DEVELOPMENT AND PHYSICOCHEMICAL CHARACTERIZATION OF A PHYCOCOLLOID FILM FROM *G. hikkaduwensis:* A SEAWEED FROM SRI LANKA

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Globally, phycocolloids from seaweeds are widely used in industries due to their film forming ability. Family *Gracilaria* is one of the well renowned seaweed family which is used in phycocolloid extraction and development of film, yet poorly investigated for the said purpose in Sri Lanka. The present study, for the first time, aims at extraction of phycocolloids from *G. hikkaduwensis*, which is an endemic seaweed species in Sri Lanka. Seaweed samples were collected from shallow sea waters near to Koggala, Sri Lanka by hand picking (Department of Wildlife Conservation Permission No; WL/3/2/29/21) and identified based on morphology. Phycocolloids were extracted and a film was prepared using glycerol (80% v/w) as plasticizer by the film casting method. Physico-chemical properties of the biofilm; solubility, thickness, water vapour transmittance rate (WVTR), water vapour permeability (WVP), water content, transparency and light absorbance analysis were recorded. The phycocolloid film formation from *G. hikkaduwensis* resulted in a wet film with a thickness of 0.46 ± 0.04 mm, high in water content (62.31 ± 0.98 %), low in solubility (33.41 ± 0.56%) while having high WVTR (0.02 ± 0.02 g s^{-1} m^{-2}) and low WVP through the film (3.879×10^{-9} g s^{-1} m^{-1} Pa^{-1}). The wet film, after 6 hours of oven-drying at 50 ˚C, contained a thickness of 0.32 ± 0.08 mm, low water content (23.04 ± 0.78%) and high solubility (68.72 ± 1.23%). Light absorbance analysis of phycocolloids film exhibited potential UV barrier properties. The film forming ability of the extracted phycocolloids with adequate barrier properties suggested the possibility of the film to be utilized in various industrial applications. Thus, the present study, for the first time, unveiled a potential and previously unexplored source of phycocolloids; i.e. *G. hikkaduwensis* to develop safe biomaterials for future use.

Keywords: Biofilm, Gracilariaceae, Phycocolloids, Physico-chemical properties

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INTRODUCTION

Family Gracilariaceae possesses an array of natural compounds which can be used in bioprospecting. Globally, phycocolloids from *Gracilaria* are widely used in industries due to their film forming ability. However, these species are not adequately explored for phycocolloid extraction, development and characterization of phycocolloid based film in Sri Lanka.
We have already reported the extraction method and some bioactivities of phycocolloides from *G. hikkaduwensis*. However, formulation of a membrane was not reported elsewhere.

Thus, the present study aimed at the development and physicochemical characterization of a film form of phycocolloids from *G. hikkaduwensis*.

METHODOLOGY

G. hikkaduwensis species were collected from the Koggala beach, (location 1- 80.3318257, 5.9846798; location 2- 80.3292124, 5.9852764; location 3- 80.3271342, 5.9854886) along the south coast of Sri Lanka during May to November during the monsoon and intermonsoon periods by hand picking (Department of Wildlife Conservation Permission No; WL/3/2/29/21). *Gracilaria* species were identified based on morphology and anatomy.

Phycocolloids were extracted in hot water at 95°C for 2h with continuous stirring from *G. hikkaduwensis* (Udeshani *et al*., 2023). Extracted phycocolloids from *G. Hikkaduwensis* was used for preparation of a biofilm with glycerol (80% v/w) as plasticizer by film casting method (Hii *et al*., 2016). Physico-chemical properties of the biofilm in wet and dry conditions; solubility, thickness, water vapour transmittance rate (WVTR), water vapour permeability (WVP), water content, transparency and light absorbance analysis were carried out (Asif *et al*., 2021).

RESULTS AND DISCUSSION

Hot water extraction resulted in the yield of 23.4 ± 0.2% (w/w) dry weight of phycocolloids from *G. hikkaduwensis.*

Resulted polysaccharides wet film (Figure: 1 a) was cloudy having a slight transparency. The surface of the film was dry and uneven. Although the films were with air bubbles, in general, they were still rigid, soft and flexible. After drying, the films turned light brown (Figure: 1 b).

The phycocolloid film formation from *G. hikkaduwensis* resulted in a wet film with a thickness of 0.46 ± 0.04 mm, high in water content (62.31 ± 0.98 %), low in solubility (33.41 ± 0.56%) while having high WVTR (0.02 ± 0.02 g s^{-1} m^{-2}) and low WVP through the film (3.879×10^{-9} g s^{-1} m^{-1} Pa^{-1}).

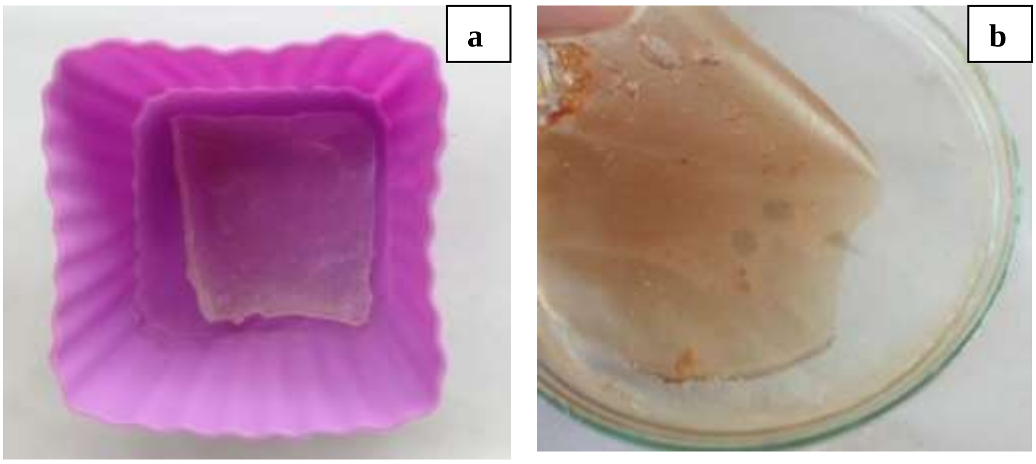

Figure 1: (a) Prepared cloudy, wet polysaccharide/glycerol film in silicon moulds (b) Prepared polysaccharide/glycerol film in silicon moulds after air drying

Followed by the drying process, a dry membrane was resulted in a thickness of 0.32 ± 0.08 which was lower than the wet film due to removing of water from the wet film, low water content (23.04 ± 0.78%) and high solubility (68.72 ± 1.23%). Light absorbance analysis of phycocolloids film exhibited potential UV barrier properties (Figure 2).

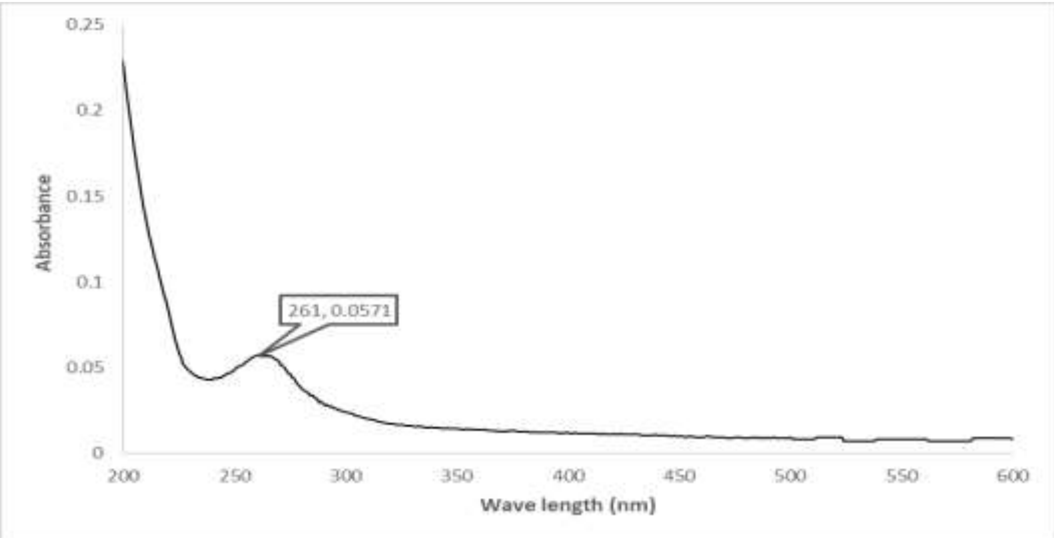

Figure 2: The ultraviolet absorption spectrum of the polysaccharides film (Model Thermo Scientific GENESYS 10S Series UV-Vis spectrophotometer)

Light absorbance values of the polysaccharide film at 200–600 nm wavelengths showed that in between 250 -270 nm, the absorbance of film was a bit high, which indicated the partial absorbance of ultraviolet by this film. According to Martins *et al*. (2012), oxidative deterioration of packaged foods might be resulted with exposure to visible and ultraviolet light, leading to nutrient losses, discoloration and off-flavours. The results of the present study showed that the prepared film had better UV barrier properties by absorbing the UV light. For instance, it allowed these polysaccharide film to be employed as preventive materials against nutrition loss and lipid oxidation-induced discoloration of packaged food.

In this study, both wet and dry film showed solubility rates which were lower than solubility values recorded from Polysaccharide based film prepared using *G. corticata* and glycerol as plasticizer (74% -81.5%) by Asif *et al*., 2021. This indicated that prepared the film in this study was more resistant towards moisture degradation. The prepared polysaccharide film in the present study had a lower water vapour permeability compared to the plastic film (2.93×10^{-3} kg $s^{-1}m^{-1}$ Pa^{-1}). Therefore, the lower WVP values of the films indicated that reduced moisture exchange through the prepared film in this study and film has high water vapour barrier properties.

The water vapour transmission rate (WVTR) is also a very crucial property for wound dressings and seaweed derived polysaccharide-based films are characterized for their applications in wound dressings (Sulastri *et al*., 2021). The WVTR values of several commercial wound dressings which are used in the market range from 90±3 to 9360±34 g m^{-2} day^{-1}. The WVTR values of the polysaccharide film in the present study was also included in the range (1728 g m^{-2} day^{-1}) indicating a possible potential use of the prepared film as wound dressings.

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the film forming ability of the extracted phycocolloids resulted in a film with adequate barrier properties suggesting the possibility of the film to be utilized in various industrial applications.

The present study, for the first time, unveiled a potential and previously unexplored source of phycocolloids; i.e. *G. hikkaduwensis* to develop safe biomaterials for future use. Further studies are highly recommended prior to using the phycocolloids film in any industrial application.

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