Electrophoretic High Molecular Weight DNA Purification for Optical Mapping

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SCODA: Electrophoretic DNA purification

Synchronous Coefficient of Drag Alteration (SCODA) is a novel electrophoretic purification technology to simultaneously purify and concentrate nucleic acids.

SCODA operates on physical, rather than chemical, molecular properties, using the non-linear response of nucleic acids during electrophoresis to separate them from contaminants. The technology excels in purification of low abundance nucleic acids from heavily inhibited samples and has been demonstrated to provide superior nucleic acid purity and molecular weight compared to conventional technologyp1,2.

High molecular weight DNA - Boreal’s SCODA electrophoretic nucleic acid purification minimizes manual sample handling and mechanical shearing forces, enabling recovery of very high molecular weight (HMW) DNA - from 100 kb to over 1 MB. The purified DNA is recovered in buffer which allows for simple transfer of the highly concentrated product for subsequent downstream analysis.

Ultra-high molecular weight DNA extraction

Boreal’s Aurora system allows researchers to perform highly automated extraction of DNA molecules up to 1 MB in length from cell cultures, or DNA embedded in agarose and PFGE plugs.

• Extract high yields of DNA from 100 kb to over 1 MB
• Recover highly concentrated and purified DNA from agarose and PFGE plugs
• Eliminate inefficient and time consuming dialysis, electroelution, or agarose digestion protocols
• Recover high purity DNA ready for library construction, optical mapping, and other genetic analysis

Boreal’s technology has been proven to extract highly purified DNA up to 1 MB in length from environmental samples including soil, sediments, and tundra; ideal for the construction of large-insert genomics and strain typing. However, optical mapping relies on methods of preparing high quality DNA >250 kb in length, which can be challenging for some organisms and sample types.

HMW DNA extraction with the Aurora

Here we explore the potential of the Boreal Genomics’ Aurora instrument to provide pure, high molecular weight DNA 250-1100 kb in length, suitable for optical mapping. The Aurora performs electrophoretic DNA purification within an agarose gel in reusable cartridges, protecting long DNA molecules from shearing forces associated with liquid handling steps common to other purification methods. DNA can be purified directly from intact cells embedded and lysed within an agarose gel, preserving the highest molecular weight DNA possible, while achieving exceptional levels of purity.

Aurora delivers DNA in a buffer solution, where DNA can be condensed and protected from shearing during recovery with a pipette. DNA is then returned to its regular cell state simply by dilution prior to optical mapping.

Optical mapping of high molecular weight DNA

Requirement for high quality, intact DNA

Optical mapping generates an ordered restriction map from single, long DNA molecules. By overlapping restriction maps from multiple molecules, a physical map of entire chromosomes is constructed, greatly facilitating genome assembly in next generation sequencing projects, comparative genomics and strain typing. However, optical mapping relies on methods of preparing high quality DNA >250 kb in length, which can be challenging for some organisms and sample types.

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Preliminary results from challenging samples

Here we present images showing HMW DNA purification taking place in the Aurora and resulting single DNA molecules imaged on OpGen’s Argus® Optical Mapping System. Future work will focus on further optimizing Aurora HMW DNA purification to bias DNA recovery in favor of only the longest molecules in a sample, maximizing the benefits of optical mapping.

References


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