



Optimization of extraction process of crude alginate from *Sargassum muticum* by response surface methodology

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Introduction

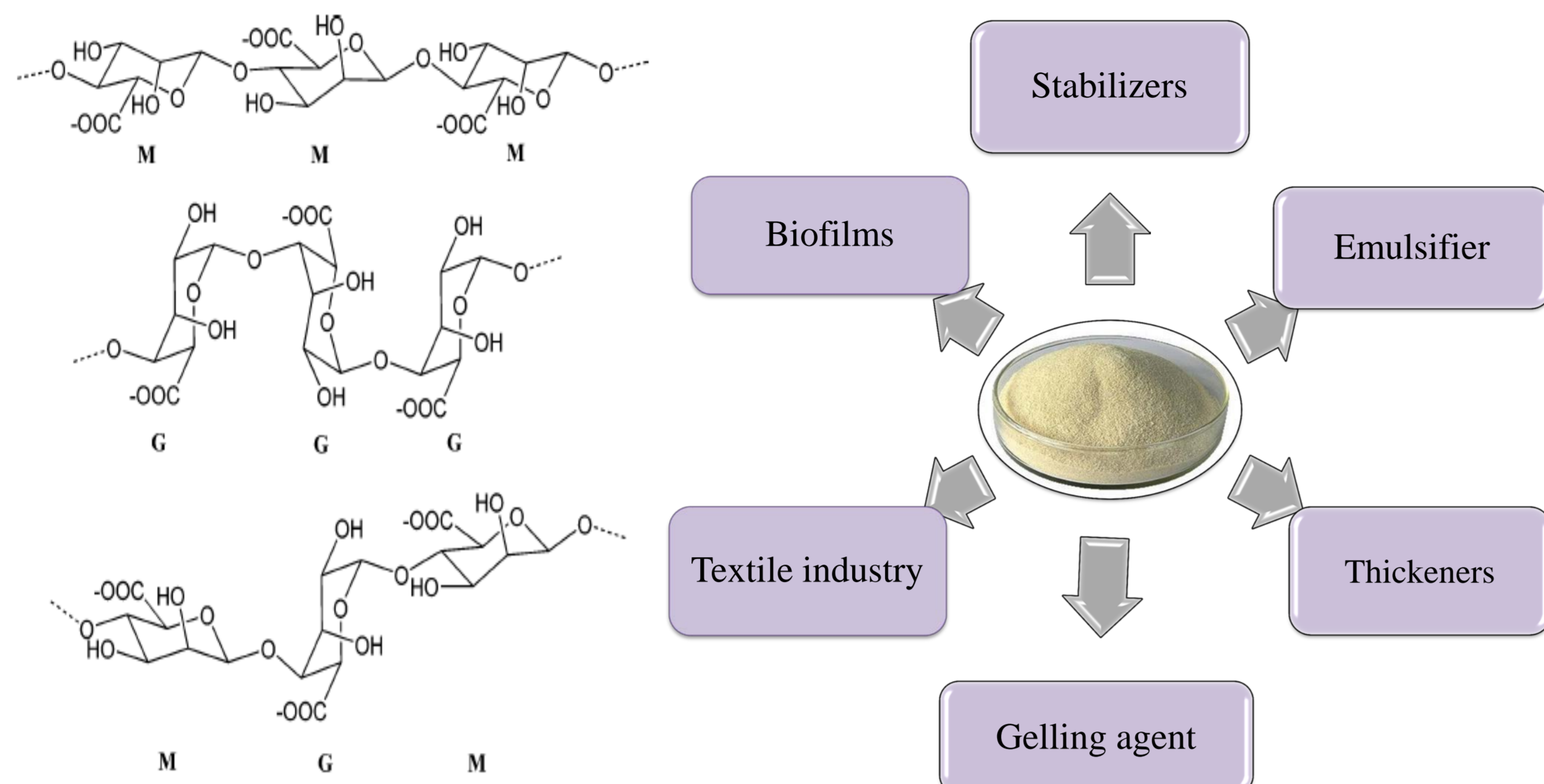


Fig. 1 Alginate structure (showing the combination of M and G blocks) and uses

• Alginates are an anionic copolymer, comprised of β-D-Mannuronic acid (M-block) and (1→4)-linked α-L-Guluronic acid (G-block) units

• M and G blocks are arranged in non-regular block wise pattern of varying proportion of GG, MG and MM blocks

• Alginates are widely used in confectionary, and ice cream industry as emulsifiers, stabilizer and thickeners

Objectives

• Extraction of crude alginate from the brown macroalga *Sargassum muticum*

• Optimization of extraction parameters (temperature, alkali and ethanol percentage) using Response Surface Methodology

Methodology

Dried algae soaked in 2% formaldehyde for 24 h at room temperature

Washed with distilled water and 0.2 M HCl added and left for 24 h

Washed with distilled water and extracted with (1-5%) sodium carbonate for 3 h in (60-100°C) temperature

Soluble fraction collected by centrifugation (15,000 rpm, 15 min) and precipitated by ethanol (60-100%)

Dried at 65°C until constant weight reached



Fig 2 (a) dried algae (b) precipitated crude alginate (c) dried alginate

Methodology according to procedures of reference 1 and 2.

Table 1 Independent variables and their levels used in the response surface design

Independent variables	Levels of variables				
	-1.682	-1	0	+1	+1.682
Temperature (°C)	60	68	80	92	100
Alkali percentage (%)	1	1.8	3	4	5
Solvent percentage (%)	70	76	85	94	100

Results

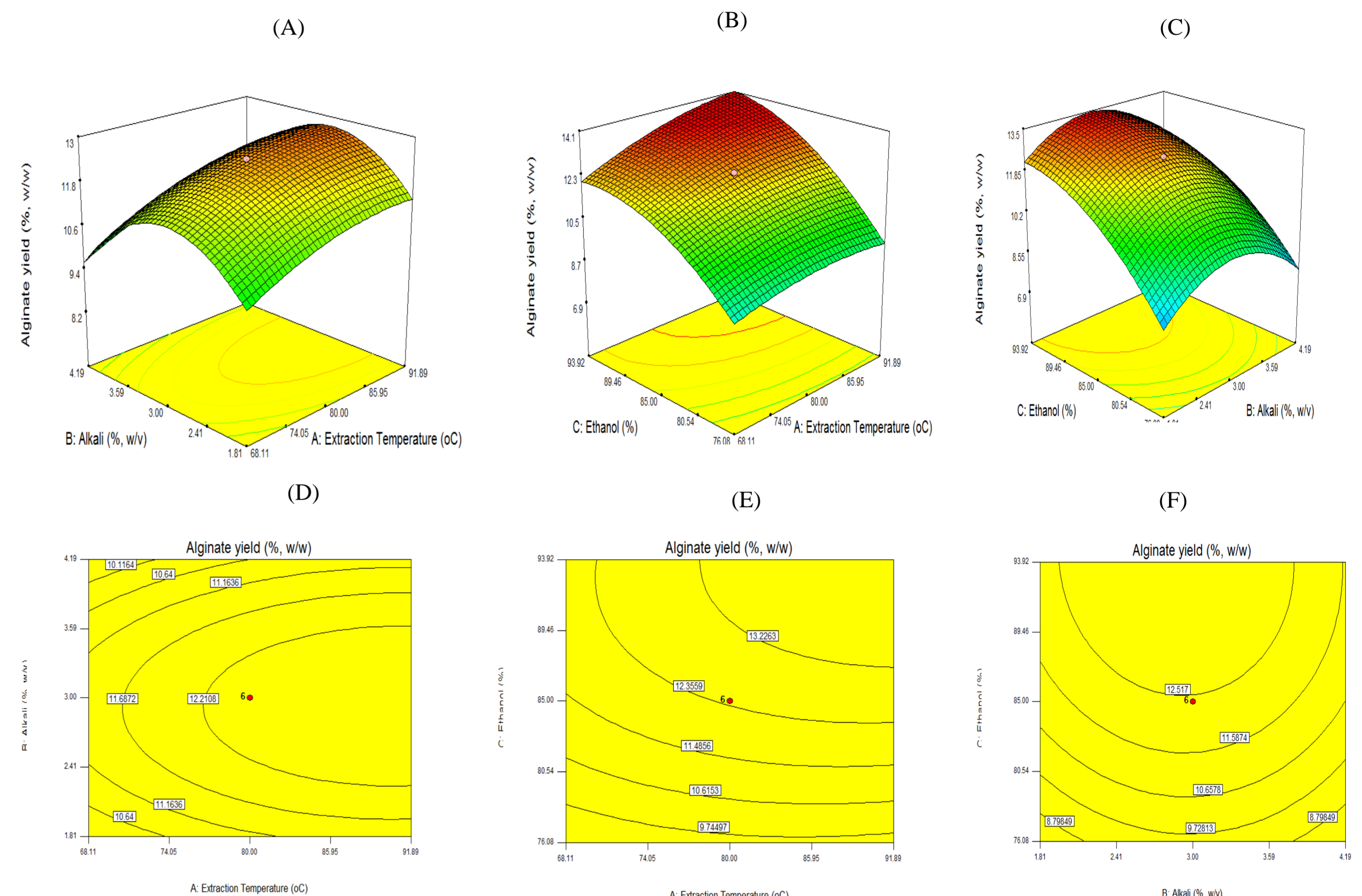


Fig. 3 Response surface plots (A, B and C) and contour plots (D, E, F) showing the effect of extraction temperature, alkali percentage, solvent percentage on the extraction yield

Table 2 Analysis of variance for the fitted quadratic polynomial model of alginate extraction

Source	SS	DF	MS	F-value	Prob>F
Model	104.5	9.0	11.6	57.0	< 0.0001
Residual	2.0	10.0	0.2		
Lack of fit	2.0	5.0	0.4		
Pure error	0.0	5.0	0.0		
Core total	106.6	19.0			

$$R^2=0.9809 \quad R^2_{adj}=0.9636 \quad R^2_{pre}=0.855$$

Model equation for alginate

$$\text{Alginate yield} = 12.43 + 0.6 * A - 0.21 * B + 1.95 * C + 0.031 * A * B + 0.37 * A * C - 0.36 * A^2 - 1.5 * B^2 - 0.9 * C^2$$

Where, A = Temperature (°C), B= Alkali percentage and C = Ethanol percentage

$$\text{Alginate yield} = 13.45\% \text{ (w/w)}$$

Major findings

• A method of alginate extraction from *Sargassum muticum* was optimized in respect to temperature, alkali and ethanol percentage

• Optimum extraction yield of alginate was recorded at: **90°C, 3% alkali and 94% ethanol**

• The experimental yield (13.45%) was not significantly different to the theoretical value predicted (13.7%) which validated the entire methodology

Reference

- Fenoradosa, Taratra André, et al. (2010) Extraction and characterization of an alginate from the brown seaweed *Sargassum turbinarioides* Grunow. *Journal of applied phycology* 22.2: 131-137
- Rioux, L-E., S. L. Turgeon, and M. Beaulieu (2007) Characterization of polysaccharides extracted from brown seaweeds. *Carbohydrate polymers* 69.3: 530-537

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