

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

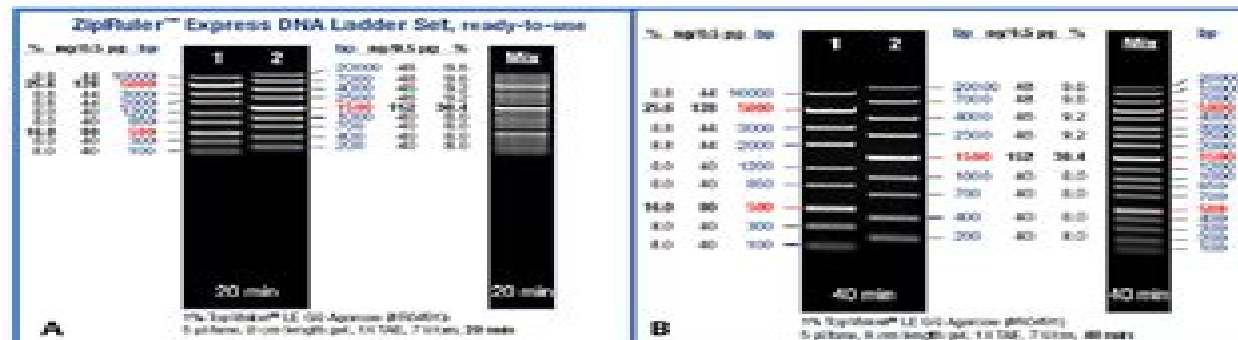


Figure 1. DNA fragments of known size are separated on an agarose gel for 20 min (A) or 40 min (B). By comparing the results, you can see how at 20 min, the DNA fragments are not well separated but by 40 min, the individually sized fragments are well separated and the size is easily determined. Figure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

Gmo Lab Instructor Manual

Jiyuan Zhang



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Instructor's Manual for Food Analysis S. Suzanne Nielsen, 2012-12-06 The first and second editions of Food Analysis were widely adopted for teaching the subject of Food Analysis and were found useful in the food industry The third edition has been revised and updated for the same intended use and is being published with an accompanying laboratory manual Food Analysis Third Edition has a general information section that includes governmental regulations related to food analysis sampling and data handling as background chapters The major sections of the book contain chapters on compositional analysis and on chemical properties and characteristics of foods A new chapter is included on agricultural biotechnology GMO methods of analysis Large sections on spectroscopy chromatography and physical properties are included All topics covered contain information on the basic principles procedures advantages limitation and applications This book is ideal for undergraduate courses in food analysis and also is an invaluable reference to professions in the food industry *Food Toxicants Analysis* Yolanda Picó, 2007-02-07 Food Toxicants Analysis covers different aspects from the field of analytical food toxicology including emerging analytical techniques and applications to detect food allergens genetically modified organisms and novel ingredients including those of functional foods Focus will be on natural toxins in food plants and animals cancer modulating substances microbial toxins in foods algal fungal and bacterial and all groups of contaminants i e pesticides persistent organic pollutants metals packaging materials hormones and animal drug residues The first section describes the current status of the regulatory framework including the key principles of the EU food law food safety and the main mechanisms of enforcement The second section addresses validation and quality assurance in food toxicants analysis and comprises a general discussion on the use of risk analysis in establishing priorities the selection and quality control of available analytical techniques The third section addresses new issues in food toxicant analysis including food allergens and genetically modified organisms GMOs The fourth section covers the analysis of organic food toxicants step by step guide to the use of food analysis techniques eighteen chapters covering emerging fields in food toxicants analysis assesses the latest techniques in the field of inorganic analysis **America's Food** Harvey Blatt, 2011-02-25 The complete story of what we don't know and what we should know about American food production and its effect on health and the environment We don't think much about how food gets to our tables or what had to happen to fill our supermarket's produce section with perfectly round red tomatoes and its meat counter with slabs of beautifully marbled steak We don't realize that the meat in one fast food hamburger may come from a thousand different cattle raised in five different countries In fact most of us have a fairly abstract understanding of what happens on a farm In America's Food Harvey Blatt gives us the specifics He tells us for example that a third of the fruits and vegetables grown are discarded for purely aesthetic reasons that the artificial fertilizers used to enrich our depleted soil contain poisonous heavy metals that chickens who stand all day on wire in cages choose feed with pain killing drugs over feed without them and that the average American eats his or her body weight in food additives

each year Blatt also asks us to think about the consequences of eating food so far removed from agriculture why unhealthy food is cheap why there is an International Federation of Competitive Eating what we don't want to know about how animals raised for meat live die and are butchered whether people are even designed to be carnivorous and why there is hunger when food production has increased so dramatically America's Food describes the production of all types of food in the United States and the environmental and health problems associated with each After taking us on a tour of the American food system not only the basic food groups but soil grain farming organic food genetically modified food food processing and diet Blatt reminds us that we aren't powerless Once we know the facts about food in America we can change things by the choices we make as consumers as voters and as ethical human beings *Your Body Can Talk, Revised 2nd Edition* Susan Levy, D.C., 2014-09-29 This book about the art and application of Clinical Kinesiology introduces the energetic system that links mind and body It shows how the body can talk and therefore be used as a diagnostic tool and to determine which healing approach will best suit an individual Clinical Kinesiology allows us to interpret this new body talk This method of muscle testing reads the body's innate wisdom when asked a question or presented with a stimulus the muscles respond clearly either strongly or weakly This system which expedites the application of acupuncture also helps realign the body's energy imbalances Readers will find specific methods of fighting disease that emphasize the dangers of unnecessary drugs antibiotics and immunization and the need for a fortified immune system especially through natural foods Other topics include rebuilding the body's ecology after an overgrowth of unhealthy bacteria or Candidiasis how to maintain the integrity of the energy system through minimizing exposure to unhealthy electromagnetic fields or EMFs optimal health for woman and issues of men's health New material in this 2nd edition includes an extensive chapter on children's health which addresses pregnancy birthing procedures and breastfeeding and illustrates a road map for giving your children and children yet to come the best potential for optimal health *Genetically Engineered Organisms* Deborah K. Letourneau, Beth Elpern Burrows, 2001-09-26 Genetic engineering suggests new avenues for constructing useful products but it also poses hazards to the health of the environment and the public Delineating those hazards is complicated difficult and important at every level of risk assessment and risk management decision making Risk assessment and risk management may be further complicated *Growing for Market*, 2003 *Food Analysis* Suzanne Nielsen, 2003-04-30 This book provides information on the techniques needed to analyze foods in laboratory experiments All topics covered include information on the basic principles procedures advantages limitations and applications This book is ideal for undergraduate courses in food analysis and is also an invaluable reference to professionals in the food industry General information is provided on regulations standards labeling sampling and data handling as background for chapters on specific methods to determine the chemical composition and characteristics of foods Large expanded sections on spectroscopy and chromatography are also included Other methods and instrumentation such as thermal analysis selective electrodes enzymes and immunoassays are covered from the

perspective of their use in the chemical analysis of foods A helpful Instructor s Manual is available to adopting professors
Caron's Directory of the City of Louisville ,1903 Beer in Health and Disease Prevention Victor R Preedy,2011-04-28

Beer in Health and Disease Prevention is the single comprehensive volume needed to understand beer and beer related science Presenting both the concerns and problems of beer consumption as well as the emerging evidence of benefit this book offers a balanced view of today s findings and the potential of tomorrow s research Just as wine in moderation has been proposed to promote health research is showing that beer and the ingredients in beer can have similar impact on improving health and in some instances preventing disease This book addresses the impact of beer and beer ingredients on cancers cardiovascular disease anti oxidant benefits and other health related concerns It offers a holistic view from beer brewing to the isolation of beer related compounds It contains self contained chapters written by subject matter experts This book is recommended for scientists and researchers from a variety of fields and industries from beer production to health care professionals Winner of the 2009 Best Drinks and Health Book in the World Gourmand World Cookbook Awards The most comprehensive coverage of the broad range of topics related to the role of beer and beer ingredients in health Addresses the impact of beer and beer ingredients on cancers cardiovascular disease anti oxidant benefits and other health related concerns Presents a holistic view from beer brewing to the isolation of beer related compounds Appropriate for scientists and researchers from a variety of fields and industries from beer production to health care professionals Consistent organization of each chapter provides easy access to key points and summaries Self contained chapters written by subject matter experts

The British National Bibliography Arthur James Wells,2000 **British Books in Print** ,1986 **Instructor's Manual for Food Analysis** S Suzanne Nielsen,2003-10-31 *Training Manual on GMO Quantification* ,2014 The content of this manual is based on the training course that was organised on the premises of the European Commission Joint Research Centre Institute for Reference Materials and Measurements Geel BE at the end of 2013 The training manual complements the training course that was intended to improve the quality of measurement results obtained when quantifying genetically modified organisms GMO in food and feed Both the training course and this manual were developed in line with the current EU GMO legislation The manual is addressed to laboratory managers and practitioners in analytical laboratories who perform GM quantification measurements and use reference materials for calibration quality control and method validation including in house verification It is also intended for analysts who need to assess measurement uncertainties as required by EC No 1829/2003 1 EC No 619/2011 2 and ISO IEC 17025:2005 This training document has been written by JRC IRMM upon request of the European Union Reference Laboratory for Genetically Modified Food and Feed EURL GMFF to further improve the reporting of National Reference Laboratories NRLs nominated under Regulation EC No 882/2004 and official GMO control laboratories within the EU This manual is organised in four chapters covering the proper calibration of PCR methods the estimation of measurement uncertainty the establishment of metrological traceability of a measurement result

and the way to prove the trueness of measurement results The training manual is a didactic support of a previous guidance document that outlines issues related to the estimation of measurement uncertainty MU in the GMO sector The training manual is also in line with the European technical guidance document for the flexible scope accreditation of laboratories quantifying GMOs that is intended for laboratories that are acquiring or are holding a flexible scope of accreditation according to ISO IEC 17025 **Instructor's Manual: Laboratory Manual for Majors General Biology**, 2009

Instructor's Manual for the Laboratory Manual for Starr and Taggart's Biology : The Unity and Diversity of Life and Starr's Biology Concepts and Applications James W. [et. al]. Perry, 2002 **GMO Food** David E. Newton, 2021-05-17 **GMO Food A Reference Handbook** offers an in depth discussion of genetically modified food It covers the history of opposition to regulation of and labeling of genetic modifications along with the potential benefits and harm involved **GMO Food A Reference Handbook** is intended to serve as a research guide for young adults in high school and beyond Students at all grade levels should be able to use the book as an introduction to the history of genetic engineering of organisms and the use of this technology for the development of new forms of crops and foods They will learn briefly about historic methods of plant and animal modification such as cross breeding and in more detail how discoveries since the late nineteenth century have greatly changed the process of plant and animal modification These discoveries include important steps forward in genetics biochemistry molecular biology genetic engineering and related fields They will also learn about the variety of social political philosophical economic and other issues that have arisen alongside these scientific advances as well as about some of the laws regulations and other solutions that have been developed for dealing with the range of attitudes about genetically modified foods The second edition covers developments since 2014 **How to Reliably Test for GMOs** Jana Žel, Mojca Milavec, Dany Morisset, Damien Plan, Guy Van den Eede, Kristina Gruden, 2011-10-26 The detection of genetically modified organisms GMOs is becoming very complex with new GMOs approved and unapproved constantly entering world markets Traceability and labelling of GMOs is defined in regulations worldwide demanding accurate and reliable testing to support the requirements of legislation This Brief provides the current state of the art on all key topics involved in GMO testing and is a source of detailed practical information for laboratories Special focus is given to qualitative and quantitative real time PCR analysis relevant to all areas where detection and identification rely on nucleic acid based methods The following topics important for testing laboratories are also discussed organization of the laboratory focusing on aspects of the quality system and methods for testing validation and verification of methods and measurement uncertainty The Brief also discusses the new challenges of GMOs and novel modified organisms using new technologies and the possible solutions for GMO detection including bioinformatics tools Finally legislation on GMOs and sources of information on GMOs are provided which are relevant not only to testing laboratories but to anyone interested in GMOs The authors of this Brief have many years of experience in GMO testing development of real time PCR methods implementation of quality system requirements validations

and verification of methods and measurement uncertainty The National Institute of Biology is a highly qualified research laboratory and a National Reference Laboratory which also performs routine analyses of food feed and seed The Institute for Health and Consumer Protection of the European Union Joint Research Centre has extensive knowledge and experience of GMO detection It hosts the European Union Reference Laboratory for GM Food and Feed in addition to chairing the European Network of GMO Laboratories *Instructor's Manual for Laboratory Manual-Plant Biology* Brooks/Cole,

Instructor's Manual for Laboratory Outlines in Biology - III Peter Abramoff, Robert G. Thomson, 1973 **Using Scientific Teaching Principles to Teach Genetic Modification** Orion D. Brock, 2020 Abstract Genetically modified organisms GMOs are frequently used in genetics based research projects and are now a major part of the food we eat Despite their importance there are many misunderstandings related to what a GMO is and how it is made To help students fully understand the mechanisms of genetic alteration a GMO lab section of Genetics was modified where students were responsible for generating their own theoretical GM crop The lab was also integrated with the relevant lecture material With IRB exemption the approximately 60 students registered into the fall Genetics lab course participated in the experiment The learning outcomes were that the students would understand 1 the genetic mechanisms of constructing a GMO 2 the lab techniques required for making GMOs and 3 the bioethical concerns pertaining to GMOs The Scholarship of Teaching and Learning SoTL is a broad set of principles that employ evidence based learning through research in pedagogy To assess the effectiveness of the altered lab this project used SoTL methodology through a pre and post assessment The backwards design method was used to design the assessments and lab methods around the predetermined learning objectives To measure student learning the pre and post assessments were given two weeks prior to the lab exercise and at the end of the semester As a control half of the lab sections did not have their curriculum modified Results were quantified based on the difference in scores between the assessments Based on the high variability in collected data these specific assessments are shown to be an ineffective measurement of learning Anecdotal feedback from students and from graded labs show that the learning goals were met Future refinement of the assessments is essential to quantifiably determine the success of the modified lab

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