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A REVIEW ARTICLE ON: MARINE BASED NUTRACEUTICALS

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ABSTRACT

Nutrients are essential food rudiments that have nutritive and remedial parcels. The objectification of active substances similar as carotenoids, collagen hydrolysates and salutary filaments contribute to the health benefits of these foods. This nutrient has been shown to profit cardiovascular and vulnerable system health and play a part in precluding infection. Marine nutrients are gaining instigation in the diet and supplement diligence. Natural marine products have been used for centuries as promising sources of bioactive motes for the forestallment and treatment of colorful conditions. Thus, marine organisms are also one of the most important food sources and have the eventuality to cure colorful conditions. Seafood provides proteins, peptides, polysaccharides, polyunsaturated adipose acids, vitamins, minerals and numerous other bioactive composites similar as polyphenols. This review summarizes marine bioactive motes and their current and implicit uses in the food and supplement diligence.

KEYWORDS: Nutrients, Bioactive Compounds, Marine Nutraceuticals, Marine Drugs, Marine Source.

INTRODUCTION

The raw foods, functional foods or salutary supplements that contain bioactive motes and have capability to give health benefits (forestallment and treatment of complaint) beyond their nutritive value are known as “nutraceuticals”.[1] This term combines two words, nutrient and medicinal element (medicinal). In recent times, functional and bioactive composites from natural sources similar as terrestrial and marine shops, creatures, or indeed microorganisms have come sustainable result that offers new motes with strong natural exertion. With the

increase in the field of health- grounded exploration these new motes are gaining further significance. Ultramodern salutary habits and life in developed countries have redounded in an adding number of conditions similar as type 2 diabetes mellitus, rotundity, metabolic pattern, cancer, or neurodegenerative conditions.[2] Bioactive factors from natural sources with an capability to contribute to the overall health have come an intriguing volition to potentially dangerous synthetic constituents. The high diversity and dynamics of marine ecosystem makes an ideal force identification of new motes and development of marine nutraceuticals. Bioactive factors from natural sources with an capability to contribute to the overall health have come an intriguing volition to potentially dangerous synthetic constituents. The high diversity and dynamics of marine ecosystem makes an ideal force identification of new motes and development of marine nutraceuticals. further than 20,000 marine bioactive composites have been insulated, still, only a small proportion of them have been completely studied and exploited to some degree.[3]

The term " nutraceuticals, " chased from " nutrients " and " medicinals " by Stephen DeFelici in 1989, is constantly used interchangeably with " functional foods " indeed though there's a slight difference between the two. Nutraceuticals are "naturally deduced bioactive composites that are set up in foods, salutary supplements and herbal products, and have health promoting, complaint precluding, or medicinal parcels" (Pandeyetal., 2011). Functional foods correspond of an component that provides a health- promoting property in addition to its usual nutritive value, for illustration, probiotic yogurts. When the food is cooked or prepared using "scientific intelligence" with or without understanding of how or why it's being used, the food is called "functional food" (FAO Report, 2007). A functional food that facilitates the forestallment or treatment of diseases or conditions other than anemia is called a "nutraceutical".[4]

Background

The conception of "nutraceutical" was introduced by Stephen DeFelice in 1989, by combining the terms "nutrition" and "pharmaceutical". The term refers to raw foods, fortified foods or salutary supplements containing biologically active motes, also known as bioactive motes[5] that give health benefits beyond introductory nutrition.[6] These bioactive composites include certain polysaccharides, peptides, phytochemicals, vitamins, and adipose acids that are naturally present in foods, can be added to foods producing fortified or functional foods

or can be formulated into salutary supplements. These bioactive motes can be attained either by birth from natural sources or by chemical and biotechnological conflation.[7]

• Nutraceuticals in the Global Market

The global nutraceutical request comprised of functional foods and potables and salutary supplements, was valued at around$ 250 billion in 2014. Consumer demand for nutraceuticals is fleetly adding with the request anticipated to reach around$ 385 billion by 2020.[8] Nutraceutical products give people with a safe and healthy life. This may contribute to overall request growth and reach further than$ 90 billion by the end of 2015 in the United States alone, while it may reach$ 180 billion worldwide. This has been attributed basically to the growing population worldwide, increased frequence of serious conditions due to changes in life, and enhanced focus on indispensable drugs encyclopedically.[9]

In the regions where nutraceutical product consumption is high, a number of salutary supplements, medical foods, food complements, and functional foods have raided the food and health request with the end of maintaining health and precluding complaint. Within these regions, consumption rates of these products vary with the country, age and coitus of the population. For illustration, consumption of nutraceutical products is advanced in the USA. It has also been set up that input of nutraceutical products varies with life, for illustration increased physical exertion and high fruit and salutary fiber input is associated with the use of nutraceutical products, whereas nutraceutical product consumption decreases with rotundity, smoking and increased input of salutary fat.[10]

Nutraceuticals and functional food diligence have grown significantly in the last two decades. Foods that promote health beyond furnishing introductory nutrition are nominated “functional foods.”. The acceptance of these products by larger populations, especially in the West, is ever adding. The United States has dominated the scene of the Nutraceuticals and functional food request lately. Nutraceuticals give health benefits, grease the mending process, and help conditions, therefore attracting a large clientele. This is also relected by the fact that nutraceuticals and indispensable drug have been incorporated in the class in all health- care professional education.

Table 1: Marine bioactive molecules: sources, applications and health perspectives.[11]

Category	Bioactive Molecules	Applications	Major Marine Source	Health Perspectives
Protein and Peptides	Collagen	Edible coating in meat industry (e.g., sausages)	Fish (albacore tuna, silver-line grunt, brown-backed toadfish, hake, trout, lingcod, catfish, rainbow trout, yellow sea bream and common horse mackerel etc.)	Anti-oxidant, anti-hypertensive and anti-skin-aging activities.
	Gelatin	Stabilizer, texturizer, or thickener in ice cream, jam, yogurt, cream cheese, margarine, confectionaries, utilized in low fat foods and clarifiers	Fish, especially cold-water (Pollock, cod, haddock, hake and cusk	It has been shown to prevent and treat chronic atrophic gastritis
	Albumin	Whipping, suspending, or stabilizing agent	Mollusks, crustaceans, low-fat fish	Anticoagulant and antioxidant properties
Poly-Saccharides	Carrageenan	Gel formation and coatings in the meat and dairy industry	Macroalgae e.g., K. alvarezii, E. denticulatum and B. gelatinum	Anti-HIV activity and anticoagulant properties
	Agar agar	Gel formation and food gums	Red Alga is a main source of agar agar like Gelidium, Gracilaria, Hypnea and Gigartina	
	Fucans and fucanoids	Nutraceutical supplements	Cell walls of brown algae, sea urchin eggs, sea cucumbers	Nutraceutical supplements
	Chitin, chitosan, and derivatives	Gelling agents, edible protective films, clarification and de-acidification of fruits	Shrimp, crab, lobster, prawn and krill	Increase dietary fiber, reduce lipid absorption, antitumor, bactericidal and fungicidal activities
Fatty acids	Omega-3 fatty acids	Nutraceuticals (fish oil and capsules), fortification of livestock, feed and infant formula	Almost all marine sources	Almost all marine sources

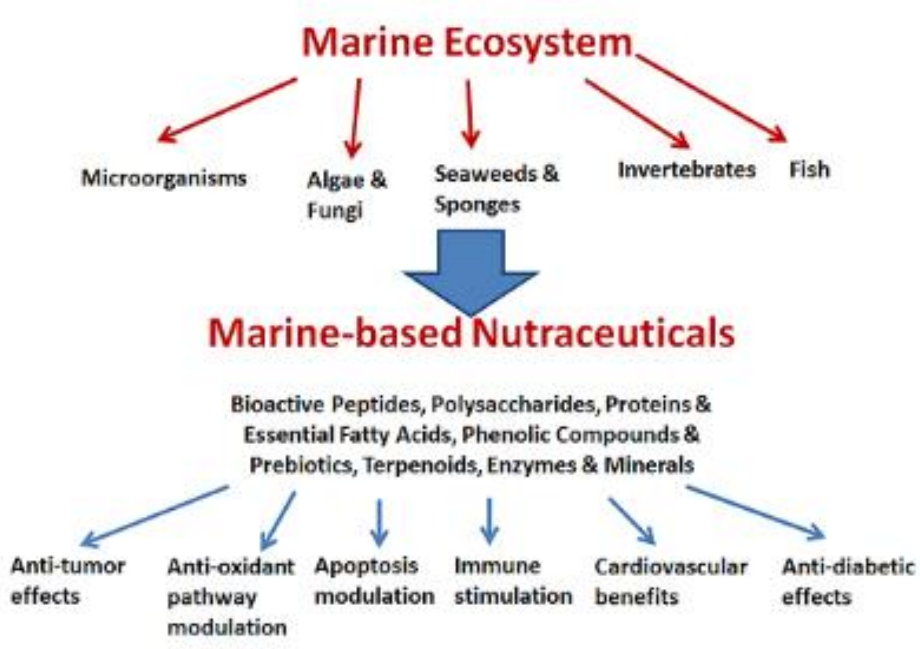


Fig. 1: Marine Based Nutraceuticals.[12]

- **Marine Sources of Bioactive Molecules**

1. Marine Algae

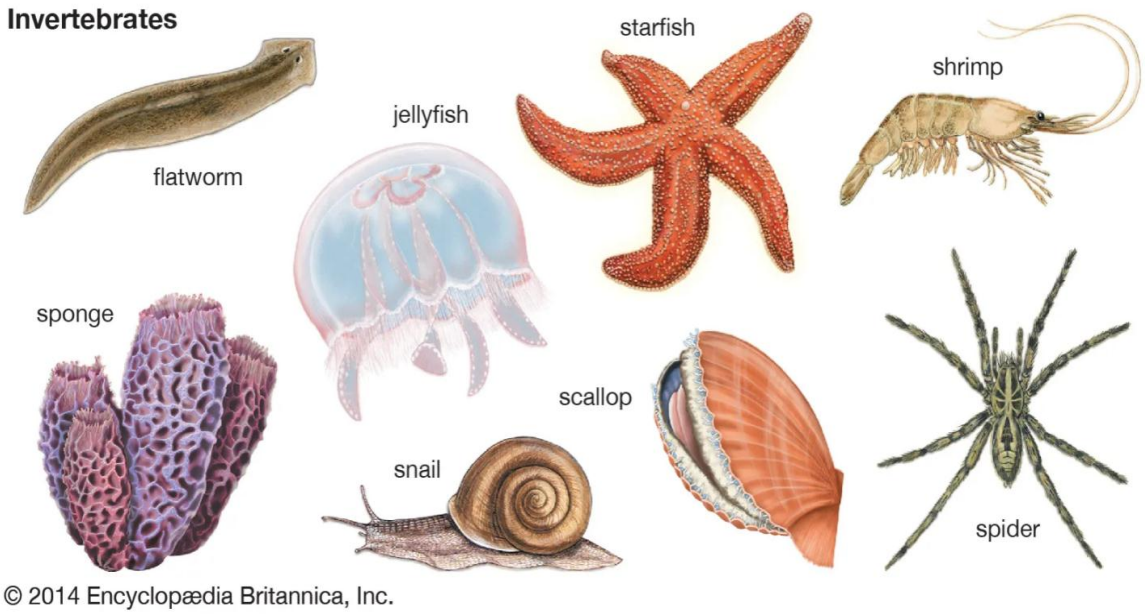
Fig.1.2.

In the nutraceutical assiduity marine algae are used as sources of food and food constituents.[13] Microalgae and macroalgae are the two main orders of algae and both have operations as nutraceuticals. Microalgae, the most primary and simply- organized members of marine factory life, are rich sources of food constituents, similar as β- carotene, Vitamins C, A, E, H, B1, B2, B6 and B12, astaxanthin, polysaccharides and polyunsaturated adipose acids.[14–15] As similar, bioactive motes from microalgae are commercially produced, used as food complements and also incorporated into child milk phrasings and salutary supplements.[16]

1. Marine Fish

Fish enthrall the loftiest position in marine beast consumption and are important to the world frugality. In 2012 fish handed roughly 16 of the world's protein conditions with herring, salmon, cod, flounder, tuna, mullet and anchovy being the most common species of fish used for food.[17]

1. Marine Invertebrates



Marine pets, like bloodsuckers, molluscs, echinoderms and crustaceans, are sources of bioactive peptides, steroids, terpenoids, strigolactones, alkaloids, ether and phenols. Excerpts or composites insulated from marine pets are known to include antibacterial, antiviral, anthelmintic, antifungal, antihypertensive, anticancer and have vulnerable modulatory parcels. A great deal of exploration has been conducted on these motes particularly for the development of numerous new remedial agents.[18]

1. SPONGES

Bloodsuckers are sessile metazoans that correspond of a glutinous material, mesophyl, and are the simplest form of multicellular creatures. Their concave ewer- suchlike body is corroborated by spicules (a needle- suchlike silica or calcium structure) and spongia (collagen filaments). There are numerous chemically-different composites like alkaloids, terpenoids, polyketides, macrolides, polyphenolic composites, peptides and sterols that are insulated from bloodsuckers with the eventuality to cure colorful affections.[18]

2. Molluscs

Molluscs together with echinoderms, have been extensively consumed as marine foods and are considered natural functional foods. expansive exploration has been performed on bioactive motes from these sources revealing numerous significant findings. Bioactive peptides attained from the fermented blue mussel and oyster gravies significantly drop hypertension whilst ground abalone and its shells are used for treating eye conditions. numerous Asian populations consume cuttlefish, squid, octopus and nautiloids due to their remedial goods, for illustration rickets are cured with the bones of cuttlefish, as well as gastrointestinal diseases and observance inflammation.[18]

3. marine microalgae

Marine alga has rich biodiversity eventuality and can give colorful conditions as food and bioactive composites for treatment and remedies for colorful types of bacterial illness like tuberculosis, viral infections like mortal immunodeficiency contagion and herpes contagions, fungal infections, and protozoan infection like malaria; it's also helpful against helminthic conditions.[19]

4. Marine bacteria

The number of reported secondary metabolites from marine bacteria has gradationally increased since the last decade therefore re ecting the adding attention by groups from academia and assiduity. The growing demand for new antimicrobial motes effective against the resistant strains of microorganisms has encouraged a number of exploration groups to explore the abysses for new bioactive composites. prodigiosin displayed high order of antibiotic and antifungal conditioning, high toxin averted its use as a remedial agent. Members of the Bacillus group in a broad sense are considered proli ¬ c directors of antimicrobial substances, including peptide and lipopeptide antibiotics, and bacteriocins.[19]

5. Marine Fungi

Marine- deduced fungal strains primarily produce polyketide- deduced alkaloids, peptides, terpenes, and mixed biosynthesis composites. There are a number of reports on bioactives from marine fungi similar as the insulation of gliovictin from marine fungus, Asteromycescruciatus; cyclosporin A from Tolypocladiuminflatum in 1976; and cephalosporin C, a penicillinase-sensitive antibiotic substance active against Gram-negative bacteria from marine fungus Cephalosporiumacremonium attained from the ocean near a sewage outfall of the seacoast of Sardinia.[20]

- **Marine Derived Bioactive Components**[21]

Marine ecosystems give a different range of bioactive motes with expansive operations as nutraceuticals in the food and supplement diligence. These bioactive motes can be proteins, peptides, polysaccharides, adipose acids, polyphenols, probiotics, enzymes, vitamins and minerals. The remaining sections of this review bandy the physical and chemical parcels of these different motes and how they contribute bioactivity in the environment of nutraceuticalapplications.

1. Proteins

Proteins from marine sources including fish(cod, tuna, herring, rout, hake, pollock and haddock), crustaceans, molluscs, extremophiles like Dunaliella, and seaweeds have unique parcels similar as gel- conformation, film and raging capacity, antioxidant, anticoagulant and antimicrobial exertion. For illustration, collagen, gelatin and albumin are common marine proteins used in foods and are enzymatically hydrolyzed for the product of bioactive peptides which may have the eventuality to be used as nutraceuticals.

2. Peptides

Exploration is being performed to understand peptide structure, composition and sequences. Bioactive peptides have colorful nonsupervisory functions on specific cellular target phrasings.[66] numerous experimenters have concentrated on the development of pharmaceutical composites from marine- deduced peptides particularly for ACE inhibition and antihypertensive function.[68] Marine proteins from fish, molluscs and crustaceans are amongst the richest sources of bioactive motes.

3. Polysaccharides

Carrageenans and alginates are direct biopolymers that have been linked as the most abundant polysaccharides set up in red and brown algae, independently.[72] piecemeal from alginate, brown algae also contain largely complex, sulfated matrix polysaccharides called fucoidans. The complex structure of the fucoidans uprooted from different marine species varies in saccharide composition, sulfate content, and positions of sulfate groups, molecular weight, relation mode, and sequence of saccharide remainders.

4. Fatty Acids

Adipose Acid Marine fish species and algae have been linked as sources of polyunsaturated adipose acids which are rich in ω- 3 or ω- 6 adipose acids. The presence of these unsaturated

adipose acids in marine- deduced foods increases their connection as nutraceuticals in the food assiduity.

- **Marketed Marine Drugs**

2.1. Cytarabine

Nucleosides, the glycosides of purines and pyrimidines, and their nucleotidic phosphate derivations, are essential factors in all living cells playing a applicable part in numerous natural processes. On the other hand, antimetabolite nucleosides are used from the same patron organisms microrganisms to inhibit the growth of challengers or bloodsuckers. Antimetabolites are, in fact, analogous to naturally produced metabolites, but they alter cell metabolism failing to perform the normal function. Nucleosidic antimetabolites may intrude seriously with normal cell function producing incapability to gain. The discovery of spongosines, D- arabinose nucleosides from Tethya or Cryptotethya crypta sponger, opened the period of marine medicines and of antimetabolite nucleosidic medicines, giving great occasion to the anticancer and the antiviral remedy.[22]

2.2. Vidarabine

Vidarabine is a prodrug, converted by viral kinases into adenine arabinoside triphosphate in infected cells. Once actuated, the medicine can act both as an asset and as a substrate of viral DNA and RNA polymerases, snooping with DNA conflation and recap. When incorporated into a DNA beachfront, replacing numerous of the adenosine bases, vidarabine leads to a destabilisation of the recently synthesised DNA beachfront, as phosphodiester islands can no longer be constructed.[23]

Although Vidarabine has covered an important part at the morning of the antiviral remedy period, the arrival of newer, more effective antivirals, similar as acyclovir, azidothymidine(zidovudine) and others, has made vidarabine a medicine no longer used in the USA and noway used in Europe. King Pharmaceuticals discontinued the marketing of Vira- A ® ointment in June 2001.[24] No recruiting trials with vidarabine are presently reported inClinicalTrials.gov database (update in October 2021); although under the hunt keyword “ vidarabine ” numerous studies are shown, they're actually appertained to the vidarabine secondary fludarabine.[25]

2.4. Ziconotide

A veritably different medicine from those above described is ziconotide(Figure 1), a peptide nearly suggesting the structure of the natural!- conopeptide poison discovered in the marine species Conus Magus, a gastropod of the Conidae family set up in the Pacific Ocean. All species of the rubric Conus are bloodsuckers of small fish and are characterised by the product of neurotoxins used to immobilise the creatures they feed on, therefore compensating for the large difference in mobility between bloodsucker and prey. They're dangerous speciesalso for humans, determining incidents of poisoning indeed fatal. The venom is contained in a gland inside a kind of stinger or "tooth", which is ejected from the body by a veritably rapid-fire movement.[26]

2.5 Omega-3 Acid Ethyl Esters

Omega- 3 Acid Ethyl Esters Polyunsaturated adipose acids(PUFAs) are applicable motes for cellular metabolic processes. Among them, linoleic acid(LA)(!- 6) and,- linolenic acid(ALA)(!- 3) are essential adipose acids(EFAs) because they can not be synthesised by humans or other advanced creatures. In the mortal body, they give rise to arachidonic acid(AA,!- 6), eicosapentaenoic acid(EPA,!- 3)(Figure 1) and docosahexaenoic acid(DHA,!- 3)(Figure 1), which play a crucial part in numerous cellular processes involved in regulation of body's homeostasis. While AA gives rise topro-inflammatory eicosanoids, the!- 3 EPA and DHA give rise to antiinflammatory motes. A balanced input of!- 6/!- 3 adipose acids is believed to be essential for proper functioning of physiological homeostatic mechanisms, and a advanced consumption of!- 3 adipose acids(FAs) integrating the Mediterranean diet(!- 6 high) may cover against inflammation and related habitual conditions.[27] The retailed!- 3 FAs substantially decide from fishes belonging to families similar as Engaulidae, Carangidae, Clupeidae, Osmeridae, Salmonidae and Scombroidae.[3] lately, they've been produced also from fungus- suchlike microorganisms named Thraustochytrids, high storers of!- 3 Fas.[28]

- **New Marine Drugs under Clinical Trial**

Among drugs already not marketed in the EU or USA, there are four drugs of marine origin, or with a marine component, undergoing phase III clinical trials while eight are in Phase II. (Table 2).

Table 2: Marine drugs under clinical trials subdivided into the three phases of clinical investigation.[28]

Generic Name	Natural Source	Chemical Class	Clinical Use
PHASE III			
Tetrodotoxin	Pufferfish	Alkaloid	Chronic pain
Plinabulin	Fungus	Diketopiperazine	Cancer
Marizomib (salinosporamid)	Actinomycetes	Gama-lactam-Beta_-lactone	Cancer
Plitidepsin	Tunicate	Depsipeptide	COVID-19
PHASE II			
Bryostatin	Bryozoan	Macrolide lactone	Alzheimer
Plocabulin (PM060184)	Sponger	Polyketide	Cancer
Tisotumab vedotin	Mollusk/cyanobacterium	ADC	Cancer
Ladiratuzumab vedotin	Mollusk/cyanobacterium	ADC	Cancer
Telisotuzumab vedotin	Mollusk/cyanobacterium	ADC	Cancer
CAB-ROR2 (BA-3021)	Mollusk/cyanobacterium	ADC	Cancer
CX-2029	Mollusk/cyanobacterium	PDC	Cancer

Scope

The abysms enthrall further than 70 of the Earth's face and represent one of the richest factors of the Earth's biosphere. The abysms contain further than 80 of the world's vegetable and beast species, in addition to an implausible number of microorganisms. Theconditions of marine surroundings are incredibly vast; for illustration, the temperature rangesfrom1.5, C in the frozen swell of both poles to 350, C in the hydrothermal ecosystemsfound on the ocean bottom. This is the reason for a extraordinary great biodiversity reflecting a just as big chemodiversity, constantly truly different from terrestrial one. Nutraceuticals and functional food industriousness have grown significantly in the last two decades. Foods that promote health beyond furnishing introductory nutrition are nominated "functional foods." The acceptance of these products by larger populations, especially in the West, is ever adding. The United States has dominated the scene of the nutraceuticals and functional food request recently. Nutraceuticals give health benefits, grease the healing process, and help conditions, thus attracting a large clientele. This is also relected by the fact that nutraceuticals and necessary medicine have been incorporated in the class in all health- care professional education. In 2012, the Indian nutraceutical request accounts for only about 1 of the global nutraceutical request. Current low per capital spend on these products in India supports the growth of nutaceuticals in India. Other factors are adding obesity in the population and rising cases of diabetes and cardiovascular conditions.

CONCLUSIONS

Marine nutraceuticals are attracting a lot of attention in the food and supplement assiduity. Marine natural products have been used as a promising source of bioactive motes to help and cure colorful conditions for centuries. Consequently, marine organisms are also one of the most important sources of foods with the eventuality to cure colorful affections. Marine food provides proteins, peptides, polysaccharides, polyunsaturated adipose acids, vitamins, minerals and numerous other bioactive composites similar polyphenols. The current review summarizes marine bioactive motes and their current and implicit operation in food and supplement assiduity. New marine rested nutraceuticals have salutary effect on mortal health. The food assiduity are poised for accelerated development in the near future. Marine coffers can be used as Nutraceuticals. As per recent studies marine- deduced Nutraceuticals play a vital part in mortal health. In the last ten times, the number of marine medicines on the EU and/ or USA pharmaceutical request has duplicated. also, a high increase of clinical trials has been registered, ultimate of them presently in the first two phases(twenty- eight out of thirty-two). utmost ofthe marine motes both in clinical use and under trial are for the anticancer remedy and ultimate of them are marine motes conjugated to an antibody(ADCs). Interestingly, while in the terrestrial terrain the factory area is the main source of pharmacologically active motes, in the marine terrain the beasties presently are the current source of sold medicines. generally, they're heterotrophic faves with little or no mobility and living in symbiosis with microorganisms, which constantly are the real directors of secondary metabolites with connection in medicine discovery.

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