

AGAR FROM *GELIDIELLA ACEROSA* BY ALKALI TREATMENT

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Abstract

A process for the preparation of high gel strength agar from *Gelidiella acerosa* species of sea weed collected from Tamil Nadu coast by alkali treatment, instead of the conventional acid treatment is described. Agar is extracted from seaweeds treated with 0.5 Sodium carbonate solution at 85 to 90°C for 15, 30, 45 and 60 min. Gel strength of 1.5% solution of the agar samples is determined using Universal Testing Machine. Proximate composition, gelling temperature, melting temperature and sulphate content were also determined. Gel strength of agar prepared after treating with 0.5% sodium carbonate solution for 30 min. has higher (700 g/cm²) than that prepared after treating for 15, 45 and 60 min. (400, 500, 350 respectively) as well as that by acid treatment (200-250 g/cm²).

Introduction

The seaweeds are very important organic renewable resources of the sea. In many countries they are used for a variety of purposes such as production of agar, agarose, alginic acid, carrageenan etc. Utilization of seaweeds in India for the extraction of soda ash, aliginic acid and iodine started during the II world War period. Although the importance of seaweeds was realized during this period, the production of agar did not start until 1960's. The export of seaweeds continued unabated until 1975 when, in order to meet the requirements of local agar industry, the Government of India banned the export of seaweeds (Silas et al., 1987). However, it is to be noted that the local industry does not produce sufficient agar to satisfy the ever increasing domestic demand. Consequently, India imports large quantity of agar. Different seaweeds, used as the raw material in agar production, have given rise to products with difference in their behavior although they can all be included in the general definition of agar. Species of genera *Gracilaria*, *Gelidium* and *Gelidiella* are used for agar production in India. The most important species for commercial extraction of agar are *Gelidiella acerosa*, *Gracilaria edulis* and *G. crassa*. The yield of agar and its gel strength vary from species to species and also on the method of extraction (Armisen & Galatas, 1987).

Processing conditions play a significant role in the quality of the end product. Various workers had reported the extraction of agar in India from seaweeds by the treatment with dilute mineral acids (Bose *et al.* 1943; Thivy (1958; Kappanna and Rao 1963). The method of Thivy (1958) was adopted for production of agar as a cottage industry. Chandrakrachang *et al.* (1989) from Thailand has reported a method of agar extraction which is suitable for adoption in rural areas. Food grade agar is produced in India by mineral acid treatment (Coppen, 1989). The quality of agar produced in India, especially the gell strength, is lower (about 250 g/cm²) compared to that produced in other countries and fetch a low price. Hence, studies are conducted to improve the gel strength by modifying the present method of treatment. The results are presented in this paper.

Materials and Methods

The seaweeds *Gelidiella* were collected from the coastal waters of Mandapam, Tamil Nadu. It was dried and packed in gunny bags and transported to the laboratory. The dried seaweed, in batches of 100 g, was soaked in potable water for 24 h and then washed well. After draining, 0.5% sodium carbonate solution was added to keep the seaweeds completely dipped and heated to 85-90°C and kept for various periods viz. 15, 30, 45 and 60 min maintaining the temperature. Samples were made free of alkali by repeated washings. For comparison one set of seaweed was treated with dilute acid. Agar was extracted from these treated samples with water at a steam pressure of 15 psig (121°C) min. The extracted gel was squeezed through linen clothing and was allowed to settle in an enamel plate. Upper layer of the gel formed was scored sufficiently using a cutter to increase the surface area. It was then frozen at temperatures between 0 and -5°C for 24 h and allowed to thaw at room temperature. As soon as the thaw water was drained off, the gel obtained was bleached using dilute hypochlorite solution containing 5 to 10 ppm available chlorine for 5 to 10 min. The agar so obtained washed was again with water, drained through plastic screen and placed on galvanized wire netting and dried either in sun or in hot air at 50-60°C.

The yield of each sample was recorded. Moisture, ash and sulphate contents of all samples were determined by AOAC (1975) methods. Melting temperature and gelling temperature were also determined as per IS: 6850 (1973). Gel strength of 1.5% solutions was also determined using a Universal Testing Machine (Zwick GmbH & Co. Germany) as per the method given by Robert *et al.* (1988).

Results and Discussion

The composition and characteristics of the agar obtained from the seaweeds pretreated with dilute alkali for different periods are given in Table 1. Table 2 shows the composition and characteristics of the agar extracted after acid treatment. The yields of agar which were obtained by the alkali treatment method were 12 to 13.5 percent while it was only 7.5 percent by acid treatment. Yield obtained by the pretreatment with 0.5% aqueous sodium carbonate solutions for 15 min. gave 12% yield while treatment for 30 min. and above gave 13.25 to 13.5% showing that treatment for minutes was sufficient to soften the tissues for complete extraction of agar. The variation in yield was not significant with increase in treatment time beyond 30 min. The alkali treatment increased the yield significantly compared to acid treatment.

According to Chandrakrachang and Chinadt (1988) the most important properties in determining the quality of agar are gel strength, gelling and melting temperature, sulphate and ash content, and the clarity of the solution.

The difference in gel strength obtained by varying pretreatment time was remarkable. 30 min. pretreatment gave an agar of high gel strength than the other three groups. The gel strength of the agar obtained by 15 min. pretreatment was 400 g/cm² whereas the gel strength with 30 min. treatment was 700 g/cm². Hence, treatment for 15 min. with alkali was not sufficient to get maximum gel strength while the other parameters like concentration of alkali, temperature of treatment etc. were kept constant. An increase in time of treatment above 30 min. decreased the gel strength from 700 g/cm² to 500 g/cm² in 45 min. and 350 g/cm² in 60 min. The gel strength of agar from *Gelediella* sp. by acid treatment was only 250 g/cm² much lower than by alkali treatment. Agar prepared in India using acid treatment has approximately 200 g/cm² gel strength (Kalkman, 1989).

The ash content and sulphate content are also important factors in deciding the quality of agar, the lower the sulphate and ash content the better the quality. The sulphate content in alkali treated samples were in the range of 2-2.8% while in acid treated samples it was 5%. The lowest value of sulphate and ash was 2 and 5% respectively by alkali treatment for 30 min. Hence, it is inferred that the pretreatment with alkali for 30 min. does maximum desulphation with maximum yield and gel strength. shengyao *et al.* (1988) studied the effect of alkali treatment on agar from *Garcilaria*. The 3, 6 anhydro 1-galactose content of agar isolated from alkali treated *Gracilaria* was high and a reverse relation was observed about the sulphate and galactose content.

Table - 1. Composition and characteristics of agar by alkali treatment

Duration	Yield %	Moisture %	Ash %	Sulphate %	Gel strength g/cm ²	Gelling temp. O°C	Melting temp. O°C
15 min	12.00	6.50	5.25	2.8	400	40	84.0
30 min	13.25	6.56	5.00	2.0	700	39	84.0
45 min	13.40	6.80	5.20	2.5	500	40	84.5
60 min	13.50	6.80	5.30	2.5	350	40	84.5

Table - 2. Composition and characteristics of agar by acid treatment

Yield %	Moisture %	Ash %	Sulphate %	Gel strength g/cm ²	Gelling temp. O°C	Melting temp. O°C
7.15	6.5	7.3	5	250	42	77

He also reported that the increase in gel strength and the increase in 3, 6 anhydro 1-galactose content depend on the degree of sulphate reduction.

It is likely that acid treatment may break long polymer chain of agar leading to reduction in gel strength. This also may result in the dissolution of lower molecular weight hydrolysed product and hence results in reduced yield.

The studies indicate that alkali treatment of seaweeds is better than acid treatment to get maximum agar yield having good gel strength. Best results are obtained by pretreatment with 0.5% sodium carbonate at 85-90°C for 30 min. and by water extraction at 15 psig pressure.

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