Bharathidasan University

Tiruchirappalli – 620024

Tamil Nadu, India

Programme: M.Sc., Biochemistry

Course Title: Chemistry of Biomolecules

Course Code:BC101CR

Unit I

Galactans

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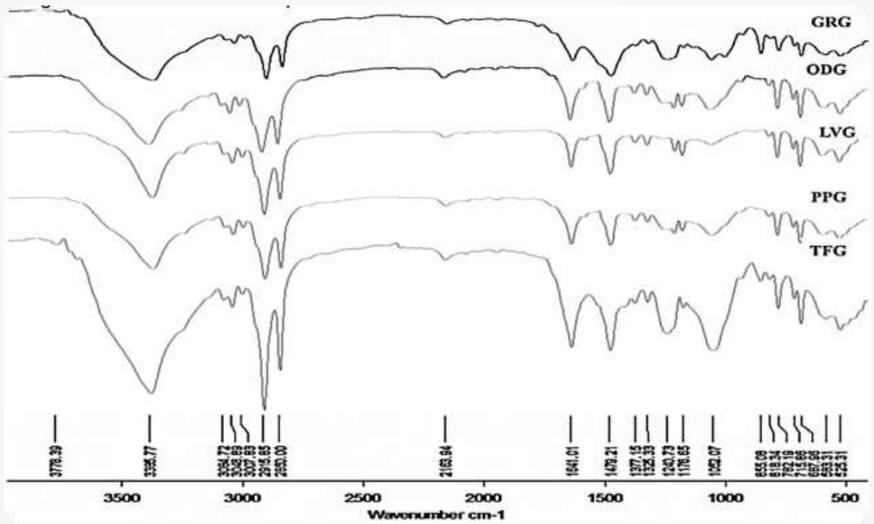
Galactans: The Versatile Polysaccharides

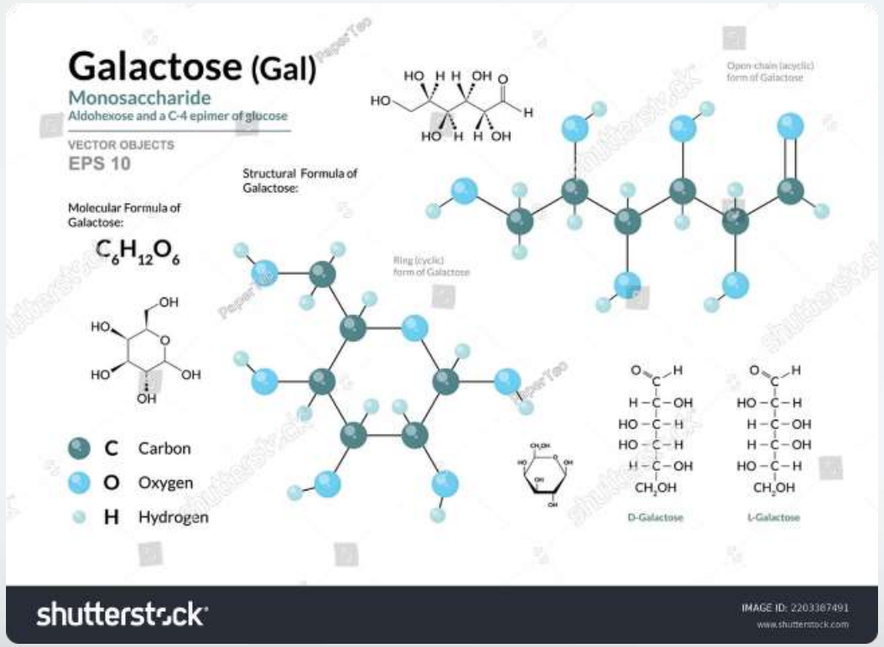
Galactans are a diverse group of polysaccharides found in various marine and terrestrial organisms, including red seaweeds, certain bacteria, and some plants. These complex carbohydrates have garnered significant interest due to their unique chemical structures and wide-ranging functional properties.



Occurrence of Galactans

Galactans are primarily extracted from red seaweeds, where they play a crucial structural and functional role. These polysaccharides can also be found in certain marine bacteria, as well as in the cell walls of some land plants, such as legumes and cereals.

Chemical Structure of Galactans



1

Backbone Composition

Galactans are composed of a backbone of galactose units, which can be linked in different configurations, such as β-1,4 or α-1,3 glycosidic bonds.

2

Variations

The galactose units can be modified with various substituents, including sulfate, methyl, or pyruvate groups, which contribute to the diversity and functional properties of different galactan types.

3

Branching

Galactans may also exhibit branching, with side chains attached to the main backbone, further enhancing their structural complexity.

Physical Properties of Galactans

Viscosity

Galactans are known for their ability to increase the viscosity of aqueous solutions, making them useful as thickening and stabilizing agents.

Gelation

Certain types of galactans, such as those extracted from agar-producing seaweeds, can form thermoreversible gels, which find applications in various food and pharmaceutical products.

Water Binding

Galactans have a high water-holding capacity, allowing them to act as effective emulsifiers and water-binding agents in various formulations.

Functional Properties of Galactans

Bioactivity

Certain galactans have been shown to exhibit antioxidant, anticoagulant, and immunomodulatory properties, making them attractive for use in nutraceutical and pharmaceutical applications.

Prebiotic Activity

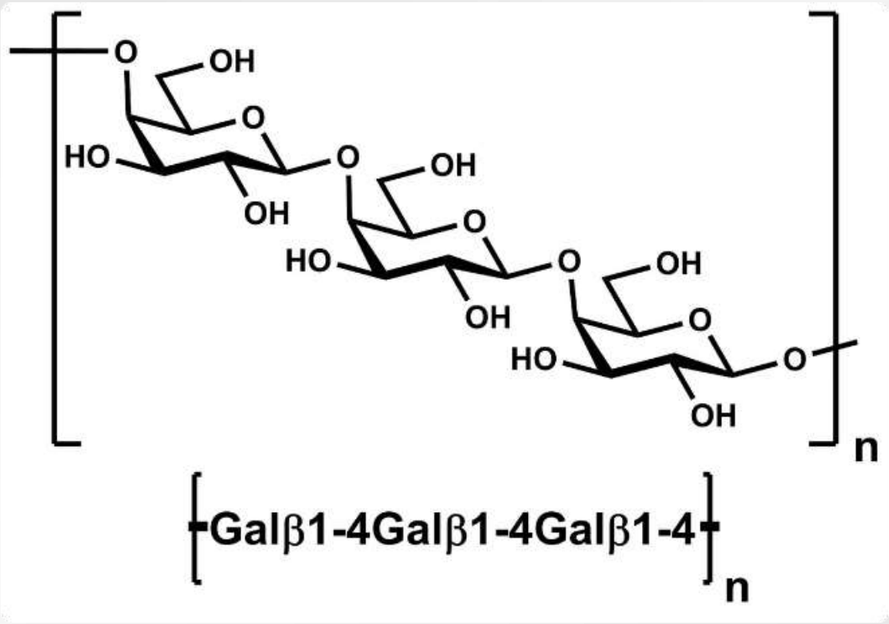
Some galactans can selectively promote the growth of beneficial gut microbiota, positioning them as potential prebiotic ingredients in functional foods and dietary supplements.

Gelling and Emulsifying

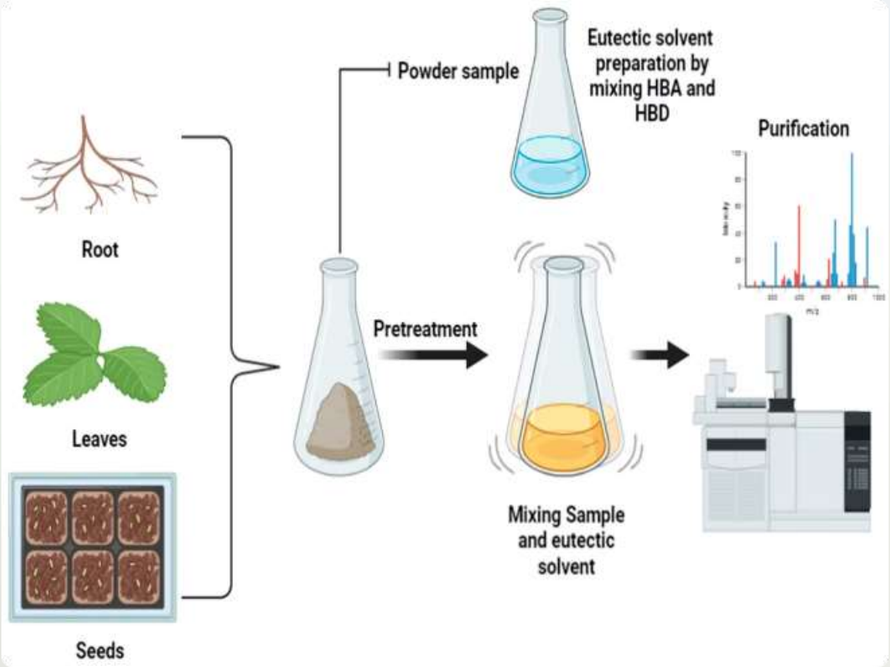
The ability of galactans to form gels and stabilize emulsions makes them valuable in the food, cosmetic, and pharmaceutical industries.

Selective Binding

Galactans can selectively bind to specific proteins or cells, allowing for targeted drug delivery and diagnostic applications.



Extraction and Purification of Galactans



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Extraction

Galactans are typically extracted from seaweeds or microbial sources using hot water, alkali, or enzymatic treatments, depending on the specific galactan type.

2

Purification

The extracted galactans may undergo further purification steps, such as precipitation, dialysis, or chromatographic techniques, to remove impurities and obtain high-purity products.

3

Characterization

Analytical methods like NMR spectroscopy, mass spectrometry, and rheological analysis are employed to characterize the structural and functional properties of the purified galactans.

Applications of Galactans

Food Industry

Galactans are used as thickeners, stabilizers, and gelling agents in various food products, such as desserts, sauces, and dairy items.

Pharmaceuticals

Bioactive galactans find applications in drug delivery systems, wound healing, and as potential therapeutic agents for conditions like cancer and inflammation.

Cosmetics

Galactans are incorporated into cosmetic formulations as emulsifiers, moisturizers, and for their potential anti-aging and skin-protecting properties.

Agriculture

Galactans are used as soil conditioners, plant growth enhancers, and in the development of biopesticides for sustainable agriculture.

Industry	Examples of red seaweeds (common name)	Usage and potential applications	References
Food	*Fucus vesiculosus*, *Laminaria digitata* (Kombu), *Undaria pinnatifida* (Wakame), *Chondrus crispus* (Irish moss), *Porphyra tenera* (Nori)	• ingredient in food preparation • food additives to modify the food taste and appearance in color • food thickener • food stabiliser to avoid protein denaturation during sterilisation process	Ruperez & Saura-Calixto (2001), Saha & Bhattacharya (2010), Verbeken *et al.* (2004)
Biotechnology	*Gelidium* spp, *Pterocladiella* spp, *Gelidiella* spp, *Gracilaria* spp.	• solid medium for microbial culture (bacteria, fungi etc.) and plant tissue culture • coating for magnetic beads used in protein absorption • separation matrix in nucleic acid and protein gel electrophoresis • gel matrix in gel filtration chromatography • immobilizes various substances (e.g. enzymes and bacteria)	Mulagalapalli *et al.* (2007), Tong & Sun (2001), Renn (1984)
Medicine and pharmacy	*Botryocladia occidentalis*, *Gelidium crinale*, *Gigartina skottsbergii*, *Sebdenia polydactyla*, *Gracilaria caudata*, *Porphyra haitanensis*, *Gigartina acicularis*, *Eucheuma cottonii* (currently known as *Kappaphycus alvarezii*), *Eucheuma spinose* (currently known as *Eucheuma denticulatum*), *Champia feldmannii*, *Gracilaria fisheri*	• anticoagulants • antioxidants • anticancer/tumor drugs • antiviral agent • antibacterial drug	Pereira *et al.* (2005), Carlucci *et al.* (1997), Ghosh *et al.* (2009), de Souza *et al.* (2007), Souza *et al.* (2012), Costa *et al.* (2010), Zhang *et al.* (2004), Lins *et al.* (2009), Al-Haj *et al.* (2009); Sae-Lao *et al.* (2017)

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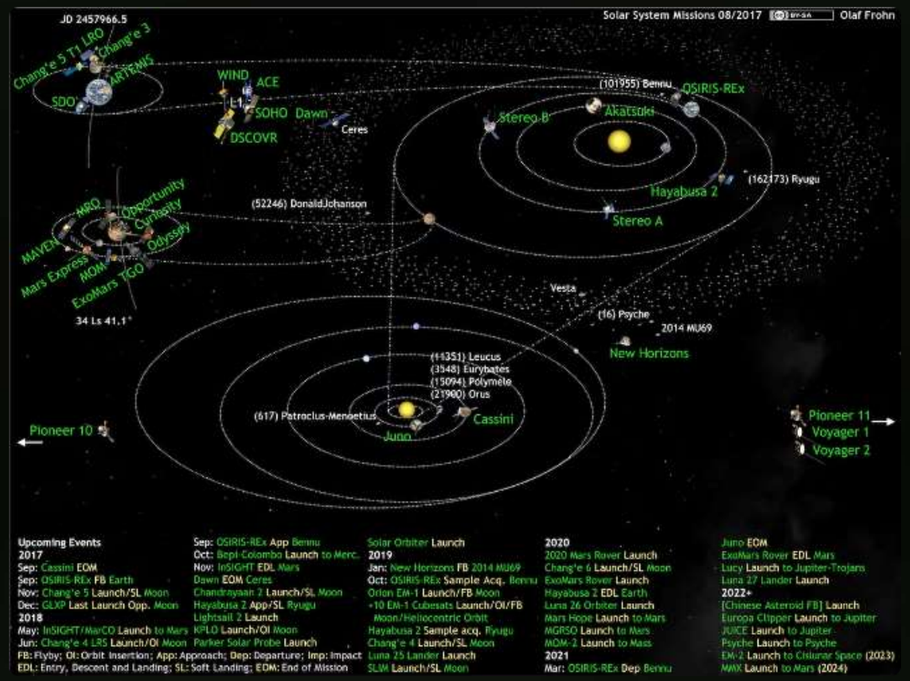

Conclusion and Future Prospects

Emerging Applications

Emerging applications of galactans in areas like tissue engineering, drug delivery, and environmental remediation are being actively investigated, promising exciting new frontiers for these versatile polysaccharides.

Sustainable Production

Efforts are underway to establish sustainable and eco-friendly production of galactans, leveraging renewable marine resources and green extraction techniques to support their widespread utilization.