

# LABORATORY EXERCISE #3. Detection of genetically modified food products by gel electrophoresis

## Introduction

PCR products of differing lengths can be separated from each other based on size by an analytical method called gel electrophoresis. In this method charged macromolecules (such as DNA, RNA or proteins) migrate through a porous gel typically made from agarose (polysaccharide polymer derived from sea weed) or polyacrylamide when an electrical current is applied. The DNA sample is loaded into a well within the gel and placed near the anode (negative charge). As DNA has a very high negative charge due to the presence of the ionized phosphate groups on its backbone, it will migrate away from the negative anode toward the positively charged cathode as electrophoresis takes place. During the migration, smaller DNA fragments will pass through the gel pores more easily and thus migrate through the gel faster. Larger DNA molecules take longer to get through the pores and will migrate slower. The separated DNA "bands" or fragments can be visualized within the gel by staining with ethidium bromide. This dye intercalates (inserts) itself into the DNA and will fluoresces under ultraviolet light. In other words, DNA fragments will appear as fluorescent bands in the gel when exposed to UV light (Fig 1).

*Concept check: If you compared two DNA fragments, one of 200 base pairs (bp) and the other of 1000 bp, which fragment will appear lower on the gel/have migrated faster?*

*Q: During gel electrophoresis, DNA is separated based on what two properties?*

*A: Size and charge*

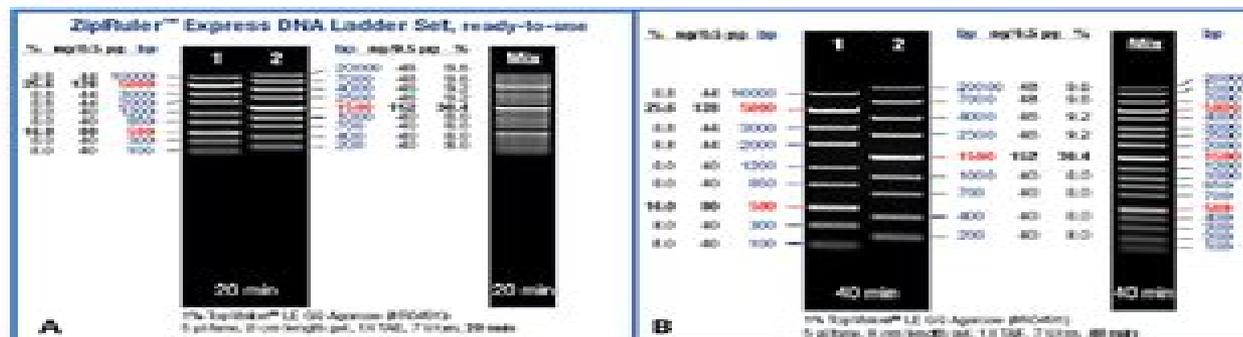


Figure 1. DNA fragments of known size are separated on an agarose gel for 20 min (A) or 40 min (B). By comparing the results, you can see how at 20 min, the DNA fragments are not well separated but by 40 min, the individually sized fragments are well separated and the size is easily determined. Figure adapted from Biogen.

# Gel Electrophoresis Lab Manual

**P. M. Swamy**



## **Gel Electrophoresis Lab Manual:**

**Nucleic Acid Electrophoresis** Dietmar Tietz, 2012-12-06 Electrophoresis is a powerful method to analyze nucleic acids DNA RNA Various sophisticated techniques such as capillary electrophoresis pulsed field electrophoresis fingerprinting using RFLP and RAPD DNA sequencing and mobility shift assay are described in detail The required apparatus appropriate use preparation of probes gel staining interpretation of results tricks for troubleshooting manufacturers addresses helpful Internet resources as well as specific applications e g in legal medicine microbiology and agriculture are presented by leading experts

**Recombinant DNA Laboratory Manual** Judith W. Zyskind, Sanford I. Bernstein, 2014-05-12 Recombinant DNA Laboratory Manual is a laboratory manual on the fundamentals of recombinant DNA techniques such as gel electrophoresis in vivo mutagenesis restriction mapping and DNA sequencing Procedures that are useful for studying either prokaryotes or eukaryotes are discussed and experiments are included to teach the fundamentals of recombinant DNA technology Hands on computer sessions are also included to teach students how to enter and manipulate sequence information Comprised of nine chapters this book begins with an introduction to bacterial growth parameters how to measure bacterial cell growth and how to plot cell growth data The discussion then turns to the isolation and analysis of chromosomal DNA in bacteria and Drosophila plasmid DNA isolation and agarose gel analysis and introduction of DNA into cells Subsequent chapters deal with Tn5 mutagenesis of pBR329 DNA cloning in M13 DNA sequencing and DNA gel blotting probe preparation hybridization and hybrid detection The book concludes with an analysis of lambda phage manipulations This manual is intended for advanced undergraduate or beginning graduate students and should also be helpful to established investigators who are changing their research focus

**Pulsed Field Gel Electrophoresis** Bruce Birren, Eric Lai, 2012-12-02 Pulsed Field Gel Electrophoresis A Practical Guide is the first laboratory manual to describe the theory and practice of this technique Based on the authors experience developing pulsed field gel instruments and teaching procedures this book provides everything a researcher or student needs to know in order to understand and carry out pulsed field gel experiments Clear well tested protocols assume only that users have a basic familiarity with molecular biology Thorough coverage of useful data theory and applications ensures that this book is also a lasting resource for more advanced practitioners of pulsed field gels Reviews all types of pulsed field gel electrophoresis Describes all commercially available systems and summarizes advantages and limitations of each Includes step by step protocols for sample preparation and analysis Illustrated with photographs that depict How to run gels What the results should look like What they look like when they go wrong Covers applications to a wide range of organisms Includes bibliography of over 900 publications and cross referenced by topic application and organism

**The Fusarium Laboratory Manual** John F. Leslie, Brett A. Summerell, 2008-02-28 For the first time in over 20 years a comprehensive collection of photographs and descriptions of species in the fungal genus Fusarium is available This laboratory manual provides an overview of the biology of Fusarium and

the techniques involved in the isolation identification and characterization of individual species and the populations in which they occur It is the first time that genetic morphological and molecular approaches have been incorporated into a volume devoted to Fusarium identification The authors include descriptions of species both new and old and provide protocols for genetic morphological and molecular identification techniques The Fusarium Laboratory Manual also includes some of the evolutionary biology and population genetics thinking that has begun to inform the understanding of agriculturally important fungal pathogens In addition to practical how to protocols it also provides guidance in formulating questions and obtaining answers about this very important group of fungi The need for as many different techniques as possible to be used in the identification and characterization process has never been greater These approaches have applications to fungi other than those in the genus Fusarium This volume presents an introduction to the genus Fusarium the toxins these fungi produce and the diseases they can cause The Fusarium Laboratory Manual is a milestone in the study of the genus Fusarium and will help bridge the gap between morphological and phylogenetic taxonomy It will be used by everybody dealing with Fusarium in the Third Millennium W F O Marasas Medical Research Council South Africa *Laboratory Manual on Biotechnology* P. M. Swamy,2008 **Laboratory Manual For Genetic Engineering** VENNISON, S. JOHN,2009-01-01 This systematically designed laboratory manual elucidates a number of techniques which help the students carry out various experiments in the field of genetic engineering The book explains the methods for the isolation of DNA and RNA as well as electrophoresis techniques for DNA RNA and proteins It discusses DNA manipulation by restriction digestion and construction of recombinant DNA by ligation Besides the book focuses on various methodologies for DNA transformation and molecular hybridization While discussing all these techniques the book puts emphasis on important techniques such as DNA isolation from Gram positive bacteria including Bacillus sp the slot lysis electrophoresis technique which is useful in DNA profile analysis of both Gram negative and positive bacteria plasmid transduction in Bacillus sp and the conjugal transfer of plasmid DNA in cyanobacteria Bacillus and Agrobacterium tumefaciens This book is intended for the undergraduate and postgraduate students of biotechnology for their laboratory courses in genetic engineering Besides it will be useful for the students specializing in genetic engineering molecular biology and molecular microbiology **KEY FEATURES** Includes about 60 different experiments Contains several figures to reinforce the understanding of the techniques discussed Gives useful information about preparation of stock solutions DNA protein conversions restriction enzymes and their recognition sequences and so on in Appendices **Experimental Developmental Biology** Laura R. Keller,John Hyde Evans,Thomas C. S. Keller,1999 This work is designed for use as a lab manual in college level courses in developmental biology or animal development In each exercise students examine gametes and developing embryos of a single species and also perform several experiments to probe its developmental process *Basic Laboratory Methods for Biotechnology* Lisa A. Seidman,Cynthia J. Moore,Jeanette Mowery,2021-12-28 Basic Laboratory Methods for Biotechnology Third Edition is a

versatile textbook that provides students with a solid foundation to pursue employment in the biotech industry and can later serve as a practical reference to ensure success at each stage in their career The authors focus on basic principles and methods while skillfully including recent innovations and industry trends throughout Fundamental laboratory skills are emphasized and boxed content provides step by step laboratory method instructions for ease of reference at any point in the students progress Worked through examples and practice problems and solutions assist student comprehension Coverage includes safety practices and instructions on using common laboratory instruments Key Features Provides a valuable reference for laboratory professionals at all stages of their careers Focuses on basic principles and methods to provide students with the knowledge needed to begin a career in the Biotechnology industry Describes fundamental laboratory skills Includes laboratory scenario based questions that require students to write or discuss their answers to ensure they have mastered the chapter content Updates reflect recent innovations and regulatory requirements to ensure students stay up to date Tables a detailed glossary practice problems and solutions case studies and anecdotes provide students with the tools needed to master the content

**Methods in Nucleic Acids Research** Gregory W. Warr, James D. Karam, Lee Chao, 1990-11-26 *Methods in Nucleic Acids Research* provides extensively referenced overviews of chapter topics in addition to step by step laboratory protocols Topics include discussions regarding the preparation and assay of antibodies against oligopeptides RNA footprinting gel retardation assays for nucleic acid binding proteins in vitro transcription and translation assays for studies of eukaryotic gene expression human genome mapping forensic analysis of DNA polymorphism in situ hybridization for the detection of specific RNA and other methods Biochemists molecular biologists immunologists cell biologists and geneticists will find this book invaluable for their research

**Biology**, 1999 *Electrophoresis of Enzymes* Gunter M. Rothe, 2012-12-06 The electrophoresis of enzymes and isoenzymes is a well established technique in biochemical clinical environmental microbiological botanical and forensic laboratories and classical electrophoresis is presently undergoing a remarkable revival This book compiles facts and methods on enzyme electrophoresis widely dispersed in hundreds of publications The author summarizes them in clearly readable tables in many carefully worked out electrophoresis and more than 140 staining protocols The exhaustive practical experience of the author and the wealth of material summarized and reviewed makes this book a must for every enzyme laboratory It will supply the practitioner with profound information on state of the art enzyme electrophoresis

*A Manual of Laboratory Experiences in Cell Biology* C. Edward Gasque, Clayton Edward Gasque, 1989 **Biochemicals and Reagents**, **Gel Electrophoresis of Proteins** B. D. Hames, 1998 A laboratory manual presenting methods in a step by step format and hints and tips from experienced researchers Among the varieties of gel electrophoresis described are one dimensional polyacrylamide isoelectric two dimensional and preparative Eight of the ten chapters of the earlier editions in 1981 and 1990 have been rewritten by new authors They discuss methods that have been developed and tested since then including capillary gel electrophoresis the

sequence analysis of gel resolved proteins fluorophore labelled saccharide electrophoresis and analyzing interactions between proteins Annotation copyrighted by Book News Inc Portland OR *General Biology Lab Manual* Russell Skavaril, Mary Finnen, Steven Lawton, 1993 This laboratory manual suitable for biology majors or non majors provides a selection of lucid comprehensive experiments that include excellent detail illustration and pedagogy **Manual of Clinical Laboratory Immunology** Noel R. Rose, 1997 Reflects changes being thrust upon the laboratory community **Clinical Lab Guide** American Chemical Society, 2000 Nucleic Acid Electrophoresis Dietmar Tietz, 1998-10-22 Electrophoresis is a powerful method to analyze nucleic acids DNA RNA **Prentice Hall Biology, 2002** Irvine Welsh, Prentice-Hall Staff, 2001-04 One program that ensures success for all students **Genetic Engineering** Tariq Ahmad Bhat, Jameel M. Al-Khayri, 2023-09-15 This new 2 volume set explores new research and perspectives in genetic engineering which enables the precise control of the genetic composition and gene expression of organism This powerful technology can be used for environmental sustainability food and nutritional security medicinal advancement and more Genetic Engineering aims to provide a deep understanding of the many aspects of this emerging technology and its diverse applications Genetic Engineering Volume 1 Principles Mechanism and Expression covers genetic engineering concepts molecular tools and technologies utilized in the manipulation amplification and introgression of DNA The volume explains the concepts of genetic engineering enzymes of genetic engineering and tools used in genetic engineering It provides an introduction of recombinant DNA into host cells and discusses the linking of desired gene with DNA vector gene cloning vector polymerase chain reactions the concept and nature of genes blotting techniques chromosome jumping electrophoresis genetically engineered microorganisms and molecular markers and their applications Genetic Engineering Volume 2 Applications Bioethics and Biosafety expresses the various appreciation and challenges of genetic engineering and issues related to bioethics and biosafety Chapters cover the legal issues of genetic engineering including intellectual property rights IPR and protection IPP and the patenting of living organisms copyrights trade secrets and trademarks The volume considers the safety and benefits of genetic engineering in human welfare such as in genetically engineered Bt and Bt cotton along with the biohazards of recombinant DNA technology Chapters explain genetically modified organisms and microorganisms genetic engineering of horticultural crops genetic engineering in the agricultural sciences and more This 2 volume book will be a valuable asset to upper level students in cell biology as well as to faculty and researchers involved in genetics molecular genetics biochemistry biotechnology botany zoology and agriculture sciences

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