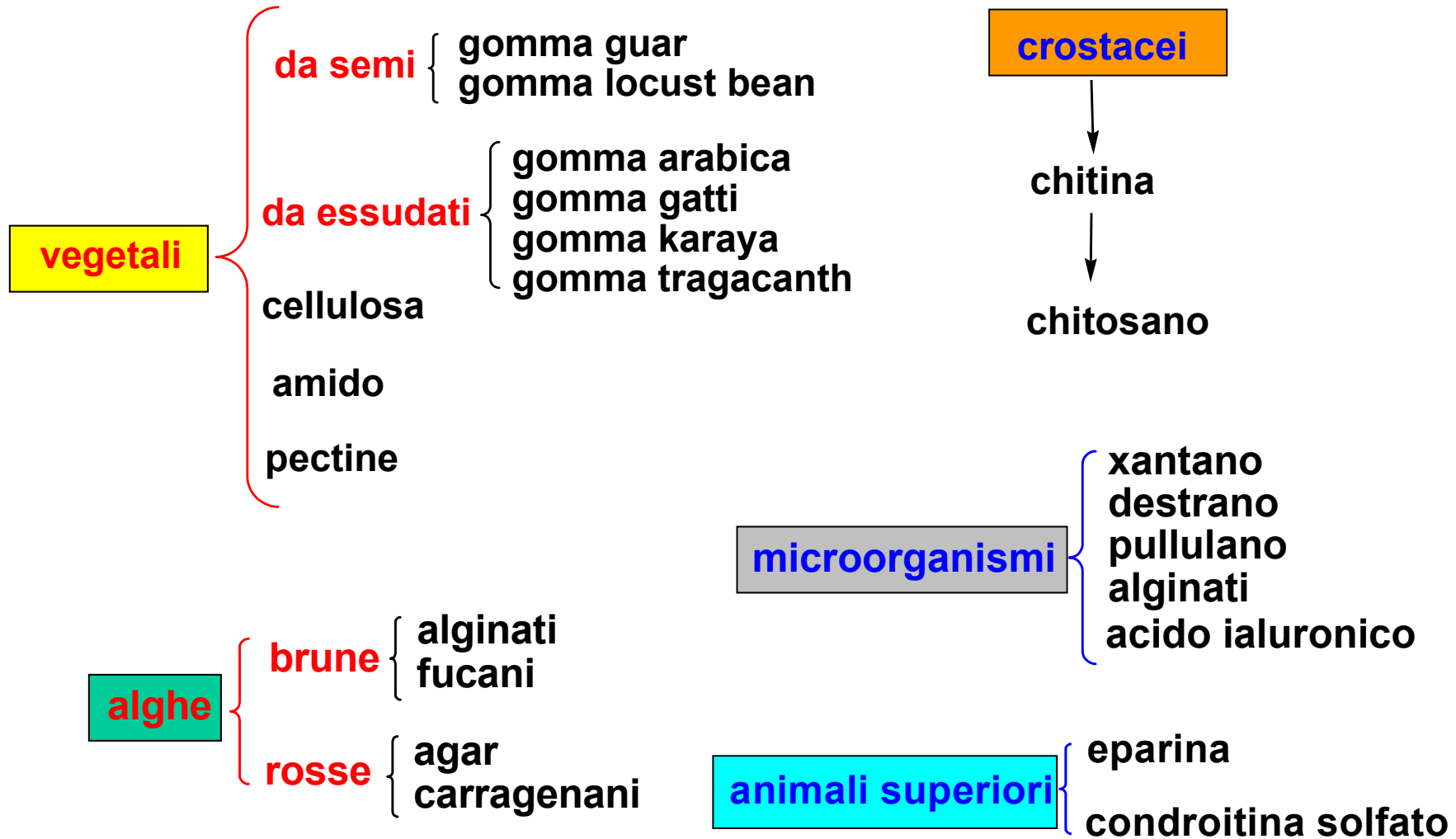
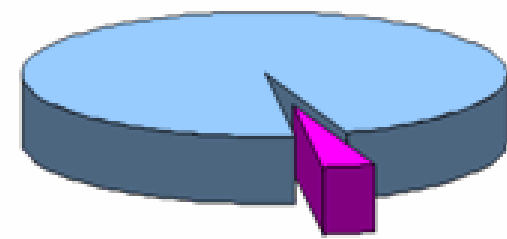
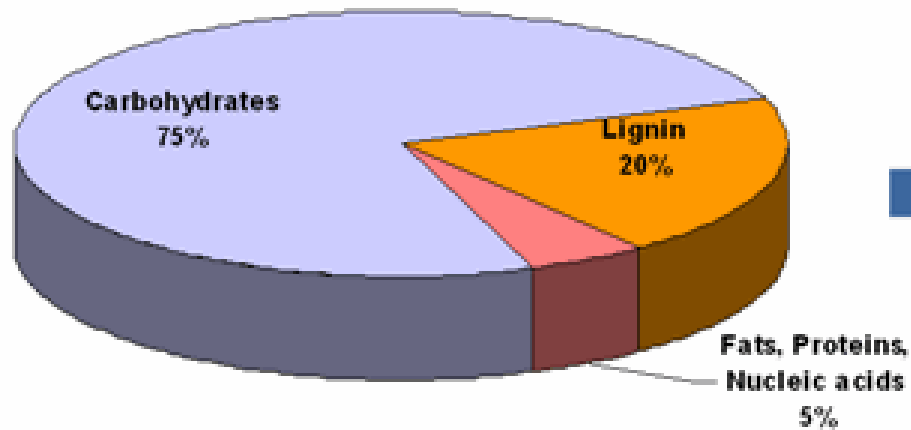


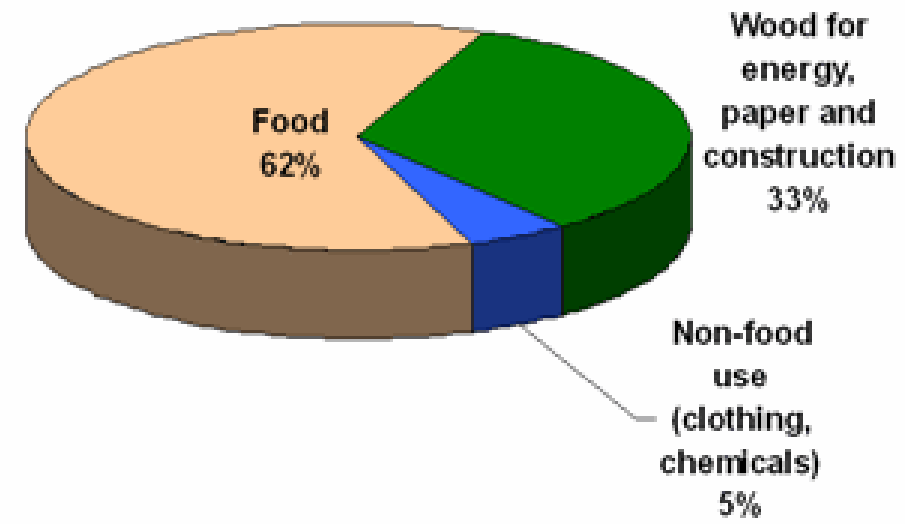
POLISACCARIDI INDUSTRIALI



Annual biomass production: 170 billion tons



Only 3.5% is used by human (6 billion tons/a)



POLISACCARIDI DI USO ALIMENTARE



Physical property	Polysaccharide	Application
Cold set, clear, gel formation with divalent cations	Alginate	Reformed fruit pieces
Gel formation with sucrose or acid	Pectin	Jams, jellies, dietary fibre
Slow metabolic uptake, low viscosity at high solids	Pectin, inulin	Dietary fibre
Heat reversible gel formation	Agar, gellan	Synthetic meat gels, dietetic jellies
Heat reversible gel formation in the presence of potassium ions	Kappa & iota-carrageenan	Synthetic meat gels, instant desserts, chocolate drinks
Smooth 'short' texture	Fully pregelatinised corn starch	Proprietary desserts, puddings
Cold set soft gel formation with water or milk	Pregelatinised and/or oxidized potato or tapioca starch	Instant desserts, puddings
Pseudoplastic behavior under conditions of high shear	Xanthan gum	Instant desserts, low calorie products
Synergistic binary component gel formation, high viscosity	Xanthan gum, galactomannans	Synthetic meat gels, slimming foods
Retardation of sugar crystallisation at low moisture contents	Gum arabic	In solid confectionery, soft sweets, pastilles
Complex formation with milk protein	Lambda carrageenan	Chocolate milk drinks
Stability at low pH-good viscosity	Propylene glycol alginate, xanthan gum	French dressings, salad dressings
Ice-crystal size retardation	Propylene glycol alginate	Ice creams and lollipop, popsicles
Gel formation with heat	Curdlan	Jelly sweets
Synergistic ternary component very high viscosity at low concentration	Xanthan, konjac glucomannan, alginate (polyglycoplex)	Low calorie, reduced blood glucose, reduced cholesterol products

POLISACCARIDI DI USO FARMACEUTICO E COSMETICO



Physical property	Polysaccharide	Application
Moisture retention	Hyaluronic acid	Skin creams
Blood anticoagulant	Heparin	Open heart surgery
Thermoreversible gelation	Gellan	Agar substitute in microbiology
Gel formation with calcium	Alginate	Antacid proprietary products e.g. Gaviscon
Blood anticoagulant	Fucoidan	Surgery (Heparin substitute)
High shear pseudoplasticity	Xanthan gum	High solids medicines and syrups
Stability at low pH-high viscosity	Xanthan gum	Fluoride dental gels
Anti-inflammatory properties	Chondroitin sulphate	Treatment of inflammation e.g. osteoarthritis
Protection for damaged tissues e.g. urinary tract	Pentosan polysulphate	Interstitial cystitis
Water retention	Psyllium seed gum	Laxative
Inert plasma thickener	Dextran	Blood plasma extender

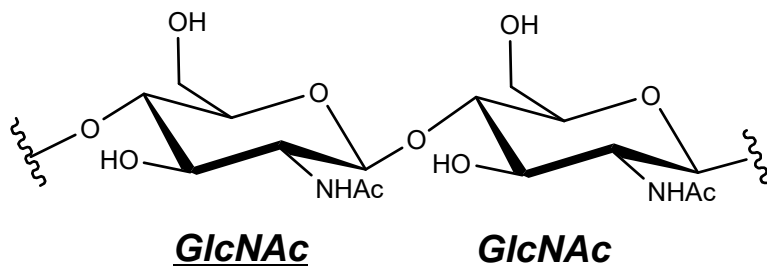
POLISACCARIDI DI INTERESSE INDUSTRIALE



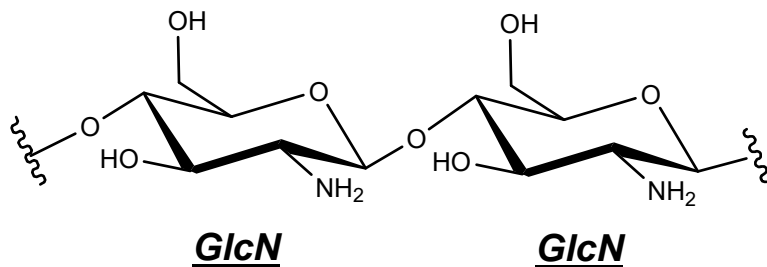
Physical Property	Polysaccharide	Application
Pseudoplastic behavior under conditions of high shear	Xanthan gum	Oil drilling muds
Compatibility with reactive dyestuffs (Procion)	Sodium alginate	Cotton textile printing, carpets
Stability, high viscosity	Guar gum	Fracking
Controlled dispersion, viscosity	Na ⁺ carboxymethyl cellulose	Wallpaper paste
High solids compatibility, viscosity	Na ⁺ carboxymethyl cellulose	Cement setting retardation
Film formation	Starch derivatives	Paper coating
Water soluble films	Pullulan	Water soluble seed coatings
Gel formation	Xanthan, locust bean gum	Explosive gels
Mineral suspension	Xanthan, guar	Mineral flotation aids
Metal chelation	Chitin	Heavy metal separation
Ion exchange support	DEAE dextran	Chromatography
High viscosity, non-newtonian, gel forming	Methyl cellulose	Adhesives, paints, cements
Viscous, compatibility with organic solvents	Hydroxyethyl cellulose	Latex paints
Film formation	Chitosan	Textile finishing

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Chitina



Chitosano

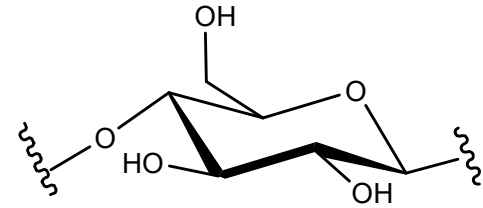


buone capacità complessanti per metalli

Beads	Drug delivery Enzyme immobilization
Microspheres ¹⁰⁵	
Coatings	Surface modification Textile finishes
Fibres	Medical textiles Sutures
Nanofibres ¹⁰⁴	Guided bone regeneration Scaffold for nerve tissue regeneration
Films	Wound care Dialysis membrane
Powder	Adsorbent for pharmaceutical and medical devices Surgical glove powder Enzyme immobilization
Sponge ¹⁰⁶	Mucosomal haemostatic dressing Wound dressing Drug delivery Enzyme entrapment
Shaped objects	Orthopaedics Contact lenses
Solutions	Cosmetics Bacteriostatic agent Haemostatic agent Anticoagulants Anti-tumour agent
Gels	Delivery vehicle Implants, coatings Tissue engineering
Tablets	Compressed diluent Disintegrating agent
Capsules	Delivery vehicle

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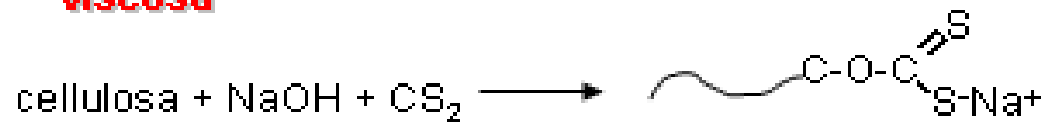
Cellulosa



Il primo polimero termoplastico fu la celluloido ottenuto nel 1870 facendo reagire la cellulosa con l'acido nitrico

1) viscosa, 2) acetato di cellulosa (esteri), 3) carbossi metil cellulosa (eteri)

viscosa

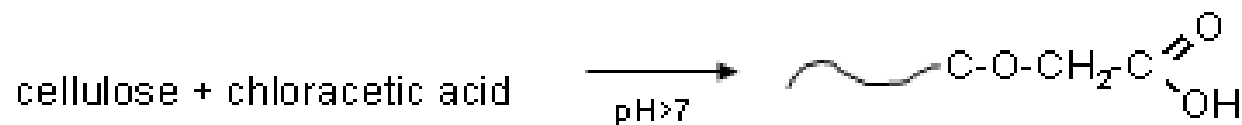


Fibra di Rayon o film di cellophane:

Acetato di cellulosa



carbossi metil cellulosa(CMC)

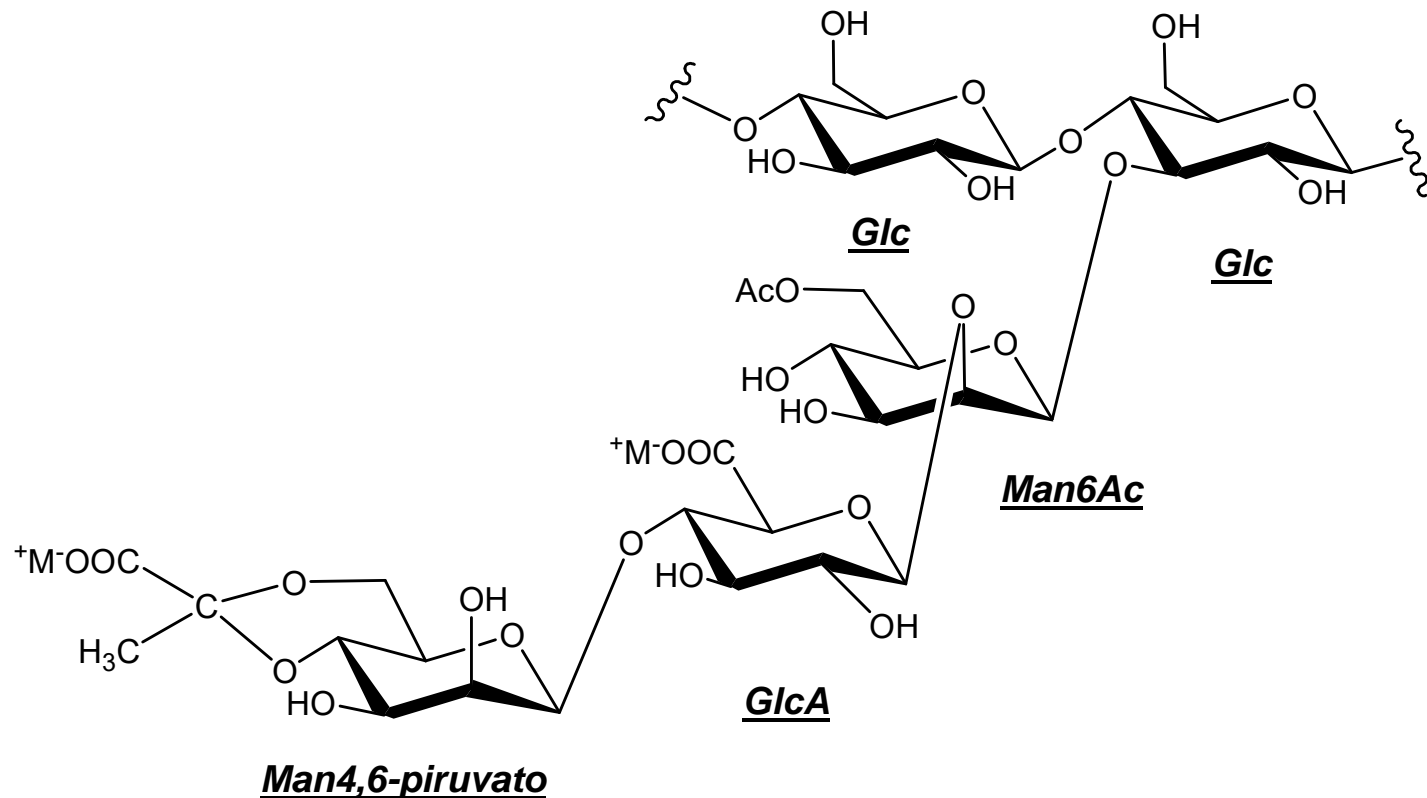


Per cibi e farmaci: imballaggio, adesivo

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Xantano

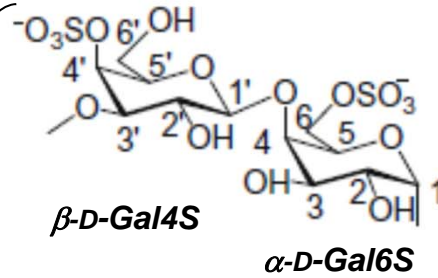
- Secreto dal batterio Gram negativo *Xanthomonas campestris*
- Stabilizza sospensioni solide
- Mantiene la viscosità a basse C e in un ampio range di temperature, di pH, di forza ionica
- Forma cross-linking con molti altri polisaccaridi formando gel.
- Applicazioni in formulazioni farmaceutiche, prodotti oftalmici, come additivo alimentare, in prodotti *gluten-free*



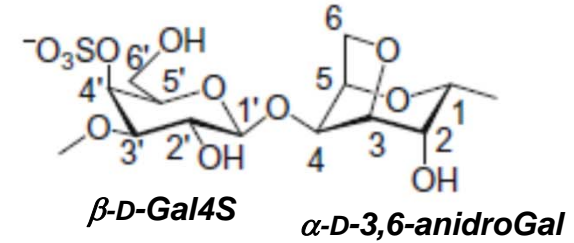
Carragenani

POLISACCARIDI INDUSTRIALI

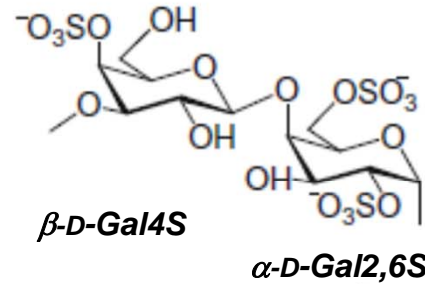
- isolati da alghe rosse (*Rodophyta*) come eteropolisaccaridi
- prodotti in quantità pari a ~ 45.000 tonnellate l'anno
- usati in industria alimentare come addensanti e gelificanti
- usati come chiarificanti delle birre (complessano e precipitano impurezze proteiche)
- usati in applicazioni *non food* come agenti incapsulanti, eccipienti, stabilizzanti



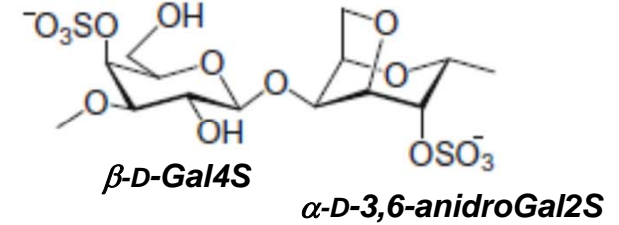
Mu-carrageenan



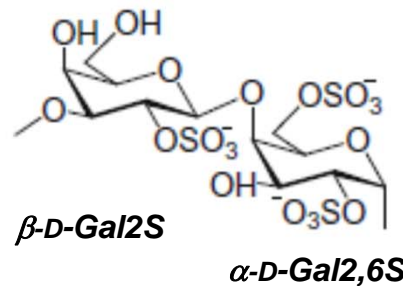
Kappa-carrageenan



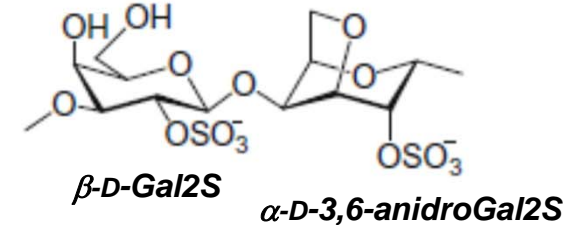
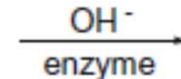
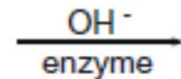
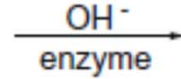
Nu-carrageenan



Iota-carrageenan



Lambda-carrageenan

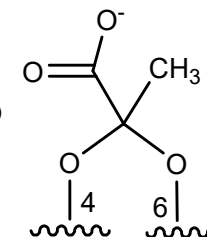
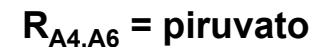
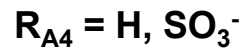
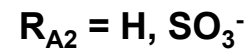
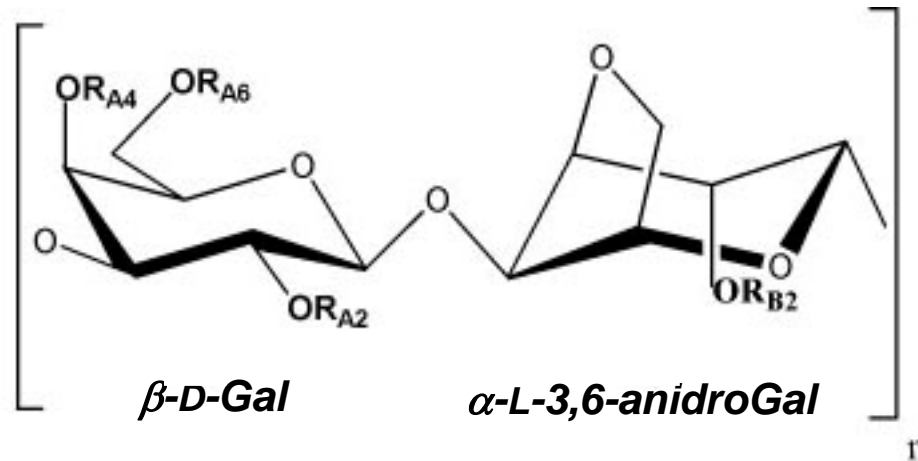


Theta-carrageenan

Agarani

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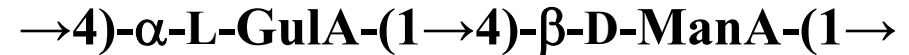
- isolati da alghe rosse come eteropolisaccaridi
- supporti per separazioni e purificazioni (gel di elettroforesi, cromatografia ad esclusione molecolare)
- usati per sospensioni di bario per analisi raggi-X del tratto intestinale
- usati in ortodonzia
- mezzi di coltura per microorganismi (batteri e funghi)
- immobilizzazione di enzimi e cellule
- biomateriali per ingegneria dei tessuti ed incapsulamento di cellule (isole di Langerhans, condrociti, etc.).



Alginati

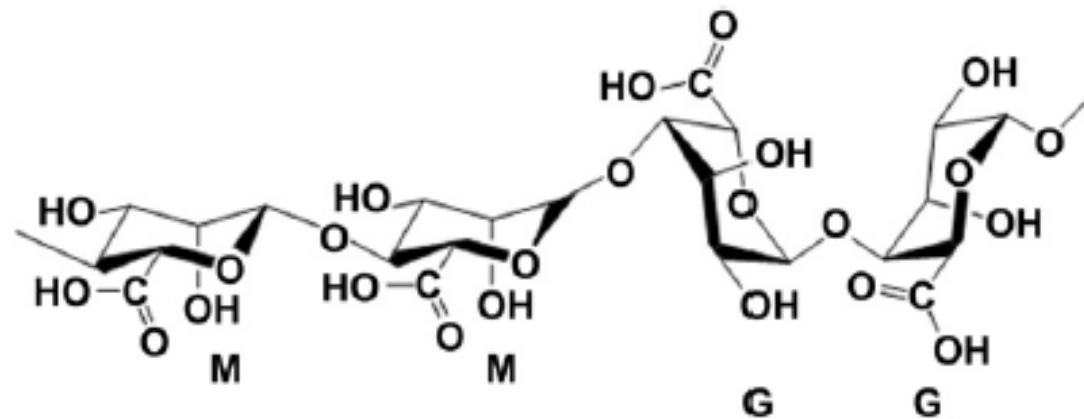
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- isolati da alghe rosse o microorganismi (incluso *Pseudomonas aeruginosa*)
- prodotti in quantità pari a ~ 30.000 tonnellate l'anno
- proprietà gelificanti in presenza di ioni (Ca^{2+}) con applicazioni come materiali biomedici:
 - trattamento delle ferite
 - incapsulamento cellulare
 - drug delivery



G

M

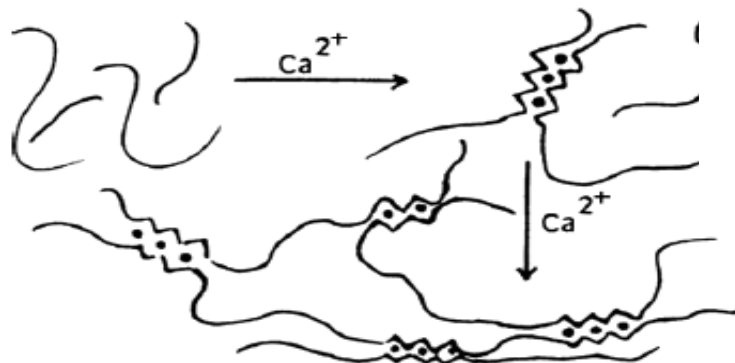


MMMMGMGGGGGMGMGGGGGGGGMMGMGMGGM

M-block G-block G-block MG-block

gel molto deboli

gel molto robusti



Alginate

POLISACCARIDI INDUSTRIALI

Alginate-based matrices/scaffolds for **drug and cell delivery** described for different tissue engineering applications

Polymer(s)/carrier/ scaffold structure	TE application	Active biomolecule	Encapsulated/seeded cell type (source)
Alginate–chitosan fibers	Not defined	Dexamethasone, PDGF-BB	–
Alginate hydrogel	Bone/cartilage	BMP-2 gene	Bone marrow stromal cells
Alginate beads	Cartilage	BMP-2	Human articular chondrocytes
Alginate beads	Cartilage	IGF-1, TGF- β 2 and FGF-2	Bovine articular chondrocytes
Alginate beads	Cartilage	rhOP-1 (medium)	Bovine articular chondrocytes
Alginate hydrogel and film	Cartilage	FGF-2 and TGF- β (medium)	Rabbit periosteal explants
Alginate beads	Cartilage	BMP-2,4,5,6,7	Chondrocytes (transfected)
Alginate beads	Cartilage	TGF- β	–
Alginate hydrogel	Cartilage	TGF- β 1, TGF- β 2, TGF- β 3 or BMP-2	Bovine synovium-derived progenitor cells
Alginate beads	Cartilage	Human platelet supernatant	Human articular chondrocytes
Alginate beads	Cartilage	Porcine platelet-rich plasma	Porcine articular chondrocytes
Alginate beads	Vascularization	bFGF, VEGF, EGF	–
Alginate hydrogel	Vascularization	VEGF and bFGF	–
Alginate beads with bioactive glass	Vascularization	VEGF conditioned medium	Human CCD-18Co fibroblast cells and HDMECA
Alginate gels in PP and PS hollow-fibers	Vascularization	Endothelial cell growth supplement	–
Alginate beads	Peripheral	BDNF	–

A proposito di drug delivery...

Ciclodestrine: - molecole coniche con cavità di dimensioni ben definite

- cavità idrofobica e parte esterna idrofila

- preparabili in vasta scala dall'amido

- vettori di sostanze idrofobiche in acqua attraverso la formazione di complessi d'inclusione

- applicazioni nel campo del drug delivery

