nattou(fermented soybean)is recommended.

Eating of cartilaginous cow, pig and chicken tissues is recommended.

Hyaluronic acid was isolated from eyeball of cow and was named from Greek name glassily hyaloid . Hyaluronic acid is found in the highest concentrations at eye and joints. Most chondroitin appears to be made from extracts of cartilaginous cow and pig tissues (cow trachea and pig ear and nose, pig pitreous gel, but other sources such as bird cartilage are also used.

The persone who do not like to eat fish are advised to eat tablet of glucosamine, hyaluronic acid and chondroitin.

Non Food Benefit of Hyaluronic Acid

Hyaluronic acid is used for anti-aging skin handling [25], wound healing [26,27], cosmetic use [28]. Hyaluronic acid has been used to treat osteoarthritis of the knee via injecting it into the joint [29,30].

Conclusion

Secret of anti-aging and long life is to eat anti-aging food, in other word, to eat whole body of fish, and cartilaginous cow, pig and bird tissues.

Acknowledgements

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