Development of chitosan/alginate nanoparticles to encapsulate *Salmo salar* by-products derived protein hydrolysates

Janani Jayasinghe Mudiyanselage[1,2,3], Aishwarya Mohan[3], Beth Mason[3], Nandika Bandara[1,2]

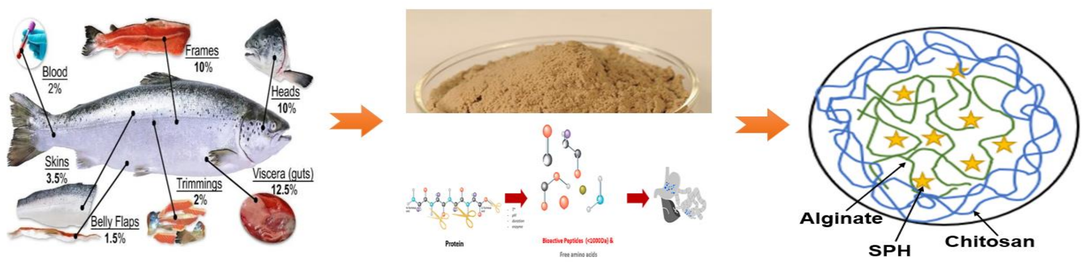
[1] Department of Food and Human Nutritional Sciences, University of Manitoba, Winnipeg, R3T 2N2, MB, Canada

[2]Richardson Center for Food Technology and Research, 196 Innovation Drive Winnipeg, MB R3T 2N2 Canada

[3]Verschuren Center for Sustainability in Energy and Environment,1250 Grand Lake Rd, Sydney, NS B1M 1A2 Canada

Introduction

- Bioactive peptides are recognized as a promising functional food ingredient that can be incorporated into foods to attain health promoting activities



- Bioactive peptides can be derived from vary food sources including plant, animal and their by-products
- Fish derived byproducts- excellent source for bioactive peptides
- *Salmo salar* is the main aquaculture species produced in Canada which produce huge amount of byproducts
- *S. salar* byproducts derived protein hydrolysates (SPH) exhibit excellent bioactivities
- Limitations in using in food industry -lower stability to gastrointestinal digestion, low bioavailability, bitter taste, hydrophobicity, interactions with other food compounds and hygroscopicity
- Solution- Encapsulation of bioactive peptides using polysaccharide-based delivery agents (Chitosan and Alginate Nanoparticles/CH/AL NPs)
- Chitosan and alginate possess favorable properties which aid in protecting SPH

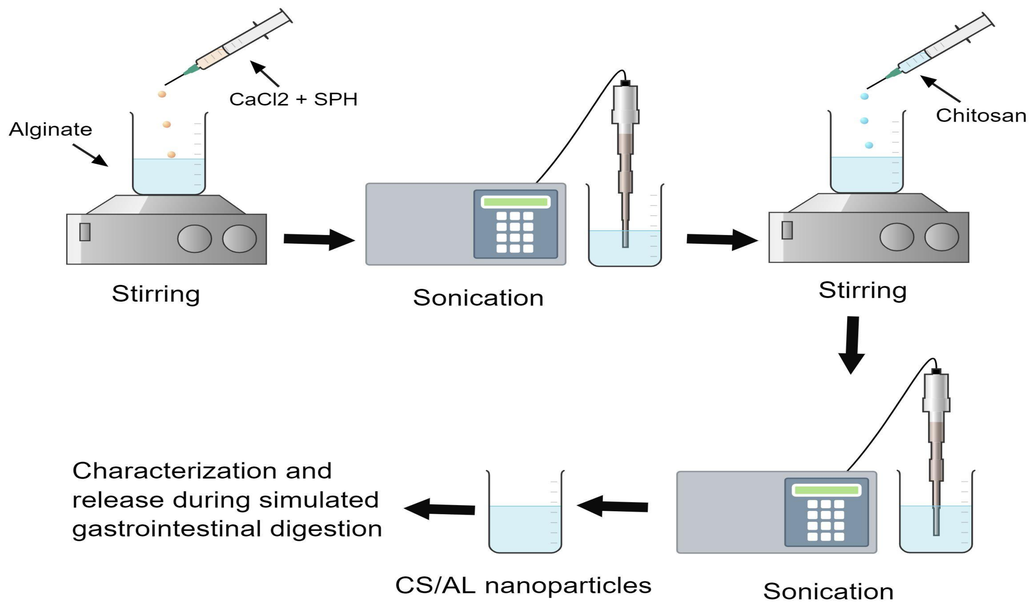
Hypothesis

- Salmon by-products derived protein hydrolysates encapsulated chitosan/alginate nanoparticles (CS/AL NPs) will provide a sustained release of hydrolysates in the gastric environment

Objectives

- To optimize the process conditions for CS/AL NPs preparation
- To characterize the prepared nanoparticles
- To study the release behaviour in simulated gastrointestinal conditions.

Method



Independent variables	Levels		
	Low (-1)	Medium (0)	High (+1)
Alginate/chitosan (w/w) (AL/CH)	2	5	8
Alginate/ $CaCl_2$ (w/w) (AL/CaCl2)	4	5	6
Alginate/ peptides (w/w) (AL/SPH)	1	2	3

Acknowledgements

FOOD PROTEINS & BIOPRODUCTS LAB NANDIKA BANDARA GROUP

CRSNG NSERC

INNOVATION.CA CANADA FOUNDATION FOR INNOVATION | FONDATION CANADIENNE POUR L'INNOVATION

CAPTURE Canadian Agri-food Protein Training, Utilization, and Research Enhancement

CIFST Canadian Institute of Food Science & Technology | ICSTA Institut canadien de science & technologie alimentaires

Results and Discussion

Optimization of CS/AL NPs preparation

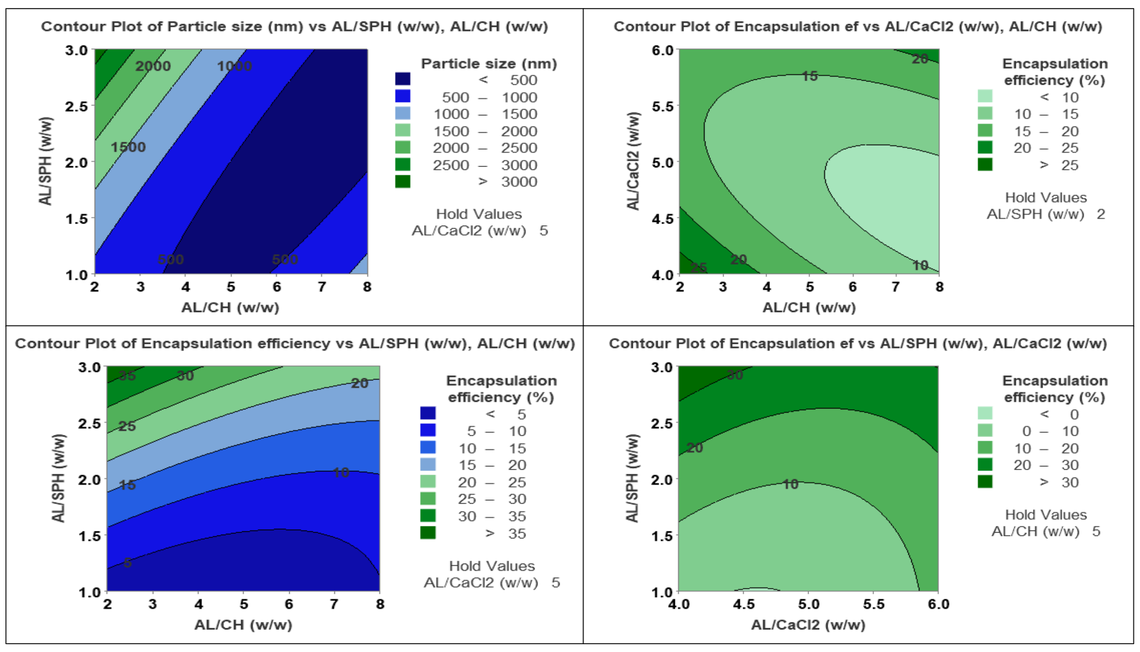
Box-Benkhan design summary

Response	R^2	Adjusted R^2	Predicted R^2
Particle size	0.8301	0.7979	0.7267
Zeta potential	0.7807	0.7526	0.6925
Encapsulation efficiency	0.8981	0.8718	0.8205

Optimized Conditions
- Alginate/chitosan (w/w): 6
- Alginate/$CaCl_2$ (w/w): 6
- Alginate/SPH (w/w): 3

Validation Study

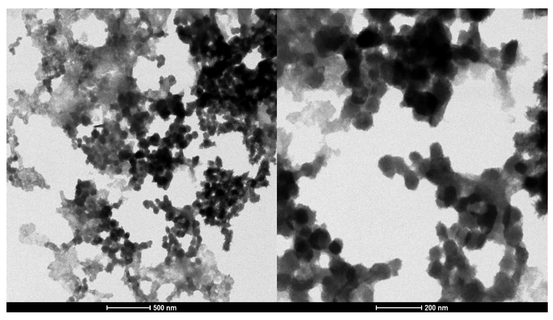
Response variable	Predicted value	Experimented value
Particle size (nm)	417	536.70±21.20
Zeta potential (mV)	-32.4	-30.22±0.88
EE (%)	29.63	29.80±4.5



Contour plots for particle size and encapsulation efficiency

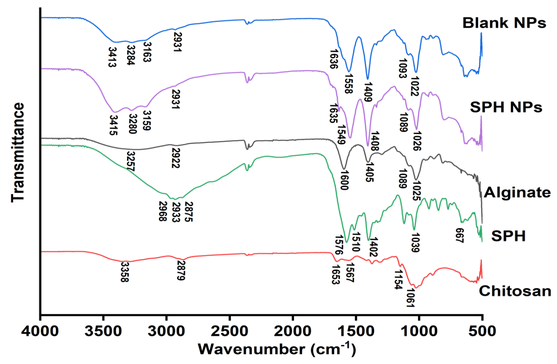
Characterization of CS/AL nanoparticles

Transmission Electron Microscopy (TEM)



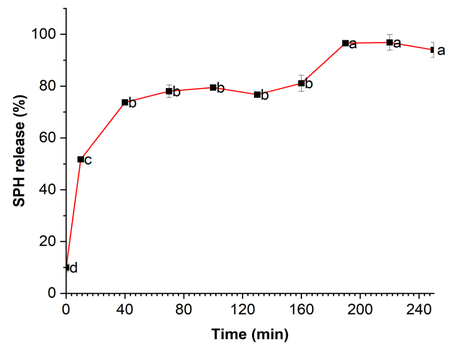
Transmission electron microscopic images for optimized SPH encapsulated CH/AL nanoparticles

Fourier transform infrared spectroscopy (FTIR)



FTIR spectra

Release in gastrointestinal digestion



Release % of SPH from chitosan/alginate nanoparticles compared to control (free SPH)

- SPH encapsulated CS/AL nanoparticles showed a high rate of release in simulated saliva digestion and a sustainable release in the intestinal juice
- CS/AL nanoparticles were able to protect the encapsulated SPH from gastric digestion

Conclusions

- CS/AL NPs system is a potential delivery technique with sustainable release of the encapsulated heterogeneous SPH
- This could be stated as an initial step in utilizing bioactive peptides derived from the *S. salar* byproducts

References