# OPTIMISATION OF METHODS FOR AGAR EXTRACTION FROM *GRACILARIA SP.*

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***Keywords:*** *Gracilaria changii, Gracilaria fisheri, Gracilaria tenuistipitata*, seaweeds, sodium hydroxide.

## Introduction

In Malaysia, the demand for agar is increasing every year. Efforts should thus be made to produce agar locally. Agar is commercially produced from red seaweeds and various extraction methods have been employed which involve heating sun-bleached seaweeds in various extraction solutions. The methods differed either in the type of extraction solution, its concentration, the heating temperature or heating time used. The gel strength of agar produced from red seaweeds is usually very weak. Alkali pre-treatment of the seaweeds has been performed in order to improve the agar gel strength. Sodium hydroxide has been used and the conditions were varied in terms of sodium hydroxide concentration, and soaking temperature and time. The objective of this study was to determine the optimum conditions for extraction of agar from *Gracilaria sp.* with high yield and high gel strength.

## Materials and Methods

Three species of red seaweeds were used in this study. *Gracilaria changii* was collected from Ban Merbok, Kedah and was grown in a pond under the supervision of Fisheries Research Institute, Pulau Pinang. *Gracilaria fisheri* and *Gracilaria tenuistipitata* were collected from Pattani Bay, Pattani Province, Thailand. After the seaweeds were harvested, they were washed and sun-dried, and stored for further processing. Agar was extracted from the seaweeds with different extraction solutions. They were distilled water, sulphuric acid, acetic acid and sodium hexametaphosphate. The concentrations of sulphuric acid and acetic acid were in the range of 0.005-0.03% while the concentrations of sodium hexametaphosphate were in the range of 0.0005-0.003 M. The extraction temperature was 121°C while the extraction time was varied from 10 to 60 min. After the optimum extraction conditions were established, the seaweeds were pretreated with sodium hydroxide and the parameters studied were sodium hydroxide concentration which ranged from 1 to 9%, soaking time of 1 to 3 hours, and soaking temperature of 80 to 100°C.

## Results and Discussion

Using distilled water, it was observed that the yield increased when the extraction time was increased. After the optimum extraction time was reached the yield plateau off (as in *G. changii* and *G. fisheri*) or decreased slightly (*G. tenuistipitata*) when the extraction time was further increased. The optimum extraction times for *G. changii*, *G. fisheri* and *G. tenuistipitata* were 40 min, 30 min and 20 min, respectively. Using the optimum extraction times, the highest yield obtained with *G. changii*, *G. fisheri* and *G. tenuistipitata* were 35%, 32% and 25%, respectively. When the agar was extracted using sulphuric acid and acetic acid, the yield tended to increase when the concentration of acid and extraction time were increased, and then decreased. This is due to the fact that agar is a polysaccharide in the cell wall of seaweeds. Acid helped destroy the cell wall but in the same time it was destructive to the agar. Therefore, there was a certain period of time to extract the agar and after that the agar would be destroyed because it was present in the acid solution for too long. When sodium hexametaphosphate was used, the yield tended to increase and the gel strength slightly decreased when the concentration and extraction time were increased. Employing 0.0005 M sodium hexametaphosphate, 121°C and 10 min extraction temperature and time, respectively, the yield of agar from *G. changii* decreased gradually when the temperature of the sodium hydroxide pre-treatment of the seaweeds was increased from 60°C to 100°C but the reduction was not significant. The gel strength increased when the sodium hydroxide pre-treatment temperature was increased from 60°C to 80°C. The concentration of sodium hydroxide significantly affected the yield and gel strength of agar. The yield decreased gradually when sodium hydroxide concentration was increased from 1 to 9%. The gel strength of agar increased when the sodium hydroxide concentration was increased from 1 to 3% but further increment in the sodium hydroxide concentration led to a decrease in the gel strength. The temperature of sodium hydroxide pre-treatment had no significant effect on the yield of agar from *G. fisheri*. However, the value was found to be lower than that of *G. changii* agar. The gel strength of extracted agar increased significantly when the sodium hydroxide pre-treatment temperature was increased from 60 to 80°C and then leveled off when the temperature was further increased. The concentration of sodium hydroxide used did affect the yield and gel strength of agar obtained from *G. fisheri*. The gel strength was increased when the concentration of sodium hydroxide was increased from 1 to 7% and then decreased at 9% sodium hydroxide. The optimum conditions for alkali pre-treatment of *G. fisheri* were at 80-90°C with 7% sodium hydroxide.

## Conclusions

The utilisation of sulphuric acid, acetic acid and sodium hexametaphosphate increased the yield of agar from *G. changii*, *G. fisheri* and *G. tenuistipitata* but have a negative effect on the agar gel strength. An extraction method which employed 0.0005M sodium hexametaphosphate, 121°C and 10 min resulted in a high yield of agar with a high gel strength. Agar with a gel strength of 661-838 g/cm$^2$ could be obtained from *G.changii* after pre-treatment with 3-5% sodium hydroxide at 80-90°C for 1-2 hours. For *G.fisheri*, a high gel strength agar (612-713 g/cm$^2$) could be obtained after 5-7% sodium hydroxide treatment at 80-90°C for 2-3 hours.

*Supported by IRPA Grant 01-02-04-0200*