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BIOFILMS FROM AGAR OBTAINED FROM AN AGAROPHYTE OF KARACHI COAST

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ABSTRACT: This study manifests the utilization of red seaweed *Gelidium pusillum* for the production of biofilms. In this study *Gelidium pusillum* was collected from Karachi coast to extract agar for making agar biofilm or bioplastic. Universal Testing Machine was used to calculate tensile property of the films. It was also observed that the addition of plasticizers along with agar enhance the strength and elongation of the agar biofilms.

KEYWORDS: Red seaweed, *Gelidium pusillum*, agar biofilm, Karachi coast.

INTRODUCTION

Seaweed is one of the important resources of the oceans all over the world. Types of seaweeds have been used for long time as food supplements for humans, animal fodder, fertilizers and soil conditioners (McLachlan, 1985). Extensive amount of studies on metabolites derived from algae proved that marine algae are potentially antioxidants, anti-inflammatory, antitumor and anti-allergic agents (Thomas & Kim, 2013). Seaweeds are the source of three hydrocolloidal extracts namely agar, alginates and carageenans (Bixler & Porse 2011; Gade *et al.*, 2013). Agar extracted from red seaweed is potentially very active because of its renewability, biodegradability and gelling power (Wu *et al.* 2009).

Environmental pollution is a major problem which increased by the frequent use of harmful chemicals such as, synthetic materials based on petroleum derivatives that are potentially carcinogenic and toxic (Jalil *et al.*, 2013). Most of the conventional polymers derived from petroleum resources are resilient to degradation (Vroman & Tighzert, 2009). The pollution caused by non-degradable plastics results in the accumulation of plastic reserves in the environment which severely affect the land as well as life forms. Recently interest in natural polymers has been increased for packaging materials (Cerqueira *et al.*, 2009) due to their biodegradable property (Leceta *et al.*, 2014; Vroman & Tighzert 2009). Use of bio polymers like agar in preparation of biodegradable plastics in response to environmental concerns has now been a center of applied research in the present time (Sousa *et al.*, 2010; Machmud *et al.*, 2013; Ismail *et al.*, 2015). It is evidenced that agar extracted from red seaweeds were proved to be cheap and good alternative to commercial grade agar, whereas some scientists have worked on agar based films from different species of red seaweeds collected from their respective regions (Sousa *et al.* 2010). Though studies have been conducted on taxonomy (Hayee-Memon & Shameel, 1996), distribution (Hameed & Ahmed 1999), elemental analysis (Rizvi *et al.* 2001) of red seaweeds from Karachi coast but the present study will fill the lacuna in the area of applied research by utilizing seaweed rom Northern Arabian Sea bordering Pakistan. The objective of this study is to prepare agar based biofilm or bioplastic from *Gelidium pusillum* collected from Karachi coast which will be helpful in reduction of environmental pollution.

MATERIALS AND METHOD

Collection of Seaweed:

Gelidium pusillum was collected from rocky ledges of Karachi coast in September 2015. The collected specimens were then brought to laboratory and washed several times to remove epiphytes and dust particles. The seaweed material then shade dried and stored in air tight bags for further usage.

Agar Extraction:

In this study a simple and short hot-water extraction method (McHugh, 2003) was used to extract agar from *Gelidium pusillum*. Three parts of seaweed material was soaked in one part of hot distilled water for 2 hours to remove excess salts. Seaweeds (10 g) were then heated on medium flame in distilled water (1500 ml) till a thickened gummy structure obtained. The mixture was then filtered to obtain agar gel which was then left to settle down at room temperature. The agar gel was frozen overnight to solidify. Gel was then thawed and oven dried at 50 °C for 24 hours. 1.5 g of dried agar was obtained from 10 g dried seaweed material.

Preparation of Bioplastic:

Extracted agar was used as main ingredient in preparation of bioplastic by casting method (Fig. 1.A). Starch (1 g), glycerol (150 ml) and sorbitol (1.5 g) were the plasticizers which mixed with the homogenous mixtures of agar to give strength to the plastic. Moreover, comparisons were made on the basis of plasticizers added.

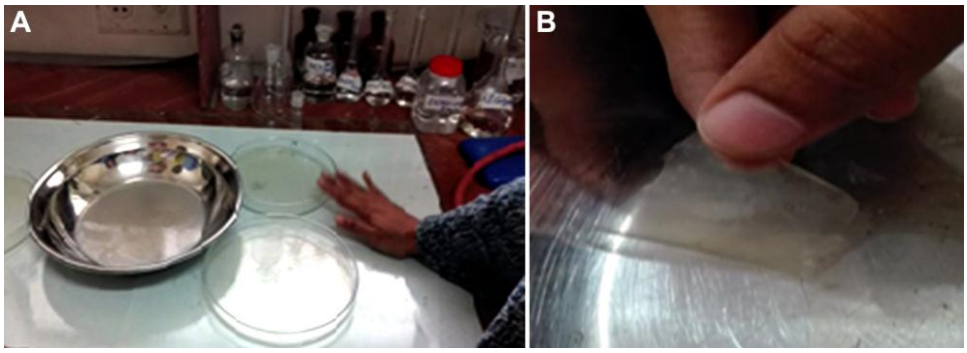

Fig. 1. A, Plates casted by agar biofilms; B, Removal of agar biofilm.

Agar (3 g) was heated with distilled water (300 ml) at 80 °C to gelatinize with continuous stirring at 150 rpm for 30 minutes. Plasticizers were then mixed with the thickened solutions at 80 °C with constant stirring to prevent any clumping. When the mixture became gummy it was then poured into casting plates and dried at room temperature. When the mixture was completely dried, films of plastic were removed gently. (Fig. 1.B).

Tensile Strength and Elongation:

The tensile strength of the films was calculated using Universal Testing Machine (Zwick) Roell, GmbH, Germany. The load cell used was 1 KN. Film sample were cut into 15 cm by 2.5 cm strips. Before testing the films were placed in desiccator at 23± 2 °C and

50 % relative humidity for 48 hours prior to determining the tensile strength. The maximum force required to break the film is reported as Fmax (MPa) whereas the length at which Fmax was recorded is E-Fmax measured in millimeters and is a measure of film elasticity.

RESULTS AND DISCUSSION

Results showed that *Gelidium pusilum* locally found on coast of Karachi is a good source of agar and agar based biofilms which is similar to the earlier reports based on other seaweeds (Sousa *et al.*, 2010; Machmud *et al.*, 2013). Two agar films were obtained during this study and both were clear and smooth. However, results showed that the agar film in which glycerol, sorbitol and starch were added was more flexible and removed easily from the casting plate as compared to the film in which only glycerol was added as plasticizer (Table 1). Presence of glycerol as plasticizer played an important role in composition and appearance of films which was evidenced in similar studies conducted previously by other workers (Sousa *et al.*, 2010; Machmud, *et al.*, 2013).

Table 1. Effect of plasticizer on tensile strength and elongation of agar films.

S. No.	Plasticizer	Fmax (MPa)	E-Fmax (mm)
1	Glycerol	0.670	5.21
2	Glycerol, Sorbitol & Starch	4.45	21.89

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