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Short communication

Graded agaroses directly from seaweed biomass: A sustainable tool for developing clean chemical process

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ABSTRACT

Here we describe few novel grading agents (GrA) for the production of graded agaroses directly from seaweed aqueous extract under ambient conditions. Graded agaroses exhibits gelling properties in a wider range (gel strength ≥100–≥1600 gcm^{-2}, gelling temperature ≤27–≥35 °C, and melting temperature ≤72–≥90 °C) which are essential for a variety of molecular biology applications. The uniqueness of this process is the ability to tailor the essential properties of agarose for desired applications, can be achieved from single seaweed aqueous extract by altering initiator nature and/or concentration (w/w) of an initiator in GrA.

1. Introduction

At present different type/grades of agarose products are available commercially which may be made up from different sources, but sources and processes are not known in public domain [SIGMA Catalog]. These agarose products are primarily used in numerous biological and other applications including separation of nucleic acids, mainly depends on their gelling properties such as gelling temperature, melting temperature and gel strength. M/s Lonza [Lonza Catalog] has reported the preparation of agarose gels using different agarose products having a variety of gel strengths (GS), gelling temperatures (GT) and melting temperatures (MT) for targeted applications, but does not disclose the method of the preparation of these agarose products as well as sources. Agarose Selection Guide of Sigma-Aldrich has reported different type/grades of agaroses for targeted applications based on their gelling properties such as (i) agarose with gel strength 1200 gcm^{-2} and gelling temperature 36 ± 1.5 °C suitable for routine nucleic acid analysis by electrophoresis; (ii) agarose with GT ≤ 30 °C, GS ≥ 400 gcm^{-2} and melting temperature ≤70 °C suitable for preparation of chromosomal DNA samples for pulsed-field electrophoresis, and (iii) agarose have GT 26–30 °C, GS ≥ 200 gcm^{-2}, MT ≤ 65 °C for DNA recovery from low melting gels, etc., but does not described the method of the preparation as well as their sources. The modified agaroses (alkylated, alkenylated, acylated or hydroxy alkylated agarose) in which the alkyl, alkenyl, and acyl groups contain from 1 to 3 carbon atoms and the hydroxyalkyl groups containing from 1 to 4 carbon atoms have been reported by Kenneth B. Guiseley [1]. These modified agaroses have low melting point, and higher clarity compared to unmodified agaroses, and are useful as thickeners, for electrophoresis and diffusive interactions.

In the previous works we successfully demonstrated the ability of few synthetic surfactants and bio-based ionic liquids for the selective precipitation of high gel strength (≥2000 gcm^{-2}) and high melting point (≥90 °C) agarose from seaweed aqueous extracts [2–4], but no graded agarose is reported from seaweed aqueous extracts in the literature. These findings encourage us to utilize such systems to prepared graded agaroses in combination with some suitable fragmenter (grading agent), a “greener” route for the preparation of graded agaroses was explored in the present work, where novel grading agents were employed for the job. The Triton X-100 and/or bio-IL were successfully recovered from the spent solutions during the downstream processing and may be reused for the subsequent batches. In our knowledge, we report this study for the first time, which value adds to the existing biomass. In future, a detail study is required to understand mechanism and phenomenon involved in this process as well as detail study for biological applications.

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