



Review Article
**GEL ELECTROPHORESIS AND ITS SIGNIFICANCE IN ORAL
PATHOLOGY- A REVIEW**

*Dr.A.Beeula¹, Dr. Shamal.S², Dr. Vibeshnan³, Dr. Adithya. B⁴, Dr. Janani. I⁵

*1 - Senior Lecturer, 2 - Prof and Head, 3 - Intern, 4 - Senior Lecturer, 5 - Reader, Oral Pathology And Microbiology,
Adhiparasakthi Dental College and Hospital, Tamil Nadu, 603319

How to cite: Beeula A, Shamal S, Vibeshnan, Adithya B, Janani I., Gel Electrophoresis And Its Significance In Oral Pathology- A Review. Int J Orofac.Bio.2024;8(2);16-20.

DOI: <https://doi.org/10.56501/intjorofacbiol.v8i2.1151>

Received: 05/10/2024

Accepted:10/10/2024

Web Published:21/10/2024

ABSTRACT

Electrophoresis is a versatile approach for separating molecules based on their size and electrical charges. It is a frequently used technique in dentistry for a various purposes, such as analyzing dental materials and proteins related to oral diseases. It helps in identifying different types of proteins with various interactions and can be used as potent biomarkers in oral diseases. Recent days the use of electrophoresis in dentistry has become a significant technique for significantly analyzing dental materials and characterizing proteins in oral diseases according to their molecular structure and mechanism. In this review article we discussed briefly about principles, advantages and limitations of electrophoresis, types and various applications of electrophoresis in oral diseases.

Keywords: gel electrophoresis, protein, biomarker, oral diseases

Address for Correspondence:

Dr. A Beeula

Senior Lecturer,

Oral Pathology And Microbiology,

Adhiparasakthi Dental College and Hospital,

Tamil Nadu, 603319

Email – drbeeularajakumari@apdch.edu.in

INTRODUCTION

In dental research, electrophoresis is a potent analytical method that is frequently employed for the separation and examination of different macromolecules such as proteins, Ribonucleic acid, and Deoxyribonucleic acid. It is based on the molecule size or electrical charge. This is achieved by pulling molecules through gel that contains microscopic pores using an electrical field. There are still researches undergoing in this field for analysing various molecular structures in identifying genetical aspects of disease conditions. Exploring the genetical structure is still behind the clouds further studies are in need also understanding the molecular techniques are at most important among dentists of interest. [1,2]

Movement of charged particles or molecules in an electric field is known as electrophoresis. This happens in an aqueous solution of the substances. The strength of the applied electric field and the molecular charges affect the migration's speed. Differently charged molecules will therefore migrate in distinct zones. An anti-convective medium, such as a gel matrix or viscous fluid, is used for electrophoresis in order to minimize zone diffusion. The size of the molecules therefore affects the migration's speed as well. This method yields highly resolved fractionation of a mixture of substances. [1, 3]

PROCEDURE

Before starting the procedure agarose gel is prepared and loading dye of 6 X concentration is ass to the DNA samples. The power supply is set between 1-3 V/cm between electrodes and running buffer is added to the gel. Gently and carefully the DNA samples are loaded into the gel. After the gel is dispersed to the desired length power off and remove the lid. Drain the excess buffer and cover with paper towel. The gel tray is then exposed to the UV light. DNA bands are predicted to be represented by orange fluorescent bands. [2, 4]

ADVANTAGES AND DISADVANTAGES: [2, 4, 5]

| Advantages | Disadvantages |
|----------------------------|-----------------------------|
| Versatility | Sample complexity |
| High separation efficiency | Sensitivity |
| Protein characterization | Analysis of the findings: |
| High separation efficiency | Cost and skilled assistance |

APPLICATIONS IN DENTISTRY

PROTEIN ANALYSIS

1. Dental caries: Dental caries is an irreversible microbial disease of the calcified tissues of the teeth, Wittig I et al analyse the protein present in the salivary bio film to find out the specific organs associated with dental caries using gel electrophoresis. [4, 6]
2. Oral cancer: Yang Y et al, identified the Proteins present in saliva, serum, and tissues from oral cancer and analysed using PAGE or 2DE. Findings stated that differentially expressed proteins linked to the onset, progression, or metastasis of oral cancer is made easier with the help of this analysis. Potential biomarkers can be found by comparing the patterns of protein expression in

control group and study participants with oral cancer. The development of prognostic indicators, targeted therapies, and early detection methods for the management of oral cancer is facilitated by the electrophoresis analysis of oral cancer biomarkers. [2, 3, 7]

3. Sjogrens syndrome: O. H. Ryu et al, conducted a study using 2D-DIGE gel analysis and compared the salivary proteomics profile of sjogrens syndrome exhibits a mixture of elevated inflammatory protein and decreased acinar protein. [8]
4. OSMF: Divyambika et al, conducted a study in which two-dimensional electrophoresis (2DE) is used in evaluating the changes in protein expression in OSMF and lesions undergoing malignant transformation in order to gain a deeper understanding of the molecular pathways underlying the development of the disease. [9]

DNA ANALYSIS

1. Forensic analysis: Syed vaseemuddin et al, extracted DNA from dental pulp is an essential and analysed using gel electrophoresis for DNA fragmentation which is applied for forensic tasks or resolving crimes to create a genetic profile. [10]
2. Genetic research: To better understand particular genes or mutations linked to dental health, genetic research can make use of the extracted DNA. Gel electrophoresis facilitates the study of DNA variations and fragments by researchers. [11]
3. Apoptosis detection: DNA ladder formation is a distinctive pattern linked to apoptosis that can be identified using gel electrophoresis.

Examining Different Proteins in Oral Cavity:

- Dental tissue proteins: The protein makeup of dental tissues, including cementum, dentin, and enamel, varies. By analysing the protein profiles of various tissues, electrophoresis can shed light on their structural and functional characteristics. For instance, electrophoresis can be used to examine amelogenins, which are crucial enamel matrix proteins involved in enamel production. [2, 3, 7, 12]
- Proteins found in saliva: Saliva is made up of a wide variety of proteins that serve a variety of purposes, such as lubricating oral tissues and having antibacterial qualities. A salivary protein's identity and quantity can be determined by electrophoresis in relation to oral health and disease.
- Inflammatory proteins: In dental caries and periodontal disease, inflammatory reactions are crucial. Determining the presence and amount of inflammatory proteins in dental plaque or gingival crevicular fluid (GCF), such as chemokines and cytokines, can provide light on the molecular causes of these disorders. These inflammatory proteins' expression levels can be examined by electrophoresis. [4, 7]
- Matrix Metallo-proteinases (MMPs): MMPs have a role in extracellular matrix component breakdown as well as tissue remodelling. Periodontal tissue degeneration is linked to MMP dysregulation. MMP expression levels in diseased tissues can be examined using electrophoresis. [13]

SALIVARY BIOMARKERS IN ORAL CANCER

Since salivary biomarkers analysis is a non-invasive method of detecting oral cancer, patients are more likely to accept it than an invasive procedure. Bio-molecules such as proteins, DNA, RNA, and metabolites are found in saliva. Variations in salivary biomarker composition are linked to the onset and spread of oral cancer. [12, 14]

CONCLUSION

Gel electrophoresis is emerges as a powerful analytical methods in dentistry, offering a versatile approach to analyse macromolecules and contributing significantly to disease diagnosis the methods principles, advantages, disadvantages highlights it's complexity and importance. Gel electrophoresis plays a crucial role in advancing our understanding of dental diseases. The diverse application such as identifying biomarkers in oral cancer and contributing to prenatal testing, underscore its broad impact on dental research and diagnosis.

FINANCIAL SUPPORT AND SPONSORSHIP

Nil

CONFLICTS OF INTEREST

There are no conflicts of interest

REFERENCES

1. Meto A, Meto A. Evaluation of Dental Materials and Oral Disease-Related Proteins in Dentistry: Efficacy of Electrophoresis as a Valuable Tool.
2. Lee PY, Costumbrado J, Hsu CY, Kim YH. Agarose gel electrophoresis for the separation of DNA fragments. *JoVE (Journal of Visualized Experiments)*. 2012 Apr 20(62):e3923.
3. Sánchez-Medrano AG, Martínez-Martínez RE, Soria-Guerra R, Portales-Pérez D, Bach H, Martínez-Gutiérrez F. A systematic review of the protein composition of whole saliva in subjects with healthy periodontium compared with chronic periodontitis. *Plos one*. 2023 May 24;18(5): e0286079.
4. Hert DG, Fredlake CP, Barron AE. Advantages and limitations of next-generation sequencing technologies: a comparison of electrophoresis and non-electrophoresis methods. *Electrophoresis*. 2008 Dec;29(23):4618-26.
5. Breadmore MC, Wuethrich A, Li F, Phung SC, Kalsoom U, Cabot JM, Tehranirokh M, Shallan AI, Abdul Keyon AS, See HH, Dawod M. Recent advances in enhancing the sensitivity of electrophoresis and electrochromatography in capillaries and microchips (2014–2016). *Electrophoresis*. 2017 Jan;38(1):33-59.
6. Sivapathasundharam B, Rajendran A. *Shafer's textbook of oral pathology*. Elsevier Health Sciences; 2012 Jun 30.
7. Yang Y, Huang J, Rabii B, Rabii R, Hu S. Quantitative proteomic analysis of serum proteins from oral cancer patients: comparison of two analytical methods. *International journal of molecular sciences*. 2014 Aug 18;15(8):14386-95.
8. Ryu OH, Atkinson JC, Hoehn GT, Illei GG, Hart TC. Identification of parotid salivary biomarkers in Sjögren's syndrome by surface-enhanced laser desorption/ionization time-of-flight mass spectrometry and two-dimensional difference gel electrophoresis. *Rheumatology*. 2006 Sep 1;45(9):1077-86.
9. Venugopal, D.C., Ravindran, S., Shyamsundar, V., Sankarapandian, S., Krishnamurthy, A., Sivagnanam, A., Madhavan, Y. and Ramshankar, V., 2022. Integrated Proteomics Based on 2D Gel Electrophoresis and Mass Spectrometry with Validations: Identification of a Biomarker Compendium for Oral Submucous Fibrosis—An Indian Study. *Journal of Personalized Medicine*, 12(2), p.208.
10. Vaseemuddin S. DNA extraction from pulp tissues for its application in PCR. A study to extract DNA with high purity as quantified by gel electrophoresis. *World J. of Dentistry*. 2010 Jul;1(2):85-8.
11. Mukherjee S, Ray JG, Chaudhuri K. Evaluation of DNA damage in oral precancerous and squamous cell carcinoma patients by single cell gel electrophoresis. *Indian Journal of Dental Research*. 2011 Sep 1;22(5):735-6.

12. Lin KY, Chung CH, Ciou JS, Su PF, Wang PW, Shieh DB, Wang TC. Molecular damage and responses of oral keratinocyte to hydrogen peroxide. *BMC Oral Health*. 2019 Dec;19(1):1-0.
13. Khurshid Z, Zafar MS, Khan RS, Najeeb S, Slowey PD, Rehman IU. Role of salivary biomarkers in oral cancer detection. *Advances in clinical chemistry*. 2018 Jan 1; 86:23-70.
14. Weitzdoerfer R, Fountoulakis M, Lubec G. Reduction of actin-related protein complex 2/3 in fetal Down syndrome brain. *Biochemical and biophysical research communications*. 2002 May 3;293(2):836-41.



Published by MM Publishers
<https://www.mmpubl.com/ijofb>

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial 4.0 International License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.
To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc/4.0/> or send a letter to Creative Commons, PO Box 1866, Mountain View, CA 94042, USA.

Copyright©2024 A Beeula, Shamala S, Vibeshnan, Adithya B, Janani I