

Pharmacology and Bio-medicinal properties of Chitin and its derivative

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Abstract

Crabs are decapod crustaceans belonging to the infra order brachyura. They are covered by exoskeleton having many pharmacological properties. This review shows about many properties of crab and chitin (exoskeleton). Crab meat consists of omega 3 a polyunsaturated acid which provides protection against heart diseases. Selenium provides anti-oxidant properties. Riboflavin helps in the production of steroids and RBC'S. Skin maintenance, normal growth iron absorption and support anti-oxidant properties. Copper and phosphate contained in the crab helps in the absorption, storage and metabolism of iron. Crab is used to reduce BP, psoriasis etc. Chitin of crab is having anti-inflammatory properties and it is found that chitin is a size dependent regulator of inflammation. Chitosan oligosaccharides reducing inflammation by inhibiting TNF- α in LPS stimulated inflammation. Chitin is having anti proliferative effects and it is useful for anticancer chemotherapy with decreased side effects and gradual release of drugs to cancerous cell, it can fight against several pathogenic organisms such as fungi, bacteria, yeast by its antimicrobial effect. It is observed that chitin and its derivatives are one among the powerful anti-diabetic agent, which has less side effects. Chitin can be used as anti-angiogenic agent in the formation of cancer cells. Chitin also includes wound healing and anti-inflammatory property.

INTRODUCTION

Crabs are decapod crustaceans belonging to the infra order Brachyura. They are generally covered by thick exoskeleton. Their abdominal region is entirely hidden under the thoracic cavity, have very projecting tail. They are found in tropical and subtropical regions.^[1]

The crabs have several biomedical properties. Omega3 a polyunsaturated acid contained in crab meat helps in providing protection against heart diseases it also inhibits aggressive behavior.^[13,14] The selenium contained in crab meat plays an important role in human's antioxidant defense system by preventing cells and tissues from damage, helps in functioning in immune system and metabolism of thyroid hormone.^[15] Riboflavin present in them helps in the production of steroids and red blood cells, the maintenance of the skin, the promotion of normal growth and the nervous system, promote iron absorption from the digestive tract and support antioxidant activity.^[10] Copper and phosphate content in crab helps in the absorption, storage, and metabolism of iron and involves in the formation of red blood cells and healthy maintenance of immune system, nerves, blood vessels, bone and phosphorous which is the abundant mineral in the body is involved in contraction of the heart muscles, cell growth, kidney functioning, and also in converting food to energy.^[16]

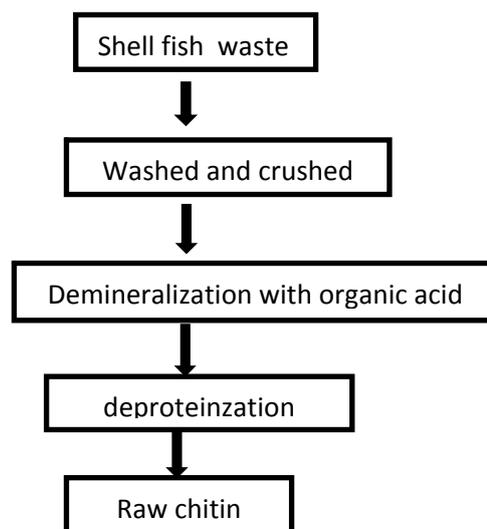
Researches have suggested that the crabs can lower the blood pressure, conditions like ulcerative colitis and psoriasis can be reduced, cognitive functions can be improved, can protect against heart diseases they also possess anti-inflammatory properties

The crab's exoskeleton is composed of CaCO₃ and pair of chelae. Chitin is a long chain polymer of N-acetyl glucosamine



EXTRACTION

The shell of the crab is deproteinized by treating with alkali (NaOH) and demineralization by inorganic acid (HCL) treatment. It is treated with organic solvent to eliminate lipids and colour.^[2]



PHARMACOLOGY OF CHITIN AND ITS DERIVATIVES

chitin ($C_8H_{13}O_5N$)_n was first isolated and characterized from mushrooms by French chemist Henri Braconnot in 1811. It has been found that second most abundant natural polymer in the world.

Chitin has application in food and medical field, agriculture, aquaculture, dental, cosmetics, waste water and membranes^[3]

Reactive oxygen species (ROS) such as hydrogen peroxide, hydroxyl radical and superoxide anion are produced from general metabolism. Oxidative biomolecules such as lipids, carbohydrate, protein and DNA produce ultimate stress. When ROS is produced body itself have a defense mechanism. But if more amount of ROS produced it may cause cancer, aging, inflammation etc.... so chitin in some crustaceans has an ability to balance this oxidative stress of body. Results suggest that chitin has antioxidant property in human health.^[4]

It is reported that the inflammation further develop to malignant transformation due to the production of oxygen species which produce oxidative stress by the phagocytic leukocytes in inflammation. So chitin will help in anti-inflammatory property by this way. And also it has been found that chitin is a size dependent regulator of inflammation.

It has been suggested that chitosan oligosaccharide may have an anti-inflammatory effect by inhibiting TNF-alpha in LPS (Lipopolysaccharide) stimulated inflammation.

Report suggests that chitin and its derivatives have antimicrobial effects against bacteria, yeast, fungi and chitosan is used as covering for fruits. The mechanism of the antimicrobial property of chitin involves cell breakdown, breakdown of cytoplasmic membrane barrier and chelation of trace metal cations by chitosan. cationic chitosan interact with cell envelop of bacteria and kill gram negative bacteria. Chitosan has more antimicrobial property than chitin due to its poly cationic amines. The antibacterial effects depends on the degree of polymerization or molecular weight. Molecular weight is critical for the inhibition of bacteria. Antimicrobial property depends on PH of medium, temperature, presence of food components etc....^[5]

Induction of lymphocyte cytokines through increasing T cell proliferation is related to tumor inhibitory effect of chitosan. By accelerating T cell differentiation, acquired immunity is enhanced to increase cytotoxicity and maintain T cell activity. low-molecular weight-water soluble chitosan will prevent the tumor growth by enhancing cytotoxic effect against tumors^[6]

Chitosan and chitin derivatives have excellent biodegradability, nontoxicity so that it is useful for anticancer chemotherapy. It has improved drug absorption, property to stabilize drug components to increase drug targeting. It protect DNA. It has anticancer property with decreased side effects and gradual release of drugs to cancerous cell.^[7]

Chitosan acts as a poly cationic (+) cellulose. Just like a fibrillar bipolymer which forms a negatively charged film. It is not hydrolysed in digestive tract by the enzyme in man, but tissue digestion of chitosan due to nonspecific enzymes

and bacterial flora. The positively charged tertiary amino group (NH₃⁺) of chitosan is attached strongly to the negatively charged molecules in stomach. Fat absorption from gastro intestinal tract can be reduced by binding with amino carbonyl group of fatty and bile acids. Emulsification of neutral lipids(cholesterol) by binding them with hydrophobic bonds.

Anti-proliferative effects of chitin

Crab is the traditional medicine of cancer. Hydro alcoholic crab shell extract inhibit the proliferation of cancer cells by increasing apoptosis and decreasing nitric oxide production. First known poly saccharide chitin ($C_8H_{13}O_5N$)_n is one of the important compound in cancer treatment^[8] Anti-tumor activity of crab was found by Jeon and kim. Low molecular weight chitosan has been shown to have anti-mestatic effects against lung cancer. carotenoids present in crab also have anti tumor activity. Esters of chitin such as Astaxanthin, zeaxanthin will also decrease proliferation of cancer cells. Human bladder cancer, oesophagus cancer etc.. can be decreased by chitin extract. Chitin extracted from crab will inhibit the development of liver carcinoma cell. Results suggested that chitin extracted from crab has anti tumor and anti metastatic potential in human hepatocellular carcinoma cell line . chitin extract inhibit cell proliferation, decrease the rate of DNA synthesis in cells and also decrease the number of metastatic colonies in lungs. This inhibitory property is due to the increased proliferation of t-cell. By this way the cancer affected human may be safe from tumor and they acquire more immunity. when chitin is taken as medicine, it suppress the proliferation of cancer cell and more number of necrotic cells can be observed.

Anti-microbial property of crab

Chitosan a derivative obtained from chitin have many properties including anti-microbial properties due to its biodegradability, biocompatibility, non toxicity and several physical and chemical properties. Chitosan possesses broad spectrum of activity and have a higher killing rate. It fights against several pathogenic organisms such as fungi, spoilage microorganisms, gram positive and gram negative bacteria. Anti-microbial activity is by the mechanism that the ionic surface interaction resulting in cell wall leakage and by the inhibition of mRNA and protein synthesis.

Chitosan have properties to improve food safety and shelf life. It is used either alone or blended with other natural polymers.

This property exploited in dentistry to prevent caries and also used as food preservatives. This property depends on the molecular weight.

Chitin or chitosan acts as edible coating in food industry also as coating on egg will act as a protective barrier against microbial contamination. Thus improve the shelf life.

Anti-diabetic property

Diabetes is an endocrine disorder with a prevalence of 246 million people in 2007. Diabetics is also a kind of epidemic which spreads day by day. Many medications are prevalent

now a days such as insulin, many oral hypo glyceemic agents. Side effects are along with this medication.

Many researches had been conducted for getting natural medicine which have anti-diabetic property. Such a way it is observed that chitin and its derivatives are one of the powerful anti-diabetic agent. No mortality is associated with the use of chitin derivatives as anti-diabetic agents^[12]

Anti-angiogenic property

Angiogenesis is the process of formation of network of new blood vessels from preexisting blood vessels. Angiogenesis involved in many conditions such as wound healing, embryonic development, metastasis, formation of tumor, inflammation. Chitin of crab is used as anti-angiogenic agent in the case of formation of cancer cells^[9] Many other drugs are used against this angiogenesis, but it may have many side effects. So we are using natural polymer chitin as angiogenic drug. Chitin is also used anti-bacterial sponges, hospital dressing, inhibitor of more production of blood vessel and decrease blood cholesterol level.

Wound healing and anti-inflammatory property

Due to the production of reactive oxygen species which produce oxidative stress inflammation may further develop to malignant transformation. Since chitin is a size dependant regulator of inflammation.

The main steps of wound healing are homeostasis, inflammation, migration, proliferation and maturation. Since chitin act as an anti-inflammatory agent it may have a property on wound healing. Chitin shows effect on wound healing by proliferation of fibroblast.^[11]

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