Impact of protein-polysaccharide complexation on designing particles for encapsulation of ω-fatty acids

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Introduction

Changing lifestyle, consumption of saturated fats, environmental contaminates etc. have increased the risk for several degenerative disorders like coronary heart diseases, inflammatory and immune disorders, hyperlipidemia, cancer, dementia and depression [1].

Omega-3 fatty acids are highly conjugated structures, have demonstrated prevention of above diseases.

Oxidation of omega fatty acids limits their nutritional benefits[2].

Designing microcapsules to prevent the oxidation using biopolymers is of consumer interest.

Materials and Methods

β-lactagolulin, n-3 fatty acids, and polysachharides (xanthan gum, carrageenan, pectin, gum arabic, chitosan, & carboxy methyl cellulose were used in this study.

Modified direct deposition method[3] with high speed homogenization was used to produce emulsions using.

Emulsions were measured for droplet size, turbidity, microscopy, flow properties, thermal properties, zeta potential etc.

Emulsions were spray drying under inert atmosphere

Powders were tested for morphology, particle size, encapsulation efficiency, surface oil, agglomeration, & thermal behaviour.

Oxidation tests were performed under ambient storage

Results

Polysaccharide type influenced the emulsion properties loaded with n-3 fatty acids.

β-lg- chitosan and gum arabic combinations showed the most stable emulsions.

Differences in droplet size, stability, thermal properties and turbiscan measurements were observed among the different samples.

Spray drying increased the particle size and powder agglomeration.

Pectin, gum arabic, & chitosan protein stabilized emulsions had above 15% encapsulation efficiency.

β-lg-chitosan stabilized emulsions followed by gum arabic, CM celullose combinations showed high protective effect for omega fatty acids.

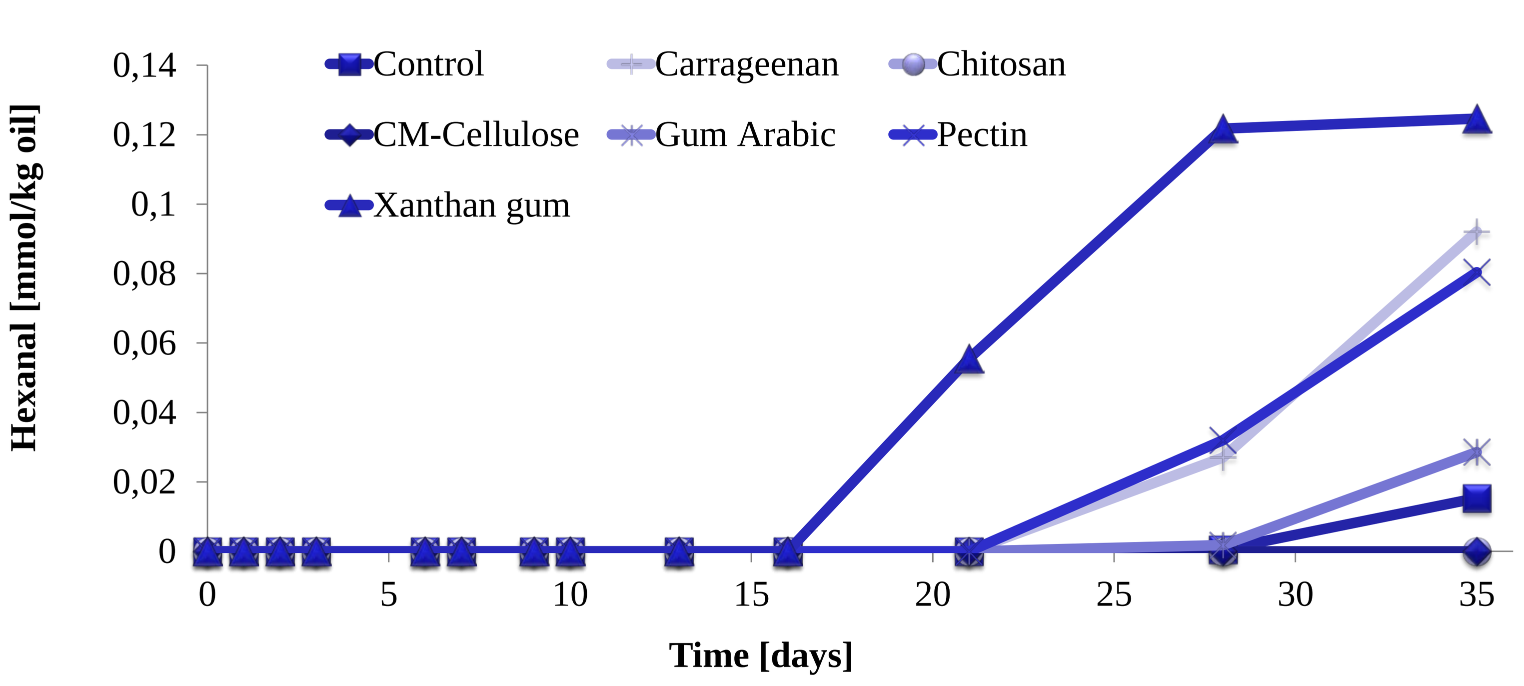

Fig 3: Hexanal formation during emulsion storage

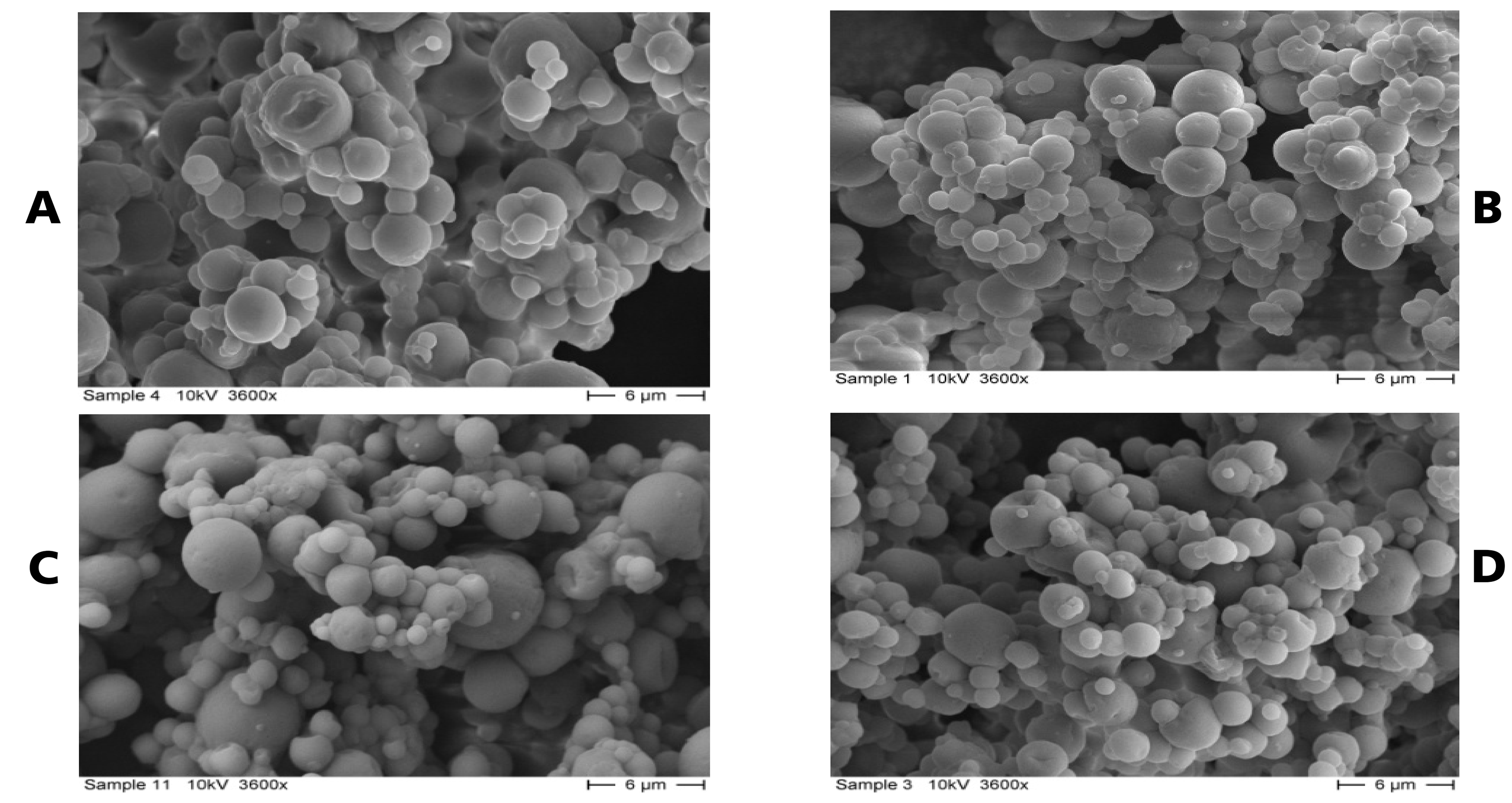

Figure 1: SEM images of of β-lactaglobuline–polysaccharide combinations on spray dried microencapsulated ω-rich powders (A-Control; B- β-lg-carrageenan; C- β-lg-chitosan; D- β-lg-pectin)

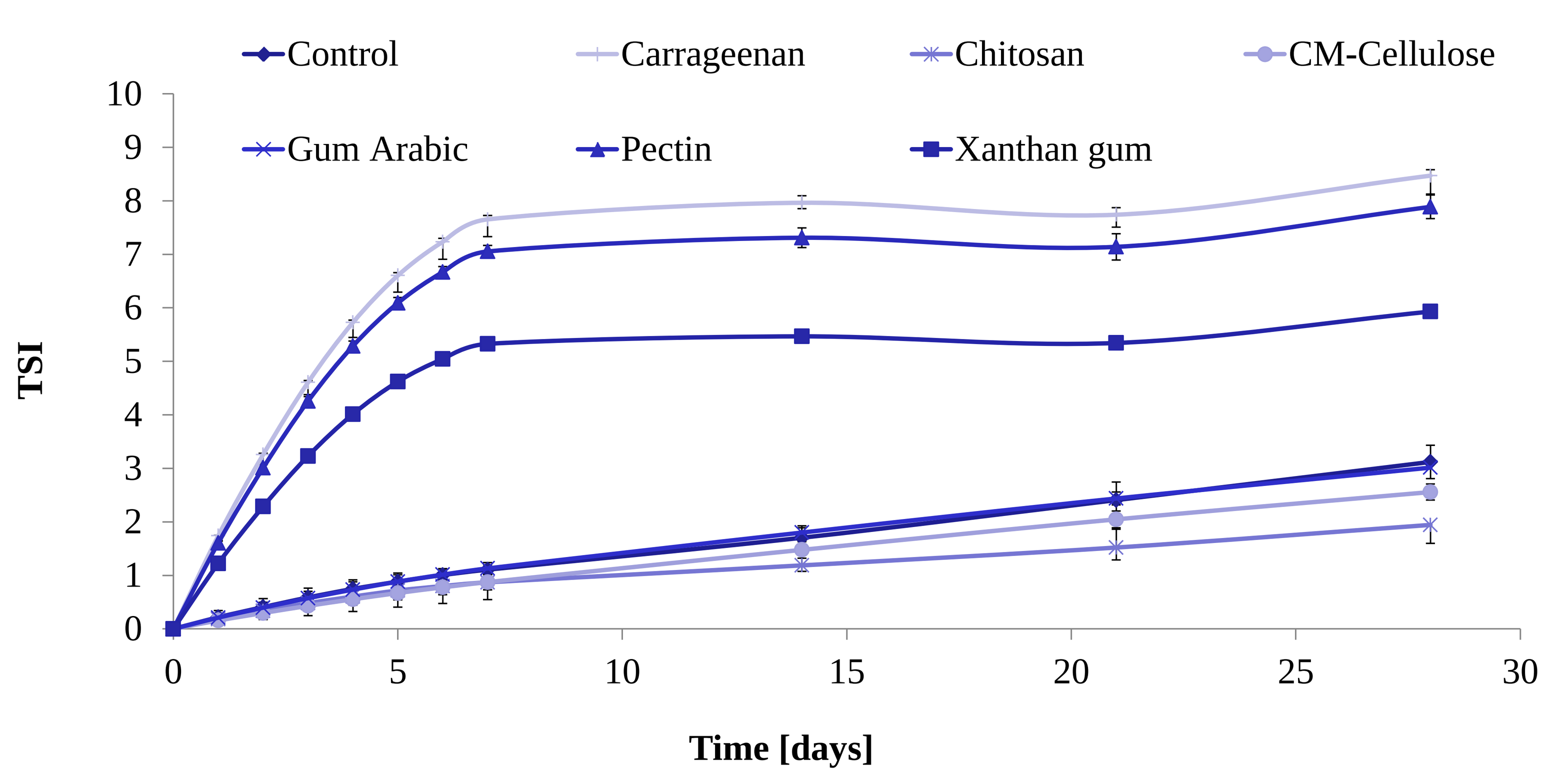

Fig. 2: Turbiscan stability Index measured from Δ backscattering data of emulsions.

Conclusion

- Encapsulation of n-3 fatty acids with biopolymers offers nutritional benefits to consumers.
- Food grade biopolymers as shell materials are widely accepted by consumers.
- Combination of protein and carbohydrate in the shells offers t both moisture and oxygen barrier properties.
- Combinations of β-lg-chitosan and β-lg-CM Cellulose are extremely stable to prevent the oxidation of n-3 fatty acids.
- High oil loading capacity
- Use of antioxidants will further increase the stability in different processing & storage conditions.

References:

[1] McClements, D.J., et. al. (2009) Critical Reviews in Food Science & Nutrition, 49(6), 577-606.
[2] Serfert,S., et. al . (2009) Food Chemistry, 113, 1106-1112
[3] Ye, A., et . al. (2011). Food Hydrocolloids, 25(7), 1677-1686

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