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EAAP European Federation of Animal Science

4th one-day symposium of the Animal Task Force & the EAAP Commission on Livestock Farming Systems: *Livestock are more than food*

Biopolymers of animal origin: production, properties and applications

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Pharmaceutical and biomedical biopolymers of animal origin

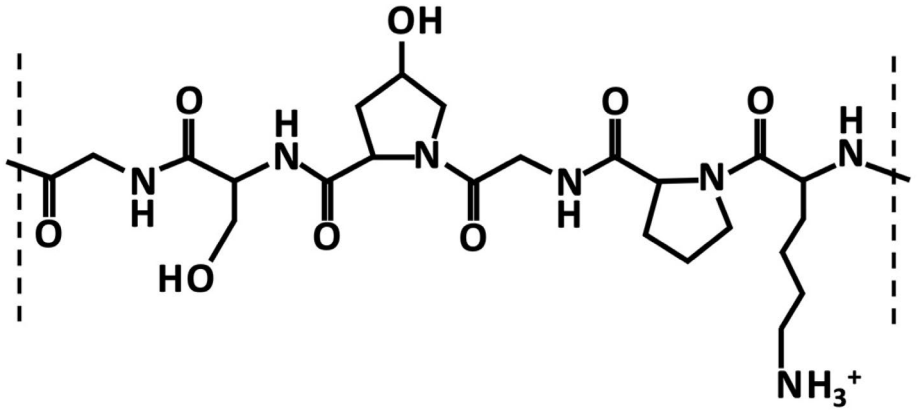
- Gelatine
- Collagen
- Insulin
- Chitosan
- Heparin
- Hyaluronic acid

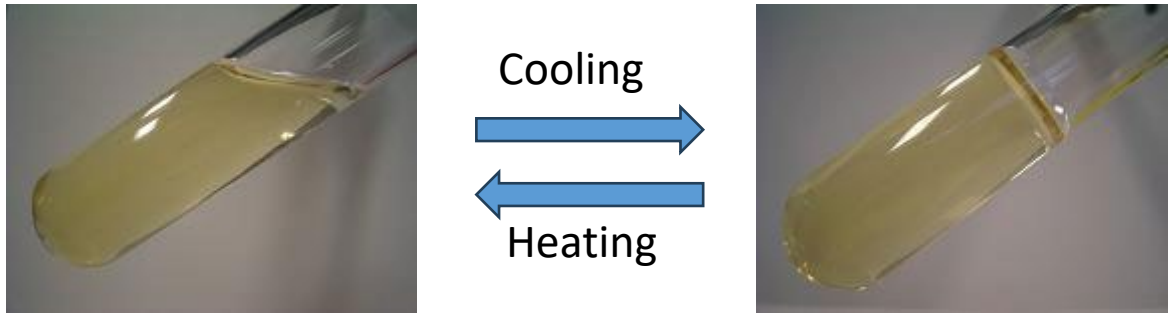
Proteins

Polysaccharides

Gelatine

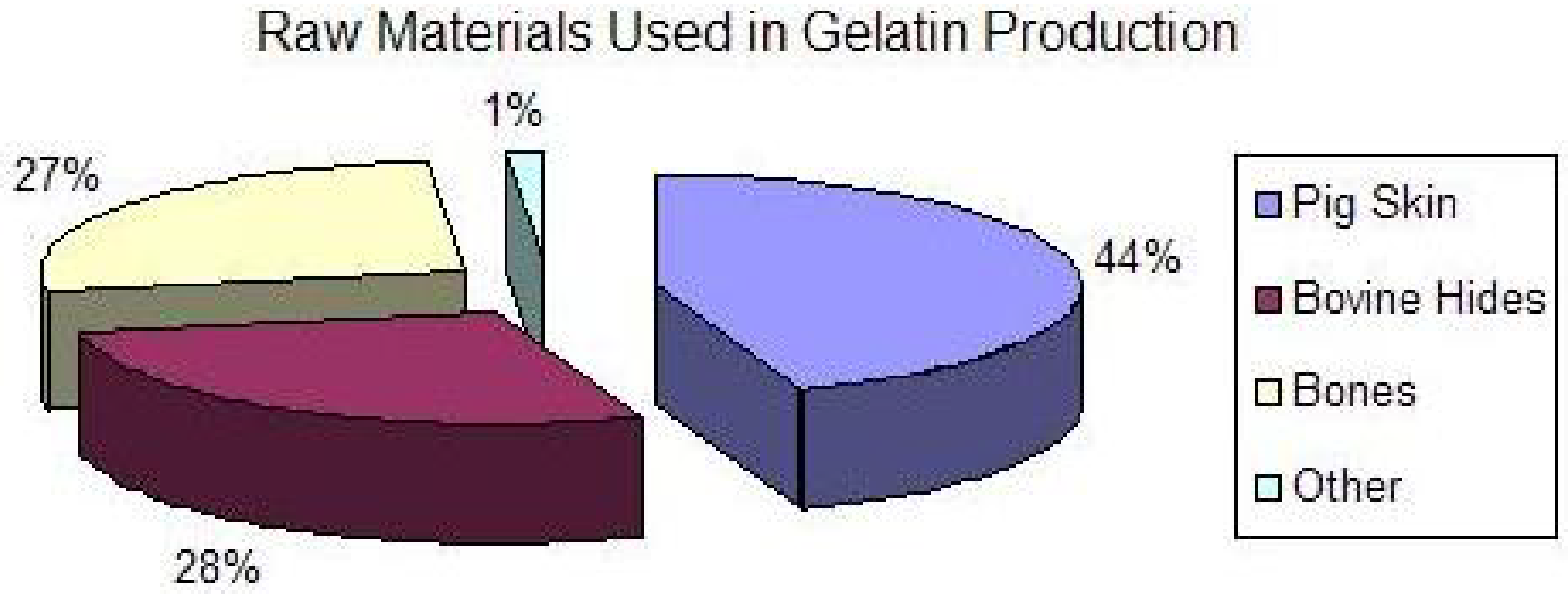
- Non-toxic
- Soluble in water at body temperature
- Has good film forming properties
- Solutions of high concentration, 40 % w/v, are mobile at 50 ^{0}C
- Changes from gel to sol at temperatures just above room temperature





Solution **Gel**

Some statistics on gelatine



http://en.wikipedia.org/wiki/Gelatin

Production of gelatine

Collagen

Acid process

- Acidification to pH 4
- Heating from 50°C to boiling
- Elimination of fat
- Filtration
- Vacuum evaporation
- Drying

Gelatin A

Alkali process

- Treatment with NaOH
- Removing NaOH
- Treatment with acid to adjust pH
- Heating from 50°C to boiling
- Demineralisation
- Filtration
- Vacuum evaporation
- Drying

Gelatin B

Pharmaceutical and cosmetic applications of gelatine

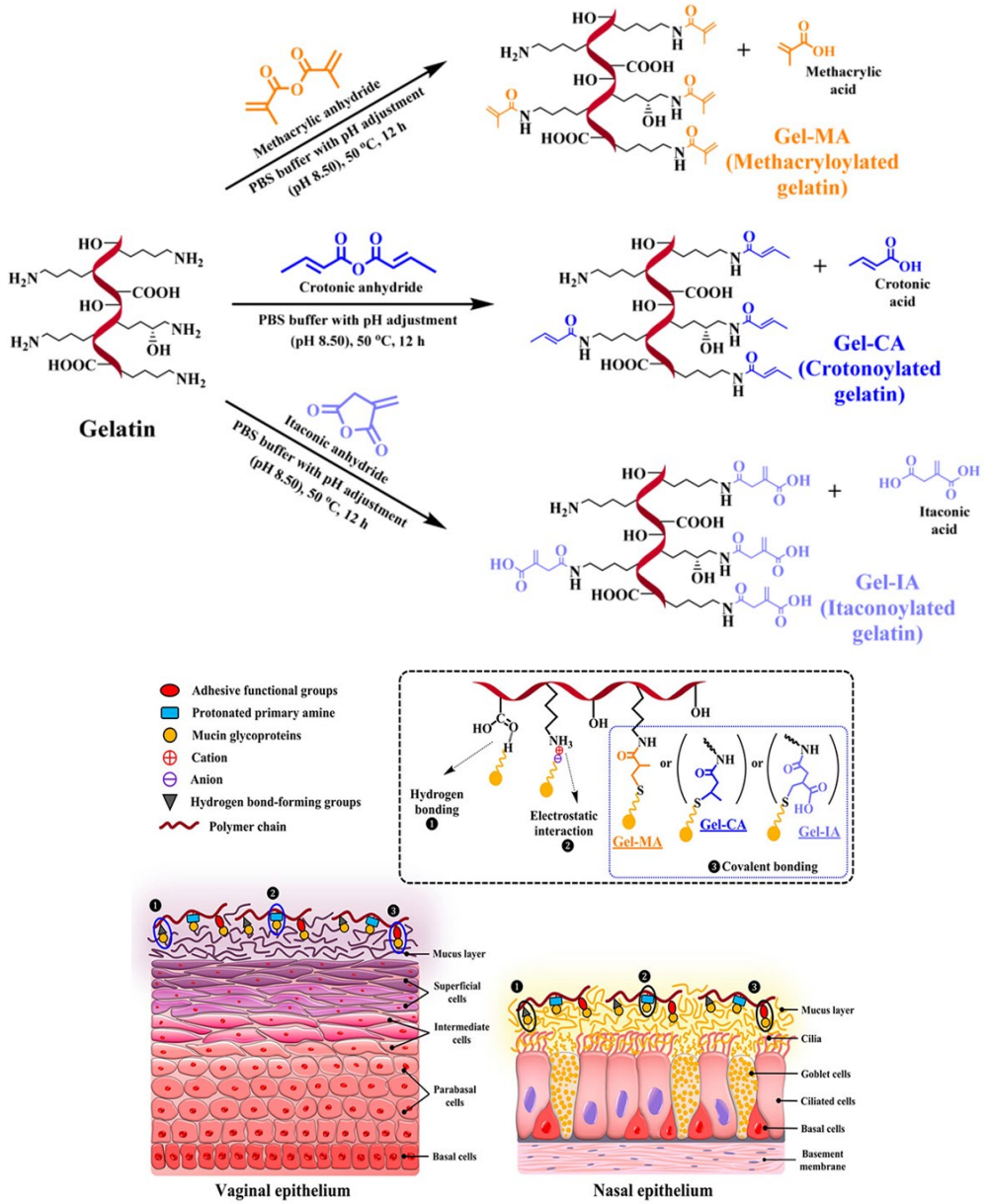
Hard capsules

Soft capsules

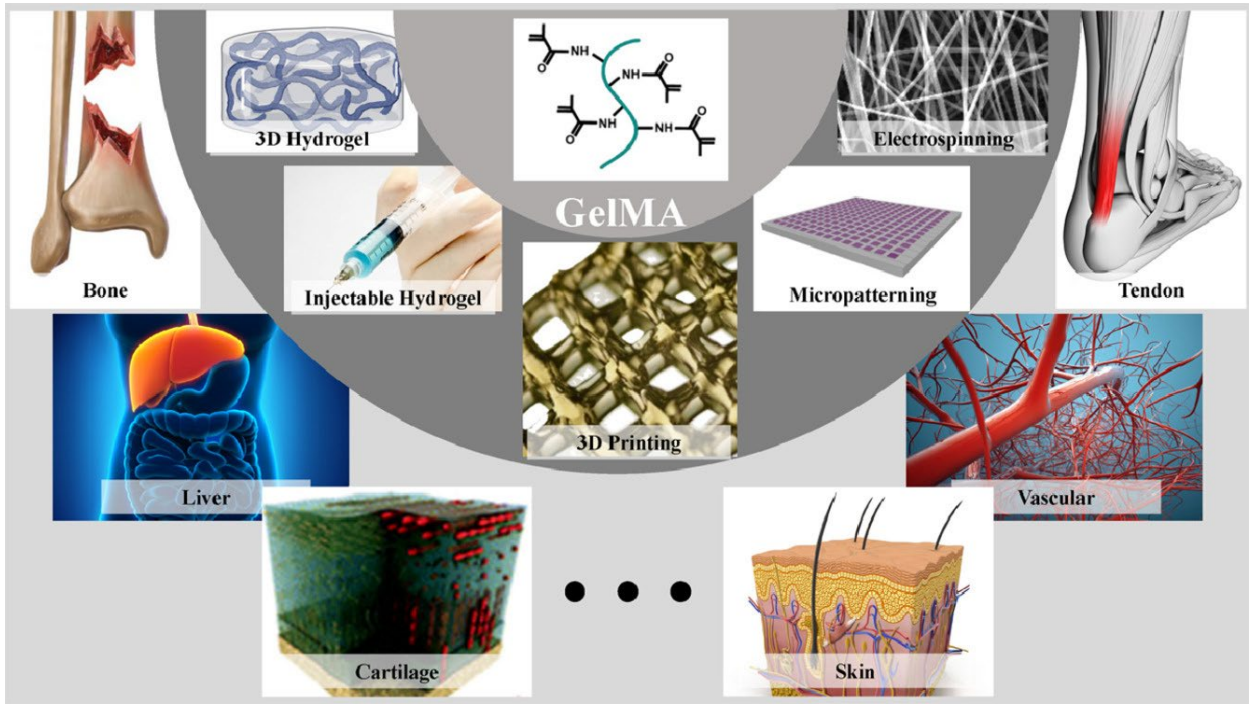
Suppositories

Topical products

Chemically modified gelatine



Biomacromolecules, 25, 1612−1628 (2024)



Engineered Regeneration, 2, 47-56 (2021)

Collagen

Collagen is a fibrous protein characterised by its unique triple-helix structure, which consists of three polypeptide chains, known as alpha chains.

The most common sources of collagen are bovine (cows), porcine (pigs), and avian (chicken) tissues, particularly skin, bones, and tendons. Bovine hides and bones are the most widely used sources.

Collagen can also be produced from the skins, scales, and bones of fish. Another source is jelly fish

Collagen's biocompatibility, biodegradability, and low immunogenicity make it an attractive material for various medical applications:

1. Wound dressings
2. Tissue engineering
3. Dermal fillers
4. Drug delivery

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Photochemical cross-linking of plastically compressed collagen gel produces an optimal scaffold for corneal tissue engineering

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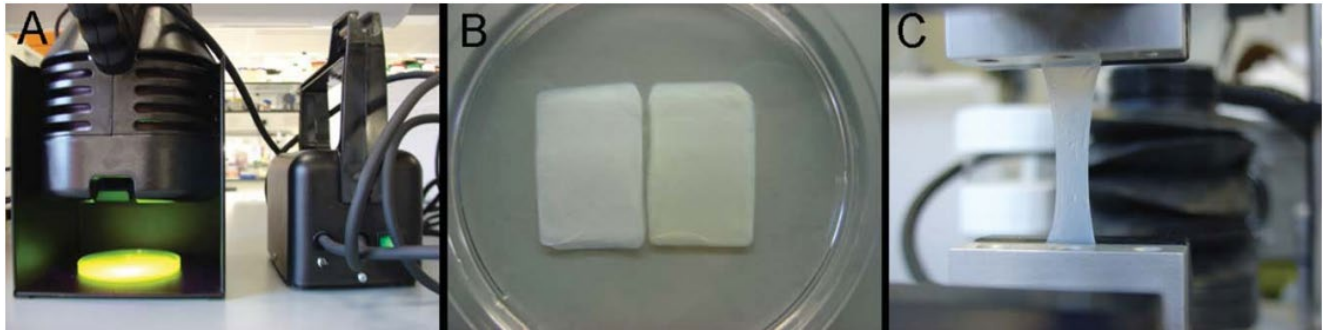
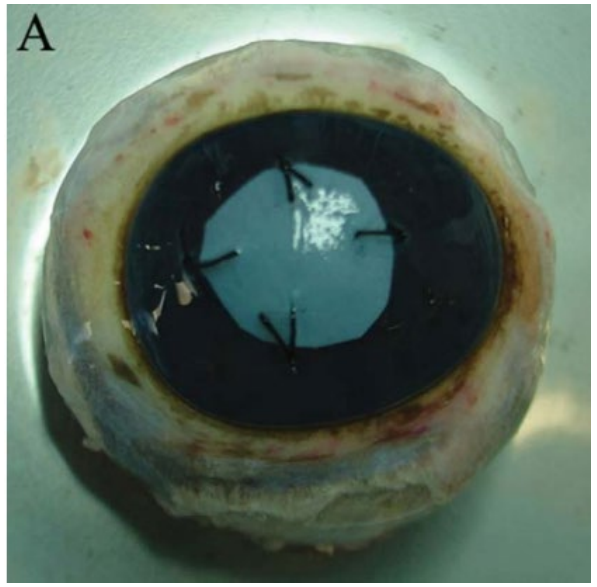
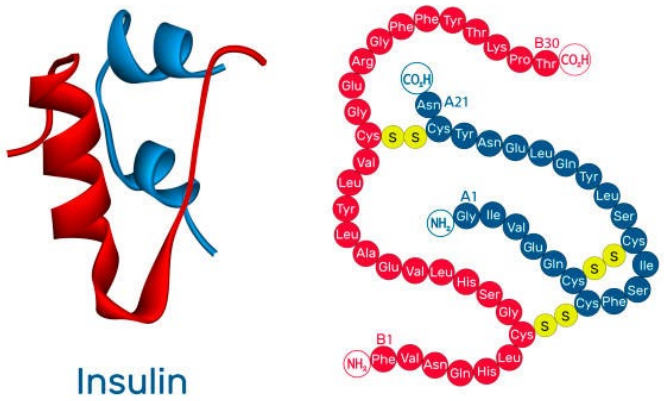




J Biomed Mater Res Part A: 99A: 1–8 (2011)

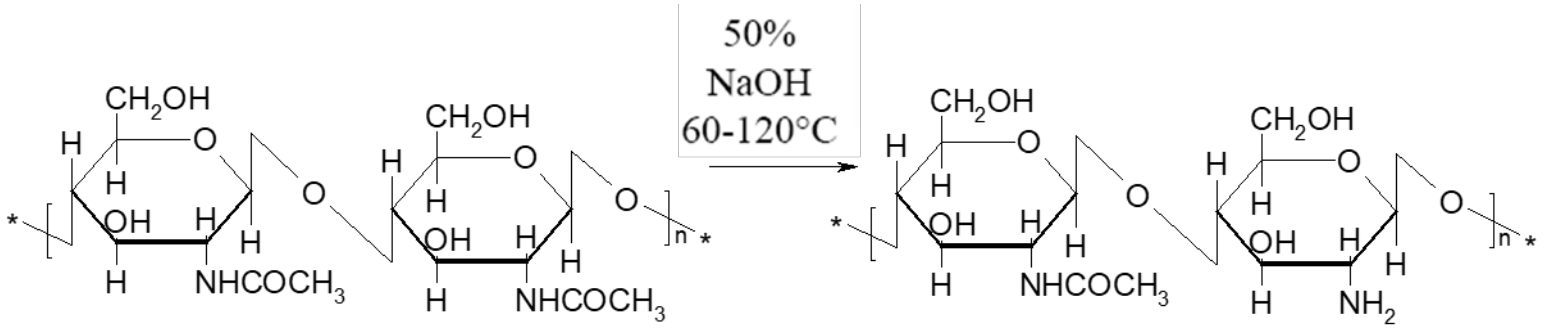
Insulin



- Insulin is a peptide hormone produced by beta cells of the pancreatic islets in humans
- It regulates the metabolism of carbohydrates, fats, and protein by promoting the absorption of glucose from the blood into cells of the liver, fat, and skeletal muscles

- It is extracted from the pancreases of animals, usually pigs and cows

Chitosan



Chitin

Chitosan

- Natural polysaccharide found in crustaceans, molluscs, fungi, insects,
- 10^{11} tons / year
- Highly insoluble

- Soluble in water under slightly acidic conditions

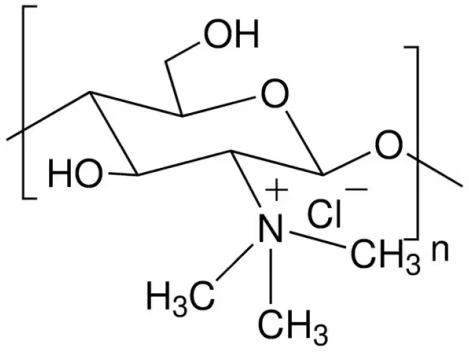
Biomedical applications of chitosan

Food supplement:
fat absorbing effects
supporting healthy
cholesterol levels and
weight management

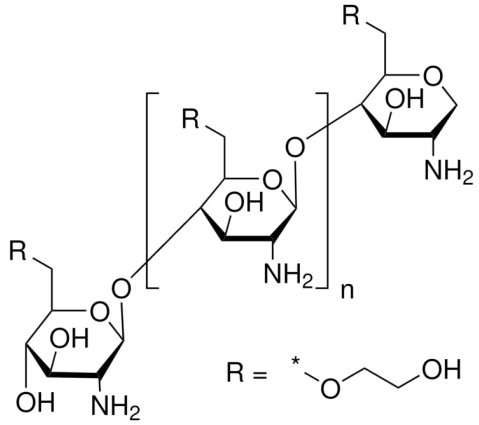
Pharmaceutical Excipient:
Binder
Disintegrant
Coating agent
Film-forming agent
Microspheres and nanoparticles
Mucoadhesive

Material for wound care:
Antimicrobial and wound
healing properties

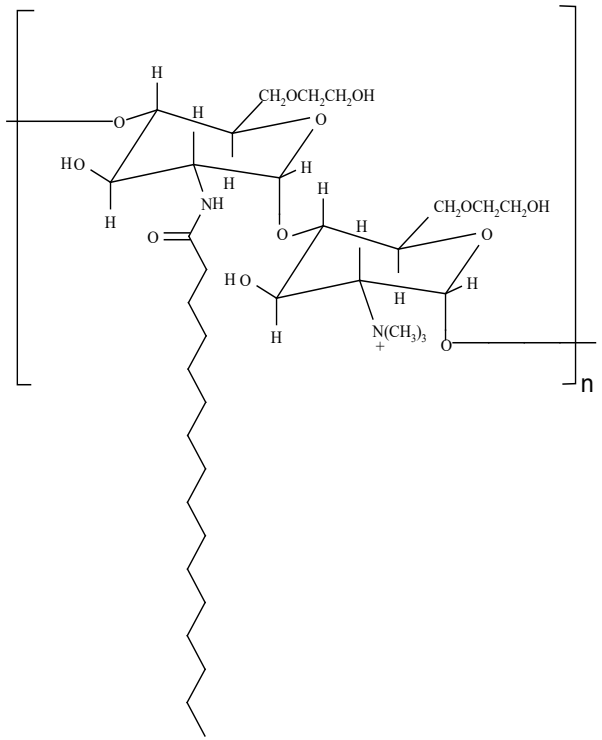
Chemically-modified chitosans

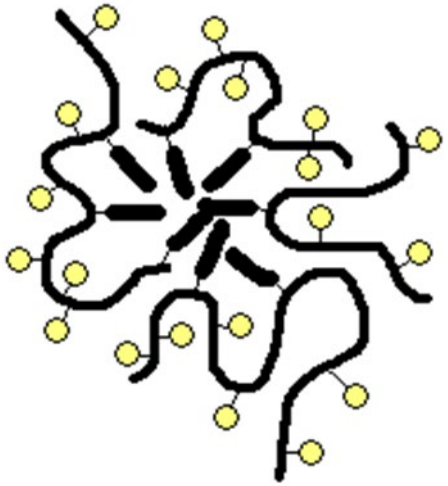


Methylated chitosan
(Sigma-Aldrich)



Glycol chitosan
(Sigma-Aldrich)



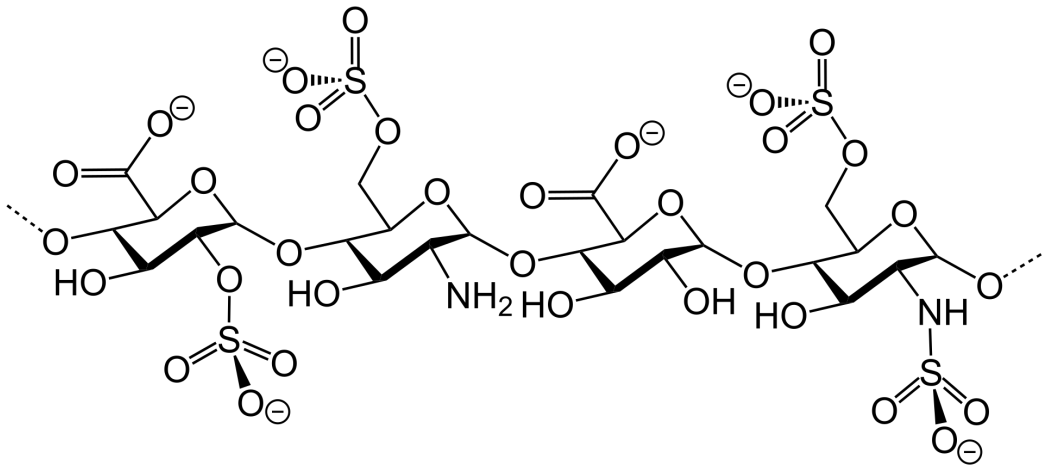


Biomacromolecules **2006**, *7*, 3452−3459

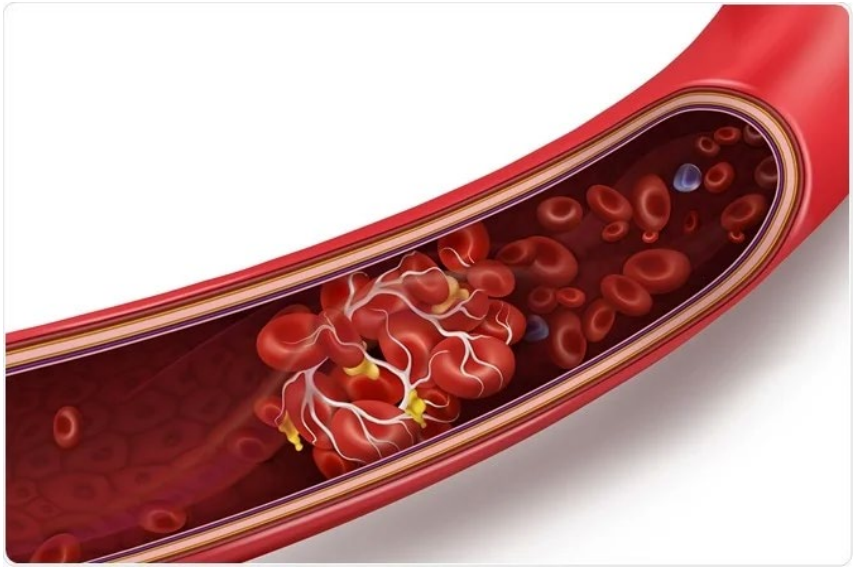
Carbohydrate-Based Micelle Clusters Which Enhance Hydrophobic Drug Bioavailability by Up to 1 Order of Magnitude

Xioazhong Qu,† Vitaliy V. Khutoryanskiy,† Ailsa Stewart,† Samina Rahman,† Brigitte Papahadjopoulos-Sternberg,‡ Christine Dufes,§ Dave McCarthy,∥ Clive G. Wilson,† Robert Lyons,⊥ Katharine C. Carter,# Andreas Schätzlein,§ and Ijeoma F. Uchegbu*,†

Heparin

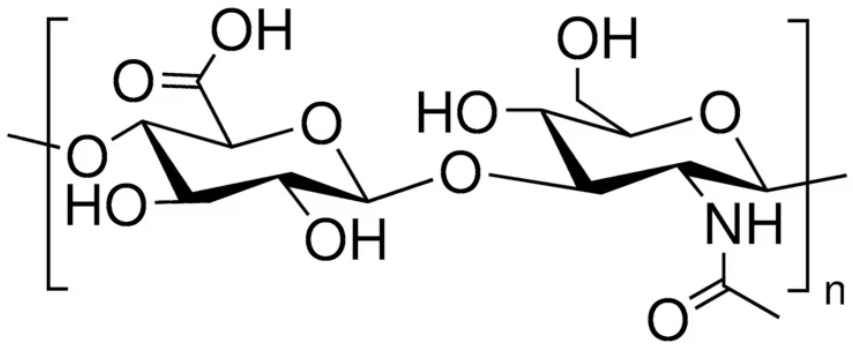


- Injectable anticoagulant used to prevent the formation of blood clots
- It is also used to create an anti-clotting surfaces inside various medical devices such as renal dialysis machines and test tubes.



Pharmaceutical-grade heparin is extracted from the mucosal tissues of animals that have been slaughtered for meat such as pigs and cattle

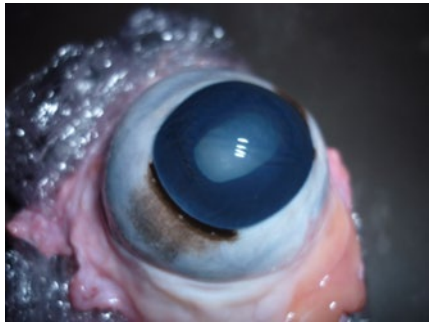
Hyaluronic acid (Hyaluronan)



- Water-soluble polysaccharide with excellent biocompatibility and ability to promote tissue repair
- Pharmaceutical applications: intra-articular injections, viscoelastic agent in ophthalmic surgery, artificial tears, wound care products, dermatology and drug delivery
- Cosmetic applications: moisturisers, lip enhancers, sun protein and hair care

Production:

- Hyaluronic acid is produced on a large scale by extraction from animal tissues, such as rooster combs and bovine vitreous humour
- Microbial fermentation (e.g. *Streptococcus zooepidemicus*)



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Conclusions

- Several classes of commercially important biopolymers are currently produced using raw materials of animal origin
- These biopolymers have found numerous applications in pharmaceutics, cosmetics, and other biomedical fields
- In some cases, their applications could be further expanded through chemical modification of these biopolymers

Acknowledgements

United Kingdom:

Prof A. Williams, Reading
Dr S. Amadesi, Reading
Prof S. Armes, Sheffield
Prof T. Georgiou, Imperial
Prof J. Keddie, Surrey
Dr M. Cook, UCL
Dr C. Dreiss, KCL

University of Reading

Dr M. Cook
Dr D. Kaldybekov
Dr R. Brannigan
Dr P. Morrison
Dr E. Mun
Dr E. Mansfield
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Dr S. I. Shah
Dr S. Aspinall
Dr F. Buang

Dr G.S. Irmukhametova
Prof G.A. Mun
Dr D.B. Kaldybekov

Prof S.E. Kudaibergenov

Dr G. Abilova

NAZARBAYEV UNIVERSITY

Prof G. Hortelano
Dr E. Mun
Dr B. Zhaisanbayeva

Dr R.I. Moustafine
Prof I.I. Semina

DWI Leibniz-Institut für Interaktive Materialien

Dr S. Filippov

GHENT UNIVERSITY

Prof R. Hoogenboom

Dr W. Samprasit
Dr P. Tonglairoum

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