



International Association  
of Rice Bran Oil

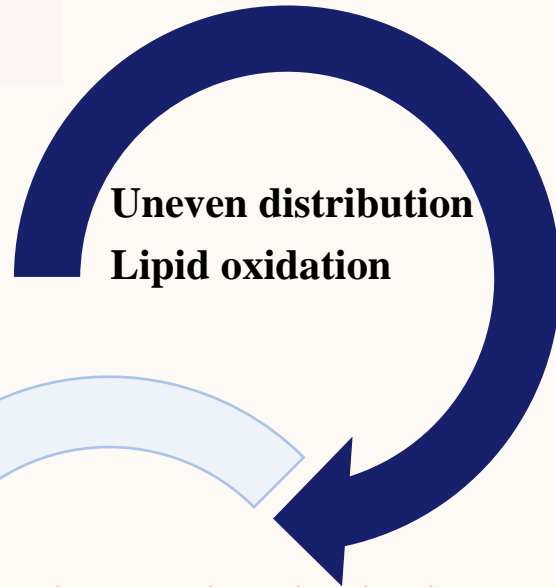
# Forming stable rice bran Oil-in-Water Emulsions using biopolymer emulsifier and Hydrodynamic cavitation processing



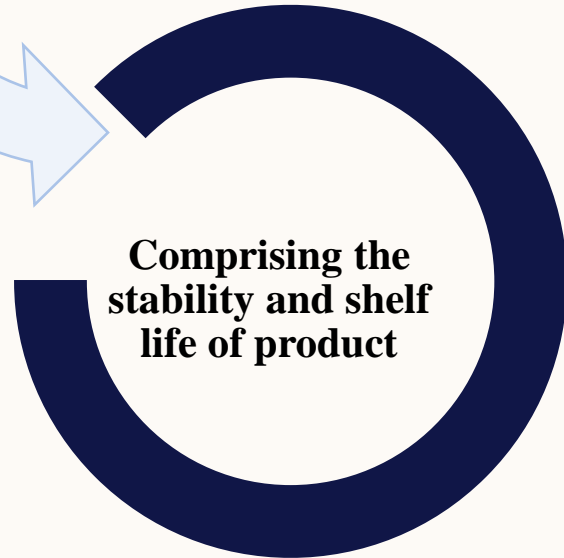
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Under the guidance of  
**Assoc. Prof. Dr. Shalini S. Arya**



# ISSUES



In a food system, it is important that the oil droplets remain both physically and chemically stable throughout the shelf life of the product



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# Solution

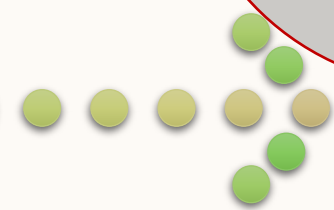
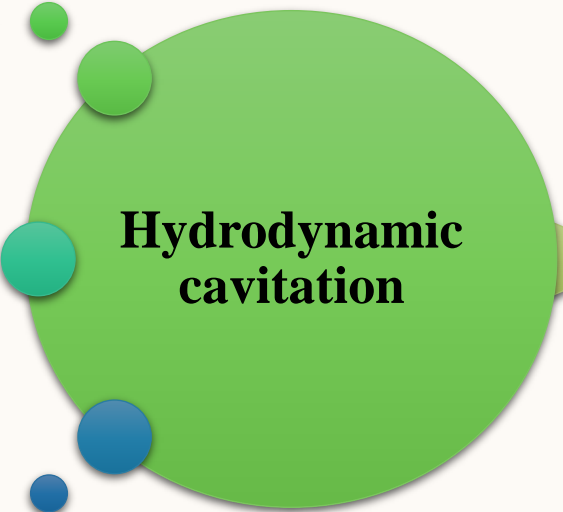
Rice bran oil



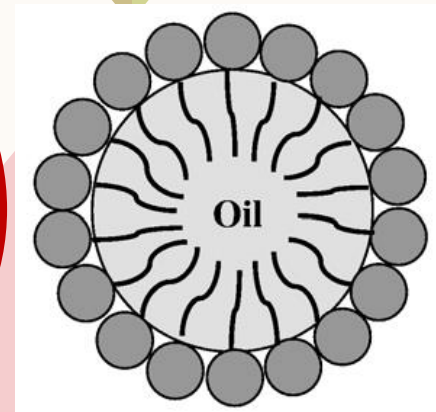
Emulsifier  
(Gum Arabic)



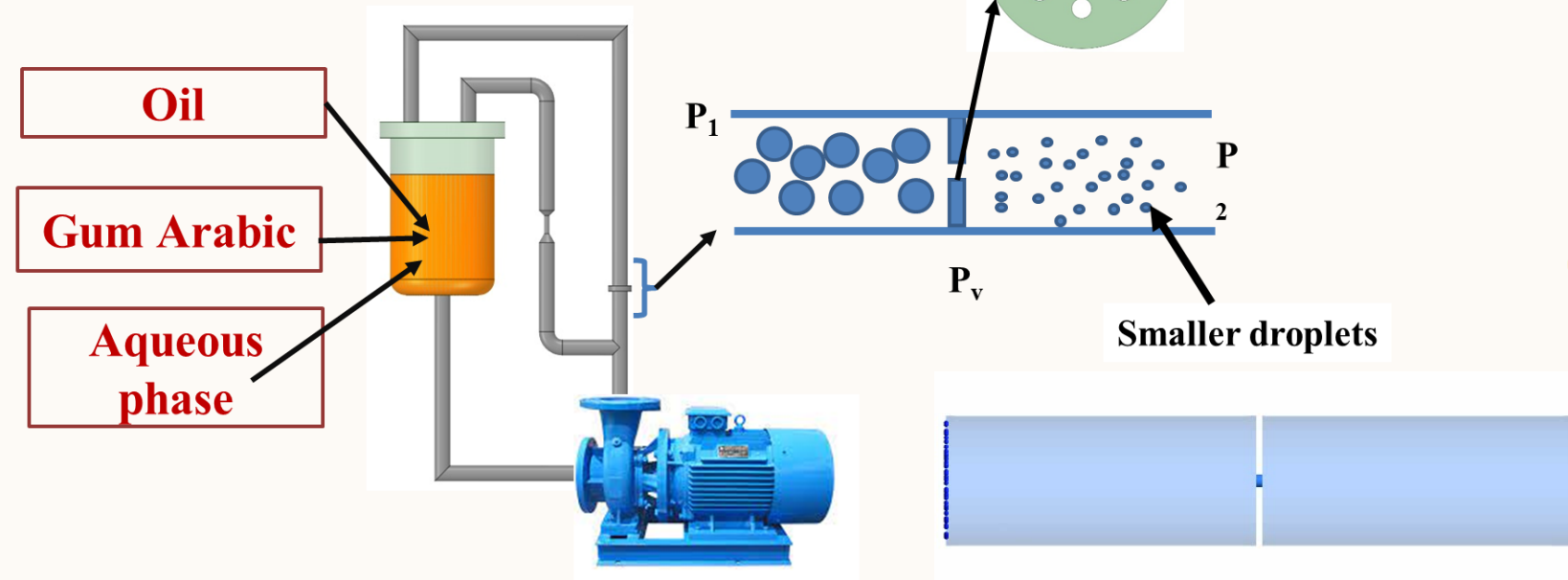
Buffer solution  
(pH=7)



- **Small droplets**
- **Low emulsifier concentrations**
- **Were stable to a wide range of environmental stresses after cavitation.**



# Hydrodynamic Cavitation Technology for Oil-in-Water Emulsion formulation



## Physical effects

- Shock waves
- Microjets
- High shear stress

## Localized hotspots

- High T ( $\approx 10,000\text{K}$ )
- High P ( $\approx 1000 \text{ atm}$ )

## Chemical Effects

- Hydrogen atoms
- Oxygen atoms
- Hydroxyl radicals
- Hydroperoxyl radicals

$$\alpha = \frac{\text{Total perimeter of holes}}{\text{Total area of opening}}$$

$$\text{Cavitation number, } C_v = \frac{P_2 - P_v}{\frac{1}{2} \rho_l v_0^2}$$

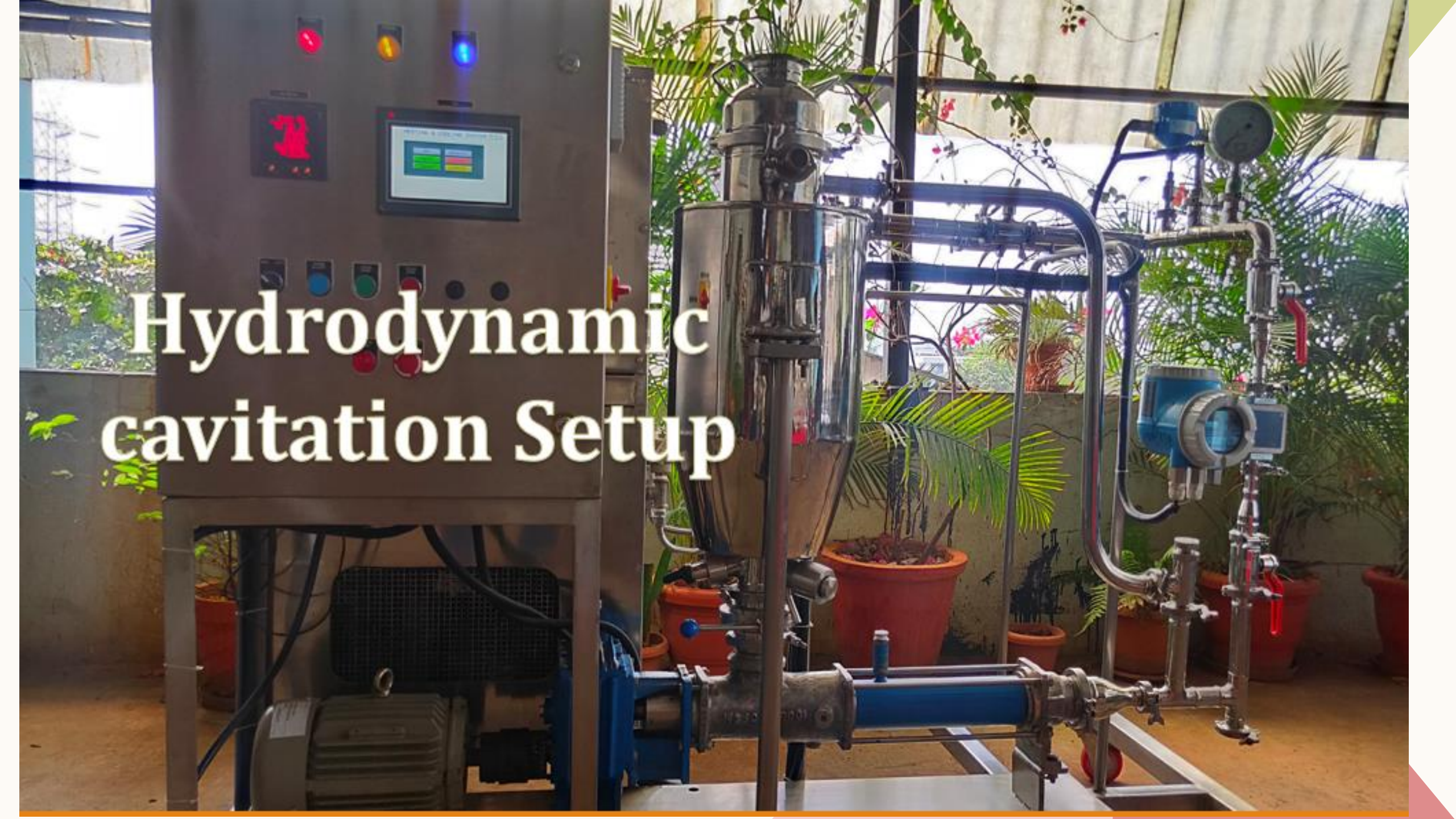
$$\beta = \frac{\text{Total flow area or area of the hole opening}}{\text{Cross-sectional area of the pipe}}$$



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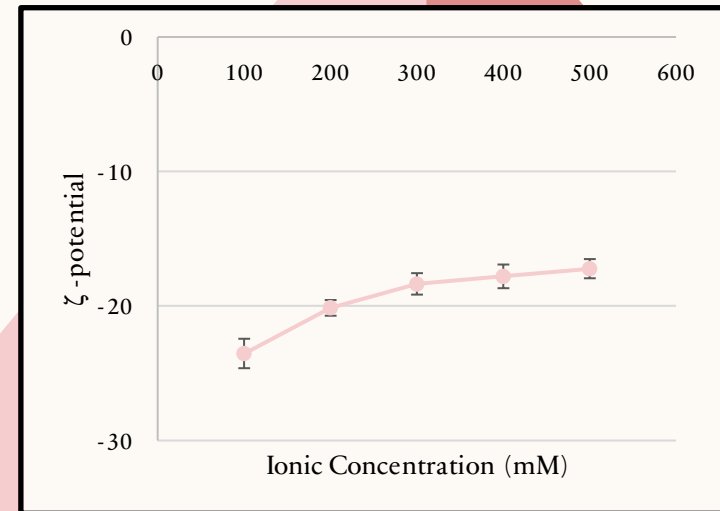
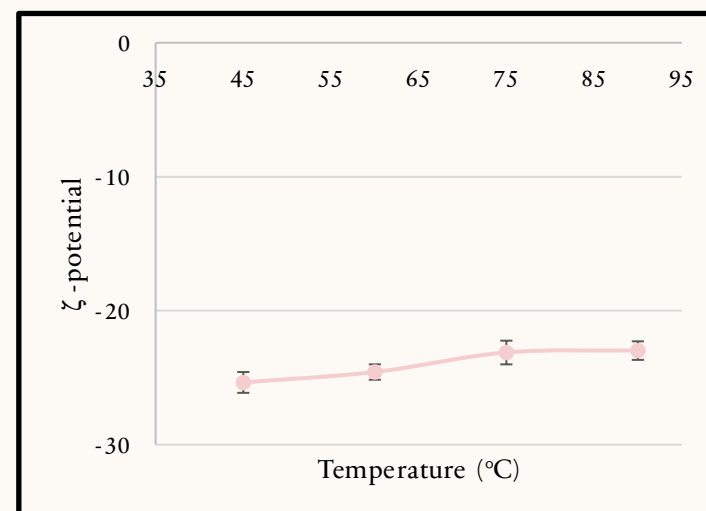
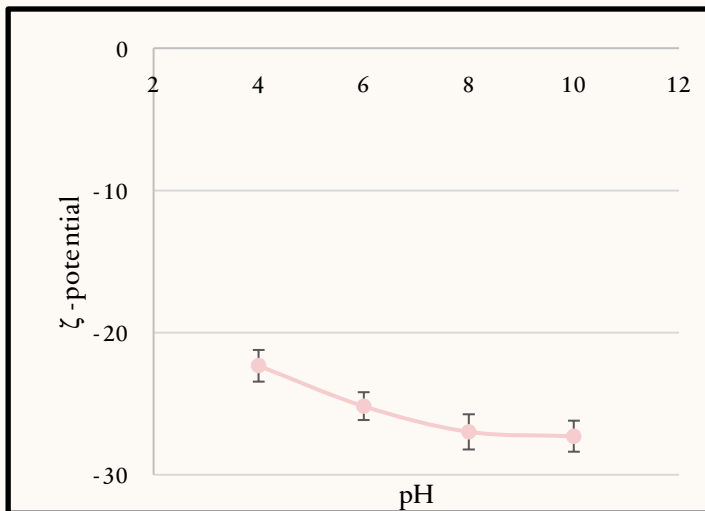
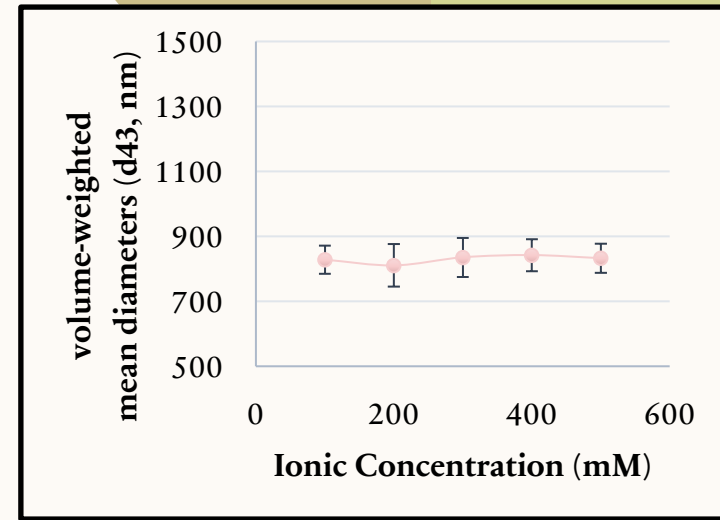
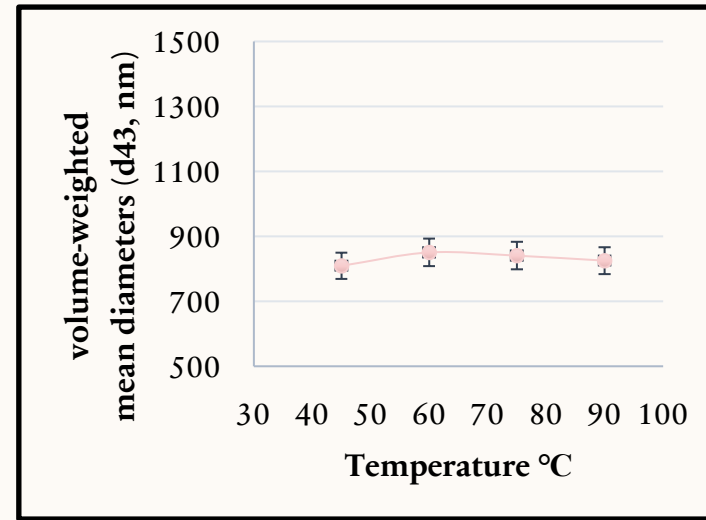
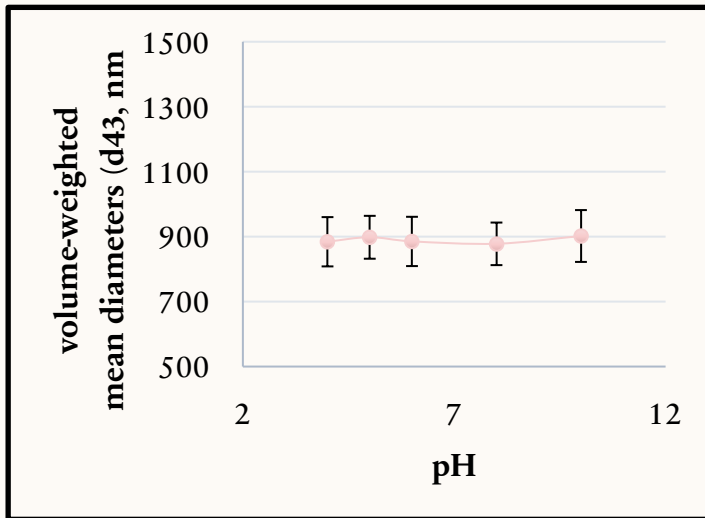


# Hydrodynamic cavitation Setup



# Stability of rice bran oil emulsions at different environmental stress

- Different pH (4, 6, 8, 10)
- Varying temperature (45, 60, 75, and 90 °C)
- Different ionic concentration (100, 200, 300, 400, 500 mM)



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# Application



**Control**



**Cupcakes with rice bran**

- More rise in volume & more sponge
- Firm texture crumb
- Glossy surface
- Tastier with better mouthfeel
- More nutritious

- **Target audience**
- Low fat food producers
- Calorie conscious consumers
- Bakery industry
- Bakery ingredient industries

Ingredients List (per 100 g)	
Ingredients	Amount (g)
Total flour	50.87
• Wheat flour	40.26
• Pearl Millet flour (Bajra)	7.63
• <b>Rice bran powder</b>	2.63
Powdered sugar	43.60
Eggs	0.58
Baking powder	1.45
salt	0.29
sodium bicarbonate	0.29
<b>Rice bran oil emulsion</b>	2.90

- This study showed that stable rice bran oil-in-water emulsions can be formed using biopolymer emulsifiers and hydrodynamic cavitation processing.
- The new gum arabic-rice bran oil-in-water emulsions was capable of forming small stable droplets at relatively low concentrations which provide fat replacement in bakery foods.
- The developed emulsion also provide immense benefit against the environmental stress of products hence solve the problem of packaging industry and storage facility problem

**THANK YOU**

The background features a large white circle on the left and a large light pink circle on the right, both overlapping a dark blue background. The pink circle contains several thin, white, concentric curved lines.