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Citation: *AIP Conference Proceedings* **2026**, 020030 (2018); doi: 10.1063/1.5064990

View online: <https://doi.org/10.1063/1.5064990>

View Table of Contents: <http://aip.scitation.org/toc/apc/2026/1>

Published by the *American Institute of Physics*

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# Exploratory Study on Thermal Microwave-Assisted Decomposition of *Eucheuma Cottonii* Carrageenan to 5-Hydroxymethylfurfural and Levulinic Acid in Aqueous Medium

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**Abstract.** Carrageenan which is a renewable and abundant shows a potential as an energy feedstock. Carrageenan which can be extracted from *Eucheuma cottonii* can decompose to hydroxymethylfurfural (HMF) and levulinic acid (LA). This work is to study decomposition process of carrageenan to HMF and LA. Carrageenans were used and poured into microwave tube filled with sulfuric acid solution. The reactions were performed at a temperature (160–190°C), a loading concentration (0.025-0.15 g/mL) and batch times which is up to 120 min. The highest experimental HMF yield was 18.4 mol%, and LA was 29.7 mol%. The possible autocatalytic role of acetic acid (AA), formic acid (FA) and levulinic acid which were produced during the reaction, was investigated by conducting reactions in the presence of these acids. As a result, FA particularly shows a role as a catalyst.

## INTRODUCTION

*Eucheuma cottonii*, one of red algae species is a good source of carrageenan. Thus, carrageenan is a renewable, and abundant feedstock[1]. Carrageenan commonly can be extracted from *Eucheuma cottonii* and purified using alkali method [2–5].

Carrageenan is carbon feedstock containing polysaccharides (4-76 wt%) which can be converted to biobased chemical products such as HMF and Levulinic Acid [1,6–8]. HMF and Levulinic acid are the platform chemical which has a wide range of industrial application i.e. resin, fungicide, polymers, and fuel [9]. Some process including thermal, acid-catalyzed, and the microwave-assisted reaction has been performed to produce HMF and LA from polysaccharides [6–8,9]. Besides LA, some organic acids such as acetic acid (AA) and formic acid are formed during the reaction. This work is to study (1) the thermal decomposition of carrageenan to HMF and LA, and (2) the autocatalytic effect during the reaction.

## EXPERIMENTAL METHODS

*Eucheuma cottonii* used as Carrageenan source was bought from farmers in Situbondo, East Java, Indonesia. Carrageenan was obtained from Sigma-Aldrich (Steinheim, Germany). LA ( $\geq 97\%$ ) and Acetic Acid ( $\geq 97\%$ ) were obtained from Acros Organic (Geel, Belgium). Formic acid ( $\geq 95\%$ ) was purchased from Merck KGaA (Darmstadt, Germany). HMF ( $\geq 99\%$ ) was obtained from Sigma Aldrich (Steinheim, Germany).

Carrageenan was prepared from *Eucheuma cottonii* and characterized following a previous study by Manuhara[5]. Carrageenan was fed into one set microwave tube e filled with demineralized water. The mixtures were mixed and heated to reaction temperature. Since the reaction time was completed, the product was filtered and centrifuged to separate liquid product. The process variables were loading concentration, temperature and reaction time. The liquid product was analyzed qualitatively and quantitatively using HPLC of Agilent Technology 1200