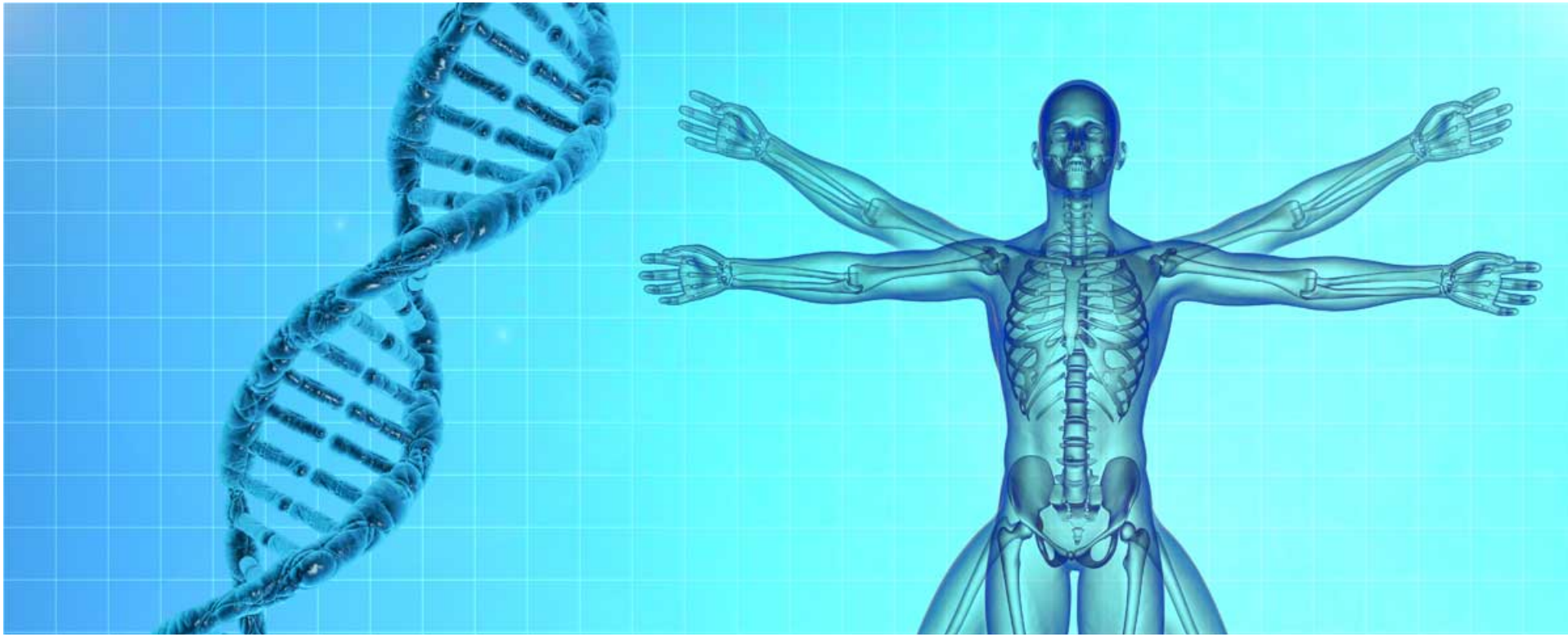
AURA
Innovations for Health

CE

International Organization for Standardization
ISO
13485

International Organization for Standardization
ISO
9001:2015

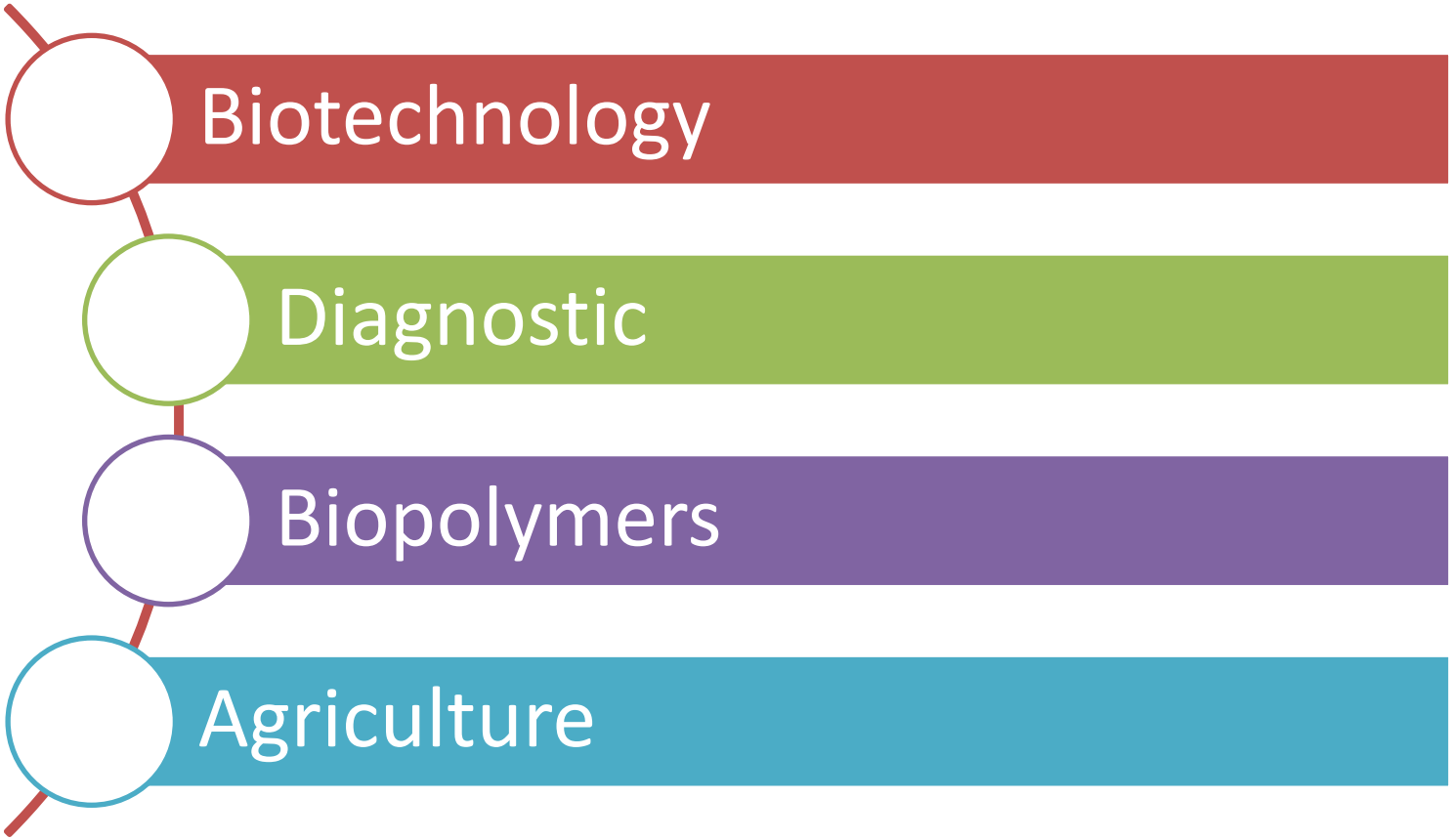


AURA BIOTECHNOLOGIES PRIVATE LIMITED
CHENNAI, INDIA

Company Overview

- AURA was founded in August 2014
- AURA having a dedicated team of Scientist who focuses on Human health Management Research
- Built with strong scientific background and professional skill
- AURA believes in Team work and collaboration
- Pioneers in Innovative Technologies & Products

Research Focus & Products



Units & Products

UNIT-I
2.37 acres
SIPCOT
Manamadurai, TN

- Chitosan
- Agar Agar

UNIT-II
16.56 Acres
SIPCOT
Manamadurai, TN

- SEAWEED Fertilizer
- VAM
- RECHAR
- NEEM Products
- Bio-pesticides
- Pesticide Formulation*

UNIT-III
6500 SFT
Chennai, TN

- Agriculture Micronutrients
- Gluconates & Glycinate*
- Organic Growth Promoters

UNIT-IV*
30000 SFT
SIDCO
Chengalpattu, TN

- Hemostatic products
- Diagnostic manufacturing
- Biopharma

Corporate & R &D*
7000 SFT
Chennai

- Molecular Biology
- Antibody generation
- Protein expression
- Immunoassay development

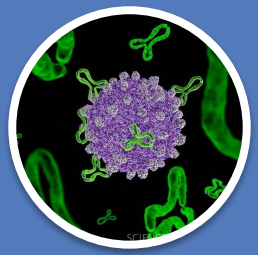
R &D & Regional office : 1500 SFT Pearl Square, Handewadi Rd, Hadapsar, Pune, Maharashtra

Immuno Diagnostic & Genomics

Our capabilities includes Design, development, validation and manufacture molecular biology and immunology products

Molecular Biology & Immunodiagnostic reagents

Real time PCR kits

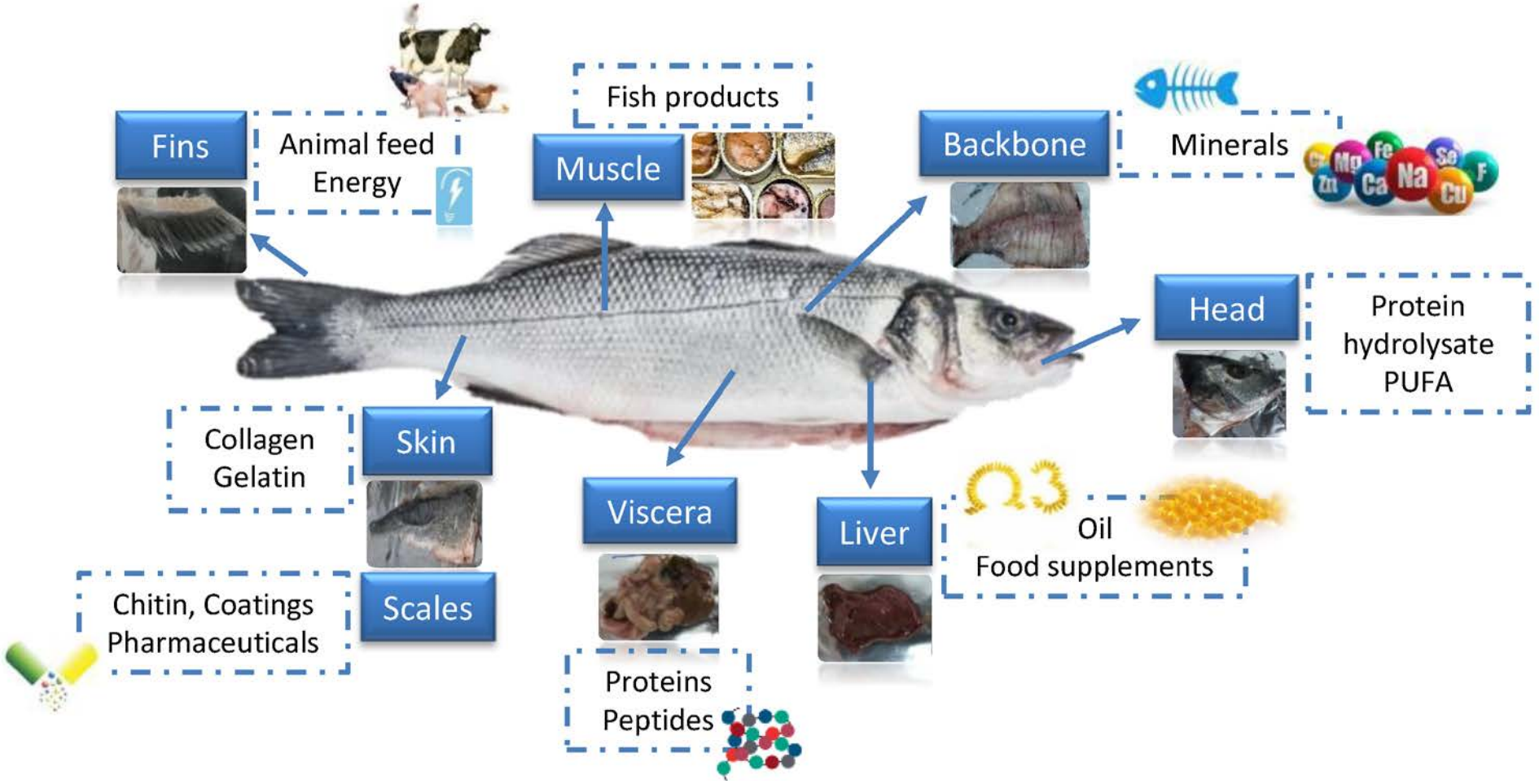


Antibody generation and production

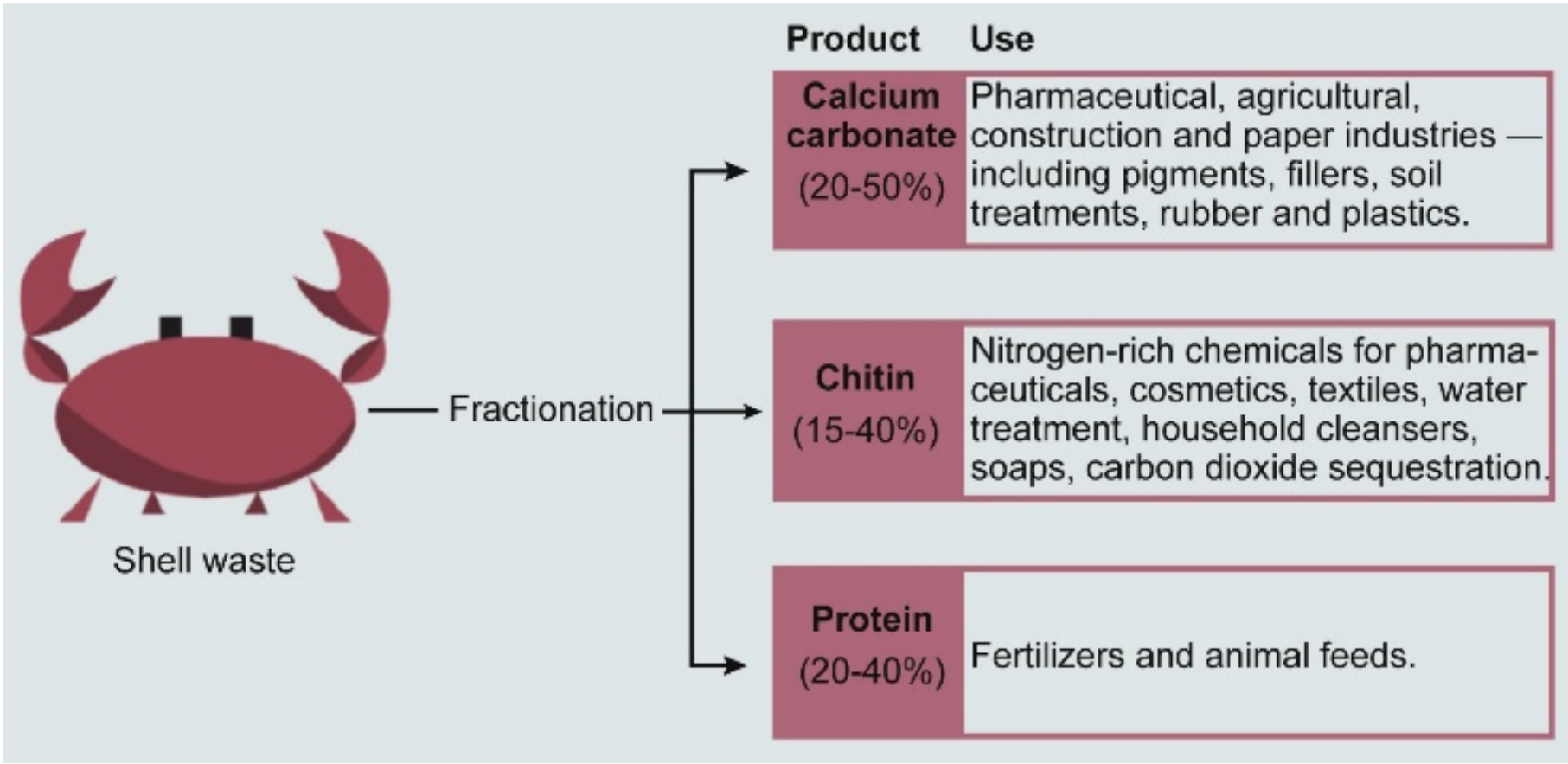
OEM/contract manufacturing reagents

Ocean Of Opportunities… OOO

Fish processing by-product



Crustacean waste Composition



Outline

1. Introduction
2. Production of Chitin/Chitosan
3. Selected Applications
4. Conclusions

Introduction

- Polymer- Large number of similar units bonded together

Synthetic	**Natural**
Low-density polyethylene (LDPE)	
High-density polyethylene (HDPE)	DNA
Polypropylene (PP)	Protein
Polyvinyl chloride (PVC)	**Carbohydrates**
Polystyrene (PS)	
Nylon, nylon 6, nylon 6,6.	
Teflon (Polytetrafluoroethylene)	
Thermoplastic polyurethanes (TPU)	

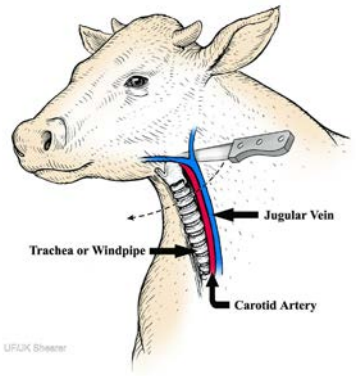
NATURAL POLYSACCHARIDE POLYMERS

Animal Polysaccharides

1.Chitin & Chitosan

3. Hyaluronic Acid

4. Chondroitin



Plant Polysaccharides

1. Starch
2. Dextrin
3. Dextran
4. Alginic Acid
5. Guar Gum
6. Xanthan GUM
7. Locust Bean Gum
8. Inulin
9. Pectin
10. Amylose
11. Arabinogalactan
12. Cyclodextrin
13. Xylan

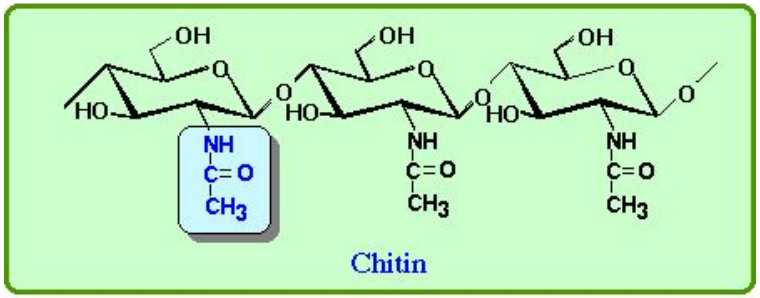
What is chitin?

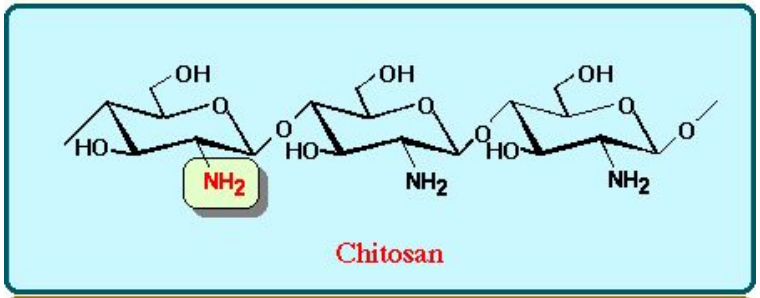
Chitin is a natural polysaccharide

- The 2nd abundant organic source on earth

- Structure similar to cellulose with hydroxyl group replaced by acetamido group

- *N*-acetyl-glucosamine units in β-(1→4) linkage

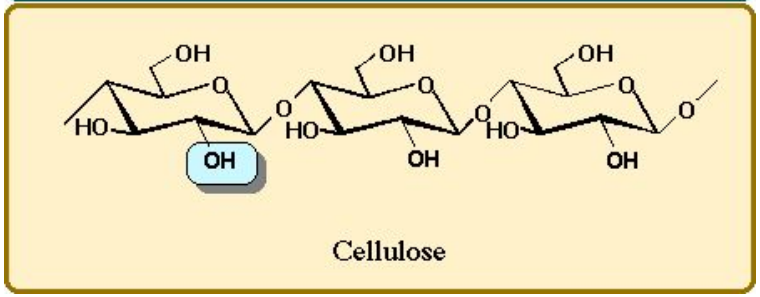




Chitosan is the *N*-deacetylated derivative of chitin

N-glucosamine units in β-(1→4) linkage

N-deacetylation of chitin into chitosan is achieved by treating with 50% NaOH



Chitin in Nature

Exoskeletons of arthropods

Spines of diatoms

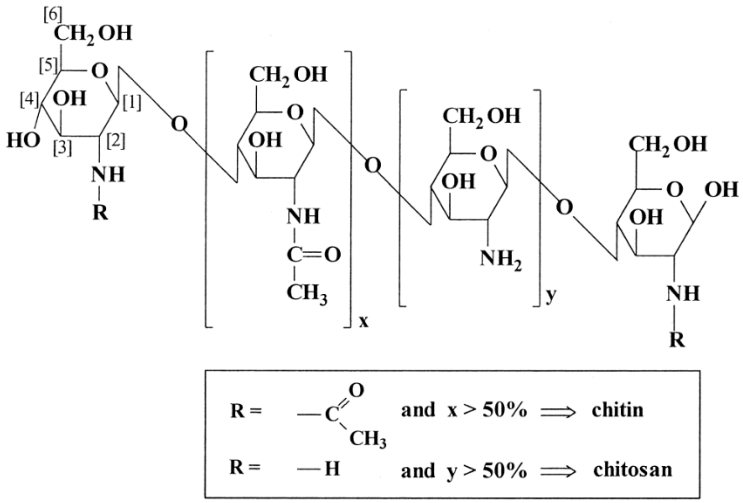
Shells of mollusks

Cell walls of fungi, mold, yeast

Simple use as feed supplement

Chitin is a Co-polymer

- Pure chitin does not exist in reality
- Chitin and chitosan tend to form co-polymer
- # of *N*-acetyl-glucosamine units > 50% => Chitin
- # of *N*-glucosamine units > 50% => Chitosan
- Degree of *N*-acetylation, DA = acetamido / (acetamido+amino)
- Degree of *N*-deacetylation, DD = amino / (acetamido+amino)
- In nature, chitin is commonly 70~90%



Structure of Chitin-Chitosan co-polymer

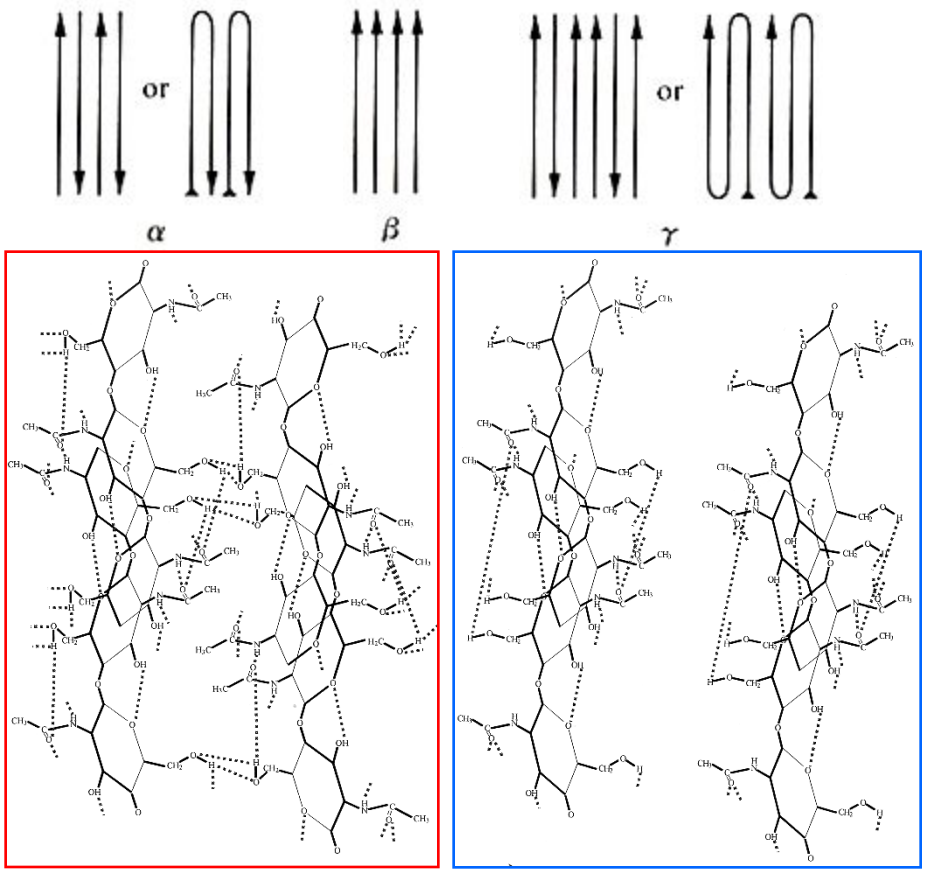
Kohr E. Chitin: fulfilling a biomaterials promise. Elsevier Science, 2001

Crystalline structure

- Chitin has 3 polymorphic forms:
  α-chitin, β-chitin, γ-chitin
- α-chitin: -
  the most abundant form
  - anti-parallel configuration
  - highly ordered crystalline structure
  - strong H-bonding (N-H····O=C)
  - rigid, intractable, insoluble
- β-chitin:

  - found in diatom spines and squid pens
  - parallel configuration
  - weak H-bonding -
  unstable, soluble in water
- γ-chitin:

  - mixture of α and β-chitin
  - intermediate properties



[1] Muzzarelli R. *Chitin.* Pergamon Press, 1977

[2] Kohr E. *Chitin: fulfilling a biomaterials promise*. Elsevier Science, 2001

Why these are promising material?

Unique characteristics of chitin and chitosan:

- Biocompatible
- Biodegradable
- Non-toxic
- Remarkable affinity to proteins
- Ability to be functionalized
- Renewable
- Abundant

Muzzarelli R. et al, *Chitin in Nature and Technology*. Plenum Press NY, 1985

Estimates of Potential Chitin Sources

1. Shellfish Sources:

Resource	Landings (MT)	Potential waste (MT)	Estimated waste (MT)	Dry waste (MT)	Chitin content (MT)
Shrimp	2,647,345	1,058,938	710,000	177,500	44,375
Squid	1,991,094	389,219	99,531	24,882	1,244
Crabs	1,348,323	943,826	482,744	144,823	28,964
Oyster Clam	2,547,287	1,783,100	304,948	274,453	12,350
Krill	232,700	93,080	93,080	23,270	1,629
Total	8,766,749				88,652

[1]

2. Fungi Sources:

It has been estimated that fungi can provide 3.2×10^4 metric tons chitin annually and can be potentially limitless

Isolation of Chitin from Shellfish and Fungi

shell

Wash and crushed

Demineralize with HCl

Deproteinate with NaOH

Raw chitin

fungi

Harvest, wash and dry

Pulverize and treat with NaOH

Extract with LiCl/DMAc

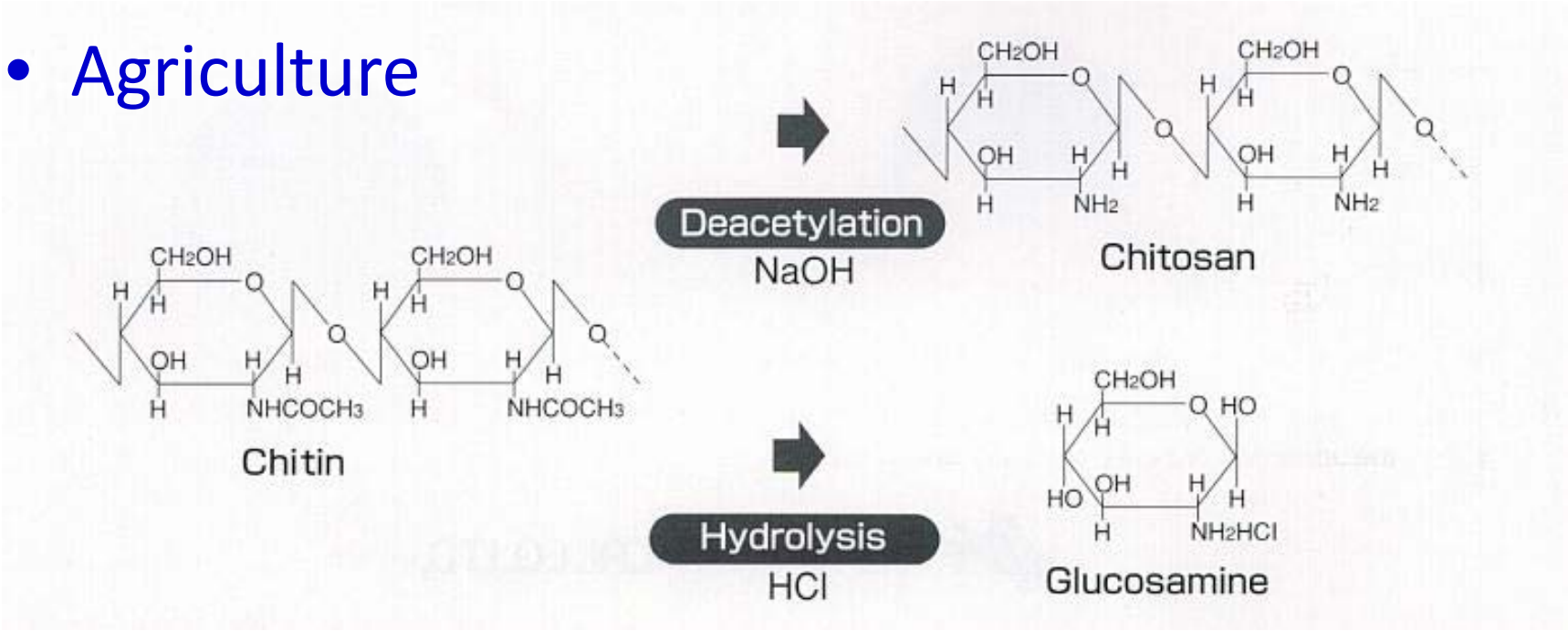
Precipitate in water, collect chitin and dry

Kohr E. Chitin: fulfilling a biomaterials promise. Elsevier Science, 2001

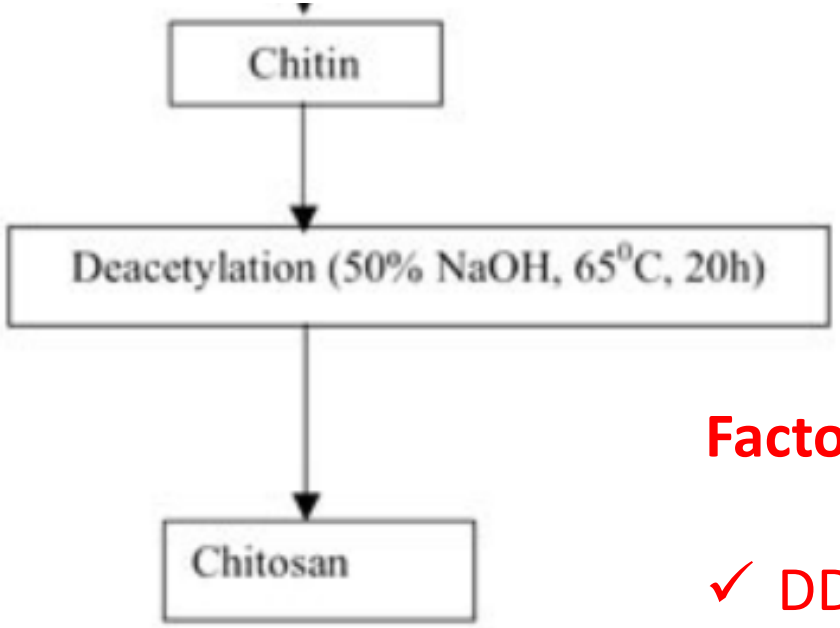
Applications of Chitin

Raw material for Chitosan manufacturing

- Glucosamine production
- Chitosan manufacturing
- Agriculture



Chitosan Manufacturing



Factors Determining the functionality

- ✓ DDA (Degree of Deacetylation
- ✓ Viscosity
- ✓ Polymer length (Molecular Weight)
- ✓ Solubility

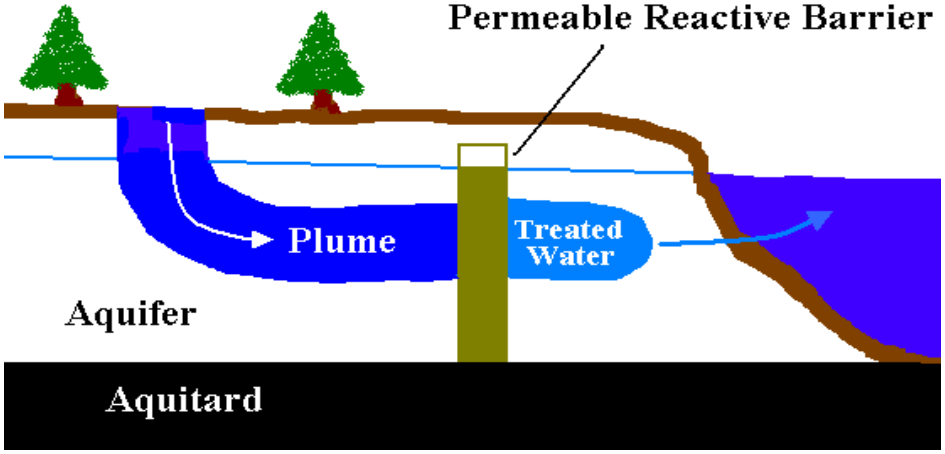
Chitosan Derivatives

- Chitosan Phthalate, succinate, acetate, lactate, hydrochloride
- Sulphated chitosan
- Carboxymethyl chitosan
- Chitosan oligosaccharide
- Chitosan low molecular weight
- High molecular weight
- Chitosan nanoparticle
- Activated chitosan

- Pharma Grade
- Nutra Grade
- Technical grade
- Agriculture grade

Application

- Water treatment
  - Removal of metal ions
  - Flocculent/coagulant (proteins, dyes, amino acids)
  - Filtration
  - Antimicrobial



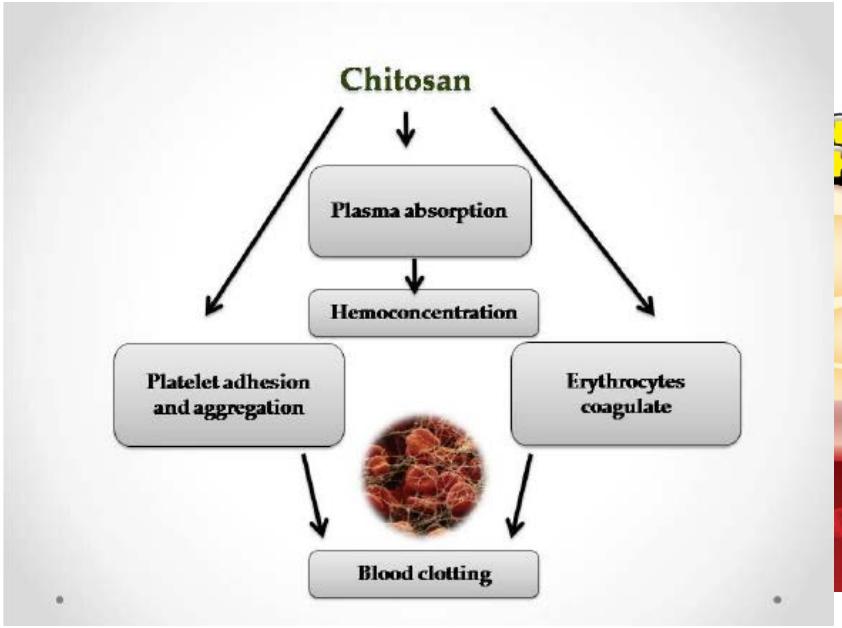
Application in Textiles and Paper

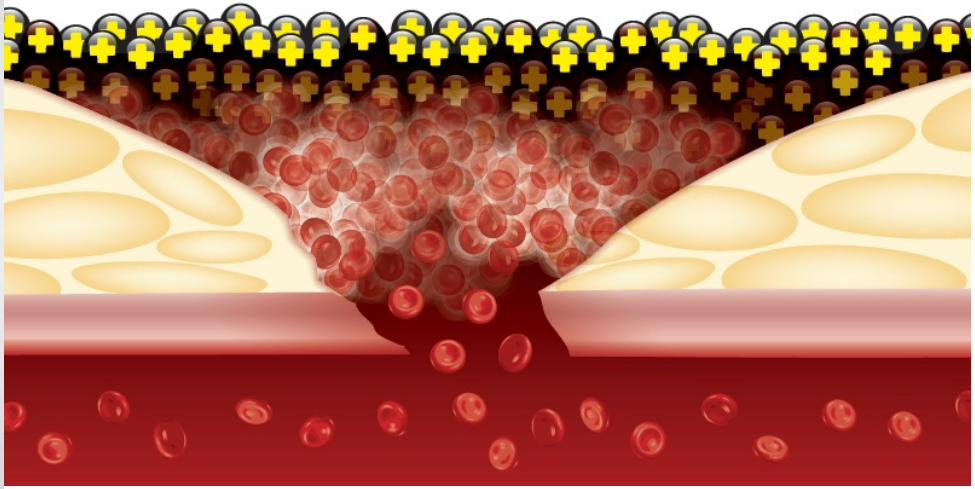
Binder in pigment dyeing	Anti-microbial dress	Chitosan fibre
Surface treatment	Photographic paper	Carbonless copy

Application- Medical

- Bandages, sponges for blood clotting
- Artificial blood vessels
- Cholesterol control
- Skin burns, artificial skin
- Contact lenses
- Controlled release of drugs

Blood Clotting Mechanism



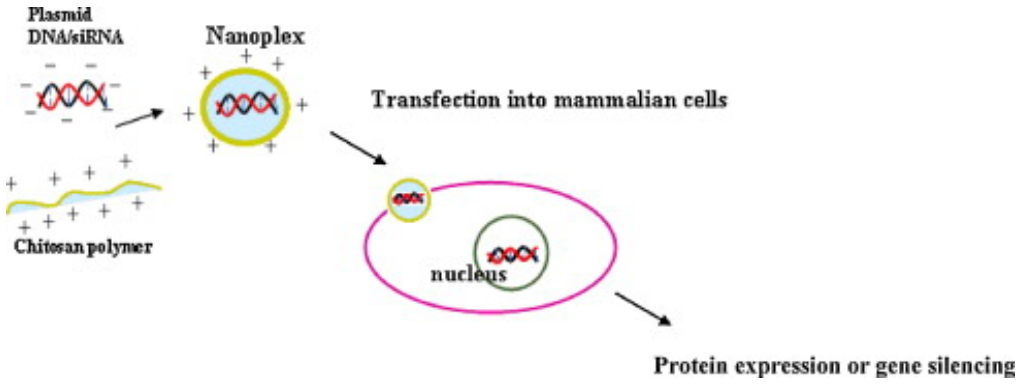


Application- Cosmetics

- Make-up powder
- Nail polish
- Moisturizers
- Hydro gel & Shampoo

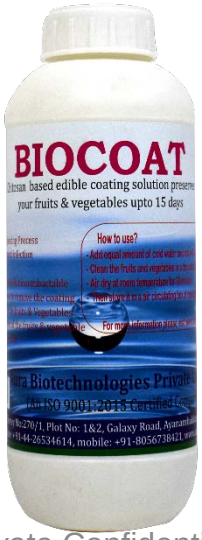
Application- Biotechnology

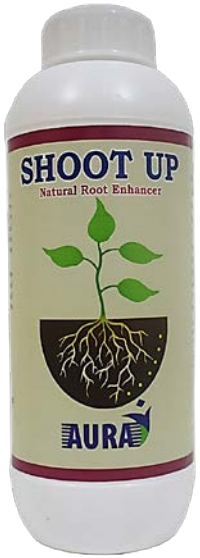
- Enzyme/cell immobilization
- Protein separation
- Chromatography
- Antimicrobial
- Gene transfer
- Glucose electrode
- Wine- clarification



Application in Agriculture

- Seed coating
- Leaf coating
- Growth promoter
- Controlled agrochemical/fertilizer release
- Nematode control
- Fungicide

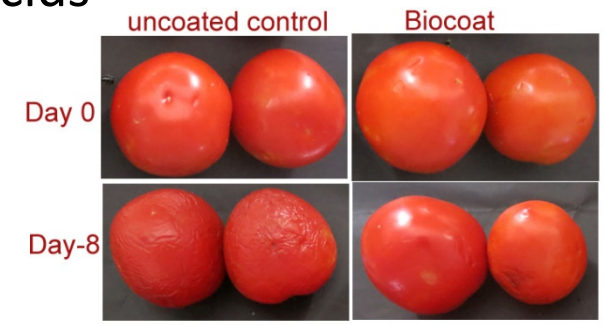




Application in Food and Nutra

- Edible coating
- Post-harvest preservative
- Food preservation & storage
- Removal of Pesticide, dyes and acids

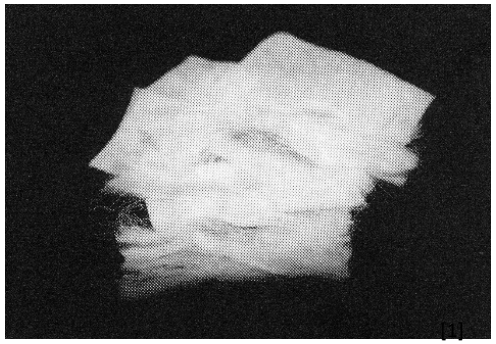
- Preservative
- Natural colour stabiliser
- Animal feed additive
- As dietary food



Biomedical Applications

Wound Dressing

- Wound dressings are used to protect wound skin form insult, contamination and infection
- Chitin-based wound dressings
  - Increase dermal regeneration
  - Accelerate wound healing
  - Prevent bacteria infiltration
  - Avoid water loss
- Chitin surgical threads - strong, flexible, decompose after the heals



[1]

Chitosan wound dressings

Material	Rank*
Methylpyrrolidinone-chitosan	3
Chitosan glutamate	11
Chitosan lactate	7
Chitosan chloride	12
Collagen fleece	6
Non-woven calcium alginate fiber	3
Gelatin sponge	7

[2]

Cell culture compatibility ranking of wound dressing materials

Anticoagulation

- Anticoagulation is essential for open-heart surgery and kidney dialysis
- Preventing blood from clotting during the surgery
- Sulfated chitin derivatives have good anticoagulant activity

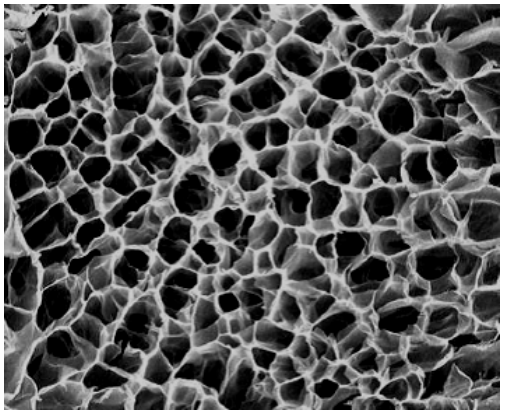
[1] Kohr E. Chitin: fulfilling a biomaterials promise. Elsevier Science, 2001

[2] Khor E. Lee Y.L. Implantable applications of chitin and chtosan. *Biomaterials* 24 (2003) 2339

Biomedical Applications

Tissue Engineering

- Tissue engineering research is based on the seeding of cells onto porous biodegradable matrix
- Chitosan can be prepared in porous forms permitting cell growth into complete tissue



Porous character of chitosan scaffold [1]

Orthopedic Applications

- Bone is a composite of soft collagen and hard hydroxyapatite (HA)
- Chitin-based materials are suitable candidate for collagen replacement (chitin-HA composite)
- Mechanically flexible, enhanced bone formation
- Temporary artificial ligaments for the knee joint

[1] Sundararajan V. et al. Porous chitosan scaffolds for tissue engineering *Biomaterials* 20 (1999) 1133

Ratner B.D. Biomaterials Science 2nd edition. Elsevier Science, 2004, chapter 7

Biomedical Applications: Drug Delivery

Hydrogels

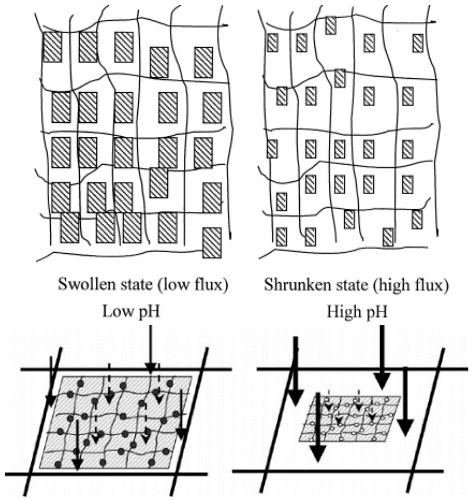
- Hydrogels are highly swollen, hydrophilic polymer networks that can absorb large amounts of water
- pH-sensitive hydrogels have potential use in site-specific drug delivery to gastrointestinal tract (GI)
- Chitosan hydrogels are promising in drug delivery system

Tablets

- Chitosan have been reported to be useful diluents in pharmaceutical preparations

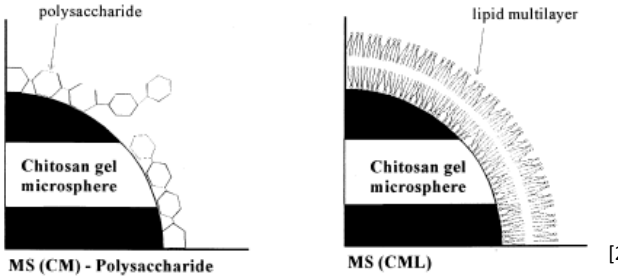
Microcapsules

- Microcapsule is defined as a spherical empty particle with size varying from 50 nm to 2 mm
- Chitosan-based microcapsules are suitable for controlled drug release



[1]

Mechanism for pH-sensitive hydrogels



[2]

Schematic structure of chitosan microcapsules coated with anionic polysaccharide and lipid

[1] Park S.B. et al. A novel pH-sensitive membrane from chitosan — TEOS IPN. *Biomaterials* 22 (2001) 323

[2] Majeti N.V. Kumar R. A review of chitin and chitosan applications. *Reactive & Functional Polymers* 46 (2000) 1-27

Application Summary









Biomedical and Pharma

Chemical and Industrial

Cosmetic

Food & Nutraceutical

Fruits & vegetables storage

Water Purification

Agricultural

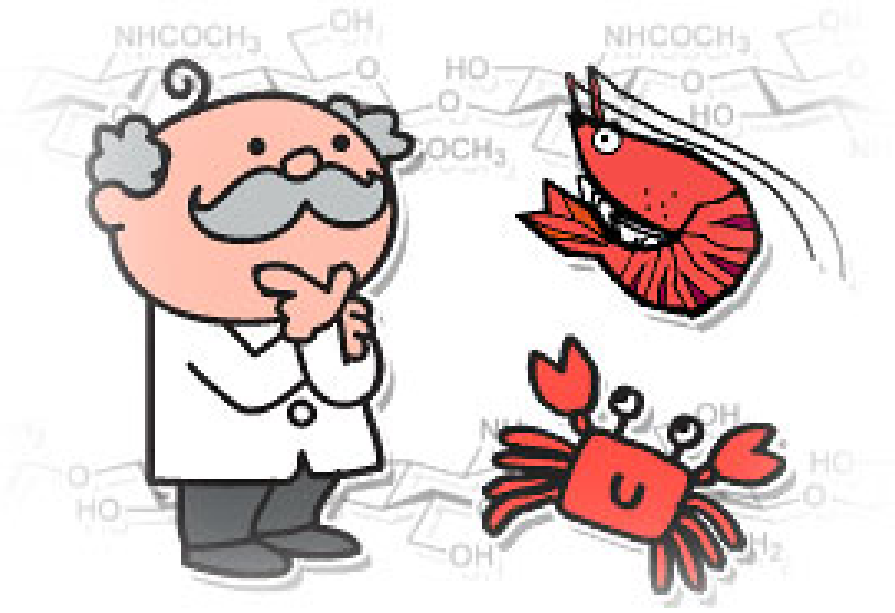
Fiber & Textiles

Paper, Paint & Leather

Conclusions

- Chitin and chitosan remain underutilized natural polymers
- Chitin and chitosan are promising materials for diverse applications
- Isolation and production need to be improved and should be eco friendly
- Functional derivative could be made for specific application.

Thank you!



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Thank You