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OPEN VESSEL AND STEAM BOILER METHODS FOR ACID BASED AGAR EXTRACTION BY *GRACILARIA CORTICATA*

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ABSTRACT: Agar is a commercially important biopolymer by marine algae and used up in various industries like microbiological, food, medicine, cosmetics. Acid based pretreatment is explored in this study for open vessel and steam boiler methods in terms of agar production at wet conditions. For the selection of acids the very strong (H_2SO_4), strong (HCl) and weak acid (CH_3COOH) were used and CH_3COOH was selected. Furthermore, the strength of CH_3COOH was optimized at 1%. The steam boiler treatment with 1h soaking in 1% CH_3COOH produced 10g agar which was better than open vessel treatment.

KEYWORDS: Steam boiler methods, agar extraction, *Gracilaria corticata*.

INTRODUCTION

The *Gracilaria* Species are the common and dominant industrial seaweed for the production of agar. During the Second World War the use of *Gracilaria* species was used to produce agar instead of *Gelidium* (Yang *et al.*, 2012). Thereafter, *Gracilari*a has become the preferred seaweed for the production of food grade agar. This is due to the success of its cultivation, the increase in its availability and successive competitive prices (Bixler and Porse, 2011). Gracilarian agar forms biopolymers which forms edible films after the interaction with pulp of certain fruits and vegetables hence the production of bio packing materials is possible through food engineering (Phan *et al.* 2009). Fidaelis *et al.* in 2014 emphasized its importance for the production of sulfated polysaccharides and described different techniques to quantify its extraction. Sousa and Goncalves in 2015, used native and alkali modified Gracilarian gel to change the chemical properties of locust bean gum.

The agar extraction process largely dependent upon the amounts of polysaccharides and gelling factors present in *Gracilaria* which is present in variable combinations and percentages, due to availability of nutrients with prevailing environmental conditions at different geographical locations (Villanueva *et al.* 2010). Yousefi *et al.* in 2013 optimized agar extraction from the native *Gracilaria vermiculophylla.*

MATERIALS AND METHOD

Gracilaria corticata collected from the Buleji north of Karachi coast and then it was cleaned by running water in order to remove the sand sediments and salt particles, dried and stored at 20 °C. An open vessel and steam boiler were used to make agar. 50gm

sample was used in every experiment which was triplicated and the mean values were used to extract results. Sulphuric acid, Hydrochloric acid and Acetic acid were of analytical grade and purchased from the Sigma Aldrich Company.

RESULTS AND DISCUSSION

Open vessel and steam boiler are the traditional techniques in agar production, used to provide elevated temperature for certain period of time to form agar. Pretreatment provides an opportunity to soften the *Gracilaria corticata* plant body during the agar extraction procedures. Steam boiling being a closed system hence preferred in many agar production factories for the quality and quantity of agar production, as fig 1 dipicting the enhanced agar production by the steam boiling process.

Pretreatment with 0.1% acid for two hours enhanced the agar yield. Steam boiler was optimized for time duration and 60 min time was observed maximal, fig 2. Strength wise strong to weak acids were sorted in agar production and acetic acid was selected as it produced agar comparatively in large quantity, fig 3. In order to optimize the percentage of acetic acid, ranged between 0.1 – 1.5% and observe 1.0% as the most suitable beyond the 1.0% there was decline in agar yield due to the degradation of formed gel by the acetic acid, fig 4. The strength of acid is responsible to reduce intermolecular hydrogen bonding (Rochas and Lahaye, 1989). Praiboon *et al.* 2006, published variations in agar polysaccharides extracted from the Thai and Japanese species of *Gracilaria* due the use of variation in agar extraction methodologies.

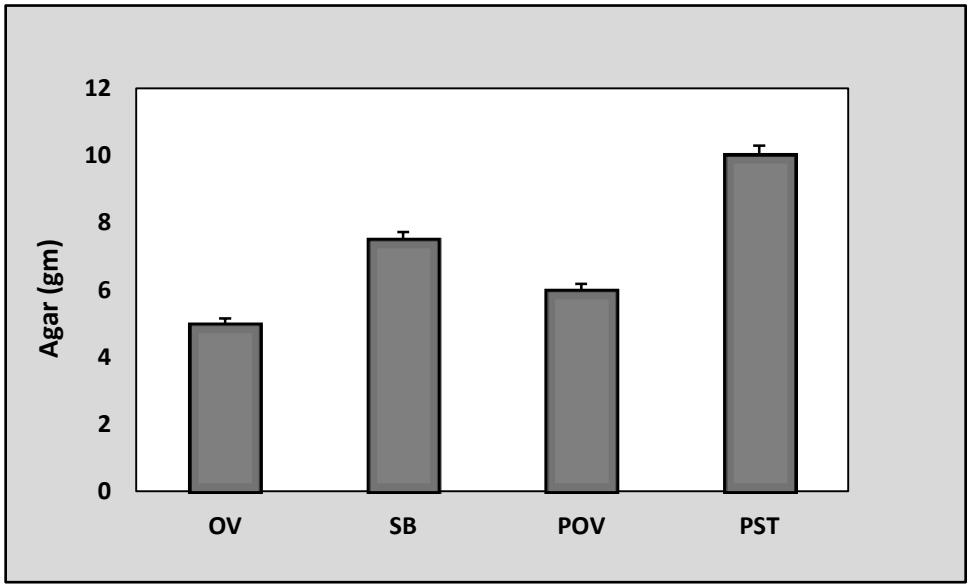

Fig. 1. Steam boiler and open vessel techniques in comparison with pretreated *Gracilaria corticata.* (Means ± S.E. n = 3) Steam boiler = SB, Open vessel = OV, Pretreated steam boiler = PST, Pretreated open vessel = POV.

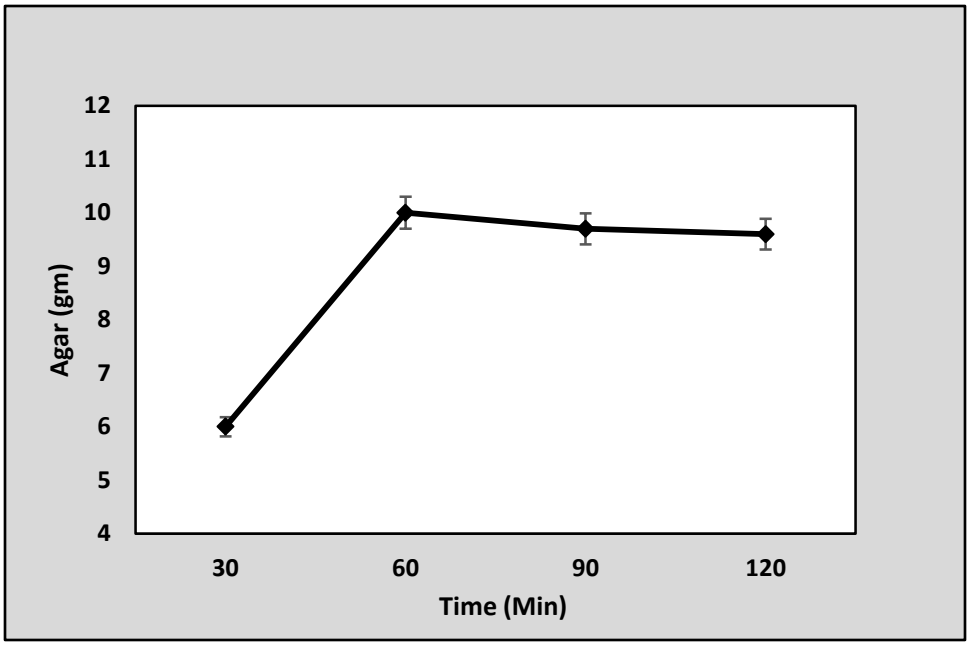

Fig. 2. Optimization of the soaking time for the agar production. (Means ± S.E. n = 3).

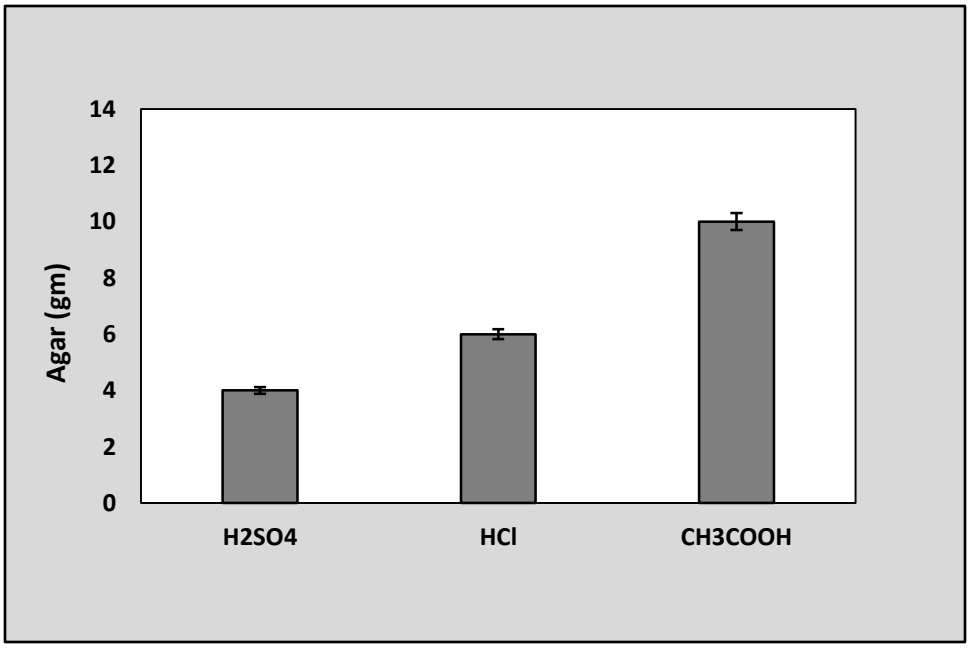

Fig. 3. Acid selection for the agar production. (Means ± S.E. n = 3).

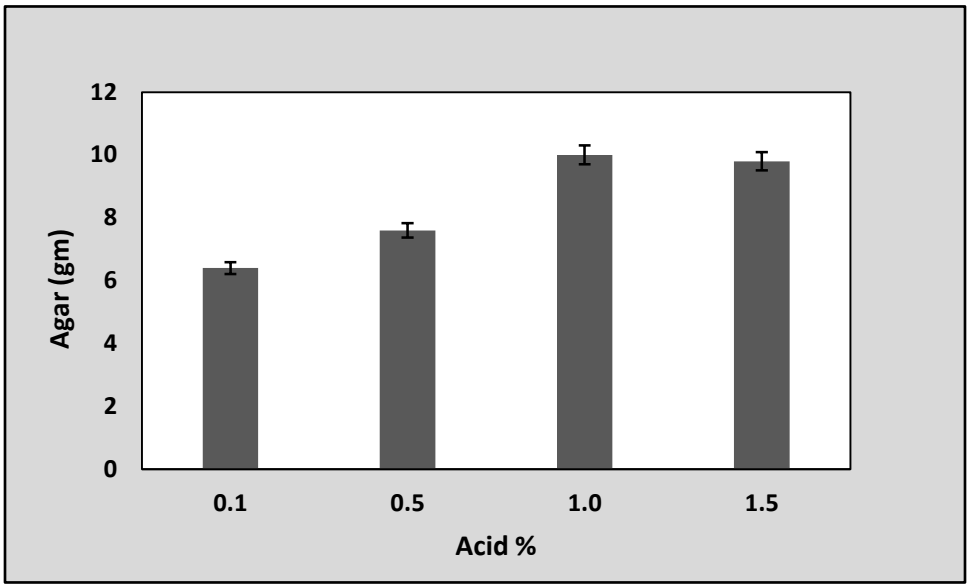

Fig. 4. Optimization of Acetic acid % for the agar production. (Means ± S.E. n = 3).

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