Preliminary Study on the Agar Quality of Laboratory-Generated Carposporelings of *Gracilariopsis bailinae* Zhang *et* Xia Grown in the Field (A short communication)

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ABSTRACT

The agar quality (gel strength, gelling and melting temperature) of laboratory-generated carposporelings of *Gracilariopsis bailinae* grown in the field for six weeks off Amunitan, Gonzaga, Cagayan was investigated. Cut sporelings grown at 1.0 m depth showed good quality agar (492 gm cm^{-2} gel strength, 43°C gelling temperature, 84°C melting temperature). This constitutes the first report on the agar quality of this species from this area.

Keywords: *Gracilariopsis, agar,* agarophyte

INTRODUCTION

Gracilariopsis bailinae Zhang *et* Xia grows abundantly in Panay Island (de Castro et al., 1991). Growth rate studies using vegetative cuttings have been done (Hurtado-Ponce, 1990) and a good quality agar has been extracted (Hurtado-Ponce & Umezaki, 1988; Luhan, 1992; Pondevida & Hurtado-Ponce, 1996). The importance of agar in food preparations and in other industries is well established. The agar quality and yield however, differ according to species, locality, environmental conditions, time of harvest and extraction time or process (Hoyle, 1975; Thomas & Krishnamurthy, 1976; Oza, 1978; Bird et al., 1981; Guerin & Bird 1987; Daugherty & Bird 1988; Bird, 1988; Hurtado-Ponce 1992; Pondevida & Hurtado-Ponce, 1996; Chirapart et al., 1997). It was also found to differ depending upon the reproductive states of the species (Whyte et al., 1981). Doty and Santos (1975) reported that from among the *Gracilaria* species they have studied in the Philippines (*G. arcuata, G. salicornia and G. eucheumoides*), *G. arcuata* seemed to be the best source of agar for bacteriological use. Recent studies by Hurtado-Ponce (1992) observed that *G. bailinae* is also good for bacteriological use.

This study describes for the first time the agar quality of laboratory-generated carposporelings of the species which were outplanted off Amunitan, Gonzaga, Cagayan at 1.0 m depth. This is part of a research aimed at the development of mariculture techniques for the species (Rabanal et al., 1997).

MATERIALS AND METHODS

Agar extraction and analysis

The sporelings of *G. bailinae* with cut apices cultured 1.0 m below the lowest tide level for six weeks in

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February to March 1996 off Amunitan, Gonzaga, Cagayan (122 ° 02' E, 18 ° 19' N) was harvested and analyzed for agar quality. The sporelings were cleaned of foreign materials and washed thoroughly with tap water and air dried and then dried at 60°C. Agar extraction was done using the modified procedure of Hurtado-Ponce and Umezaki (1988). Only 3.125 g dried sample was utilized because of limited raw material and therefore ratio and proportion was employed. The dried material was treated with 5% NaOH solution for 1 h at 90°C and then washed with tap water. The specimens were soaked in 0.5% acetic acid for 1 h and extraction was done by boiling with distilled water for 1 hour. Two replicates were used.

Gel strength was measured using Marine Colloids Gel Tester (Model GT-1). The plunger had a diameter of 1 cm and a descent rate of 2.5 mm sec^{-1}. The gelling and melting temperatures were determined from a 1.5% agar solution (Whyte & Englar 1980).

The agar solution was poured in three test tubes provided with clinical thermometer and allowed to gel. Glass beads (3 mm in diameter) were dropped one after the other and the temperature was noted when the bead failed to drop through the agar. This then was recorded as the gelling temperature. Melting temperature was also determined using the same test tube previously used in gelling temperature. The samples were heated in a water bath slowly and the temperature was noted as the beads dropped to the bottom. Analysis of these properties were done at the Seaweed Laboratory at the Marine Science Institute.

RESULTS AND DISCUSSIONS

Cut sporelings generated from the laboratory and grown at 1.0 m depth showed good quality agar (492 gm cm^{-2} gel strength, 43°C gelling temperature, 84°C melting temperature). Pondevida and Hurtado-Ponce (1996) reported that the highest gel strength shown by *Gracilariopsis bailinae* collected from the field was 784 g cm^{-2}. Although the gel strenght of this species generated from the laboratory is lower, its gel strength is higher than those of *Gracilaria manilaensis* and *Gracilaria changii*. The gelling and melting temperature recorded conform with the values obtained for the same species collected in the field with $39.0 \pm 0.5 - 45.7 \pm 0.5$ gelling temperature and $83.7 \pm 0.5 - 91.0 \pm 0.5$ melting temperature (Pondevida & Hurtado-Ponce, 1996).

The results show that the agar quality seemed unaffected by cutting despite the mechanical damage or stress inflicted to the plants. The cutting induced greater activity and hence, greater regeneration which could have produced greater molecular-sized agar polymer (Bird, 1988) thereby giving high gel strength and lower gelling temperature. In addition, the presence of young tissues could have also contributed to the high gel strength. Pondevida and Hurtado-Ponce (1996) noted that older tissues have higher concentration of stable sulfate groups which cannot be removed by NaOH, hence, affecting the quality of agar.

The temperature and salinity readings were done at weekly intervals from 10:00 AM to 3:00 PM for six weeks. During the harvest period, the temperature and salinity in the field was 26.9°C and 32.5% respectively. These results agree with the findings of Luhan (1992) where higher gel strength was observed when temperature was lowest and salinity was higher. High gel strength was also observed in *Gracilaria gracilis* when water temperature was between 23 to 25°C (Rebello et al., 1996). In contrast, Bird (1988) found higher gel strength at higher temperature (32°C) but similar higher salinity (33%) was demonstrated in *Gracilaria* sp-16.

While the data are very limited, it is apparent that sporelings of *Gracilariopsis bailinae* are also a potential source of agar. Hurtado-Ponce (1992) demonstrated that agar quality could be improved. She also mentioned that hard and brittle gels are best for bacteriological purposes while soft, elastic gels are best for food preparations.

Cutting the apices of the sporelings could be an important factor to consider for farming but its effect on agar production and agar quality needs further research.

REFERENCES

Bird, K.T., 1988. Agar production and quality from *Gracilaria* sp. Strain G-16: effects of environmental factors. *Bot. Mar.* 31: 33-39.

Bird, K.T., M.D. Hanisak & J. Ryther, 1981. Chemical quality and production of agars extracted from *Gracilaria tikvahiae* grown in different nitrogen enrichment conditions. *Bot. Mar.* 24: 441-444.

Chirapart, A. et al., 1997. Effects of partial acid hydrolysis on physical and chemical properties of agar from a newly reported Japanese agarophyte (*Gracilariopsis lemaneiformis*). *J. Appl. Phycol.* 9: 73-76.

Daugherty, B.K. & K.T. Bird, 1988. Salinity and temperature effects on agar production from *Gracilaria verrucosa* Strain G-16. *Aquaculture.* 74: 1-9.

de Castro, T.R., N.G. Guanzon Jr., & M.R.J. Luhan, 1991. Assessment of natural stocks of *Gracilaria* in Panay Island, Philippines. *Bot. Mar.* 34: 383-391.

Doty, M.S. & G.A. Santos, 1975. *Gracilaria* for the manufacture of agar. *Fish Res. J. Philipp.* 3(2): 29-34.

Guerin, J.M. & K.T. Bird, 1987. Effects of aeration period on the productivity and agar quality of *Gracilaria sp. Aquaculture.* 64: 15-110.

Hoyle, M.D., 1975. The literature pertinent to the red algal genus *Gracilaria* in Hawaii. Marine Agronomy Sea Grant Program. *Hawaii Tech. Report.* 3: 34 pp.

Hurtado-Ponce, A.Q., 1990. Vertical rope cultivation of *Gracilaria* (Rhodophyta) using vegetative fragments. *Bot. Mar.* 33: 477-481.

_____, 1992a. Rheological properties of agar from *Gracilariopsis heteroclada* (Zhang *et* Xia) Zhang *et* Xia (Gracilariales, Rhodophyta) treated with powdered commercial lime and aqueous alkaline solution. *Bot. Mar.* 35: 365-369.

_____, 1992b. Influence of extraction time on the rheological properties of agar from some *Gracilaria* species from the Philippines. *Bot. Mar.* 35: 441-445.

Hurtado-Ponce, A.Q. & I. Umezaki, 1988. Physical properties of agar gel from *Gracilaria* (Rhodophyta) of the Philippines. *Bot. Mar.* 31: 171-174.

Luhan, M.R.J., 1992. Agar yield and gel strength of *Gracilaria heteroclada* collected from Iloilo, Central Philippines. *Bot. Mar.* 35: 169-172.

Oza, R.M., 1978. Studies on Indian *Gracilaria*. IV. Seasonal variation in agar and gel strength of *Gracilaria corticata* J. Ag. occurring on the coast of Verval. *Bot. Mar.* 21: 165-67.

Pondevida, H.B. & A.Q. Hurtado-Ponce, 1996. Assessment of some agarophytes from the coastal areas of Iloilo, Philippines. II. Seasonal variations in the agar of *Gracilaria changii, G. manilaensis and Gracilariopsis bailinae* (Gracilariales, Rhodophyta). *Bot. Mar.* 39: 117-122.

Rabanal, S.F., R. Azanza, & A. Hurtado-Ponce, 1997. Laboratory manipulation of *Gracilariopsis bailinae* Zhang et Xia (Gracilariales, Rhodophyta). *Bot. Mar.* 40: 547-556.

Rebello, J. et al., 1996. Growth rates and agar quality of *Gracilariagracilis* (Stackhouse) Steentoft from Namibia, Southern Africa. *Bot. Mar.* 39: 273-279.

Thomas, P.C. & V. Krishnamurthy, 1976. Agar from cultured *Gracilaria edulis* (Gmel.) Silva. *Bot Mar.* 19: 115-117.

Whyte, J.N.C. & J. R. Englar, 1980. Chemical composition and quality of agar in the morphotypes of *Gracilaria* from British Columbia. *Bot. Mar.* 23: 277-283.

Whyte, J.N.C. et al., 1981. Seasonal variation in the biomass, quantity and quality of agar from the reproductive and vegetative stages of *Gracilaria* (verrucosa). *Bot. Mar.* 24: 493-501.