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

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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

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

ADVANTAGES AND DISADVANTAGES: [2, 4, 5]

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.

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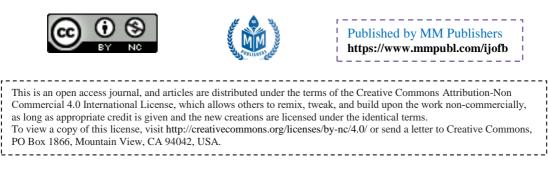
CONFLICTS OF INTEREST

There are no conflicts of interest

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