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International Journal of Orofacial Biology

Review Article

Saliva Collection Methods: A Comprehensive Guide for Scientific Research

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How to cite: Hema Shree K., Saliva Collection Methods: A Comprehensive Guide for Scientific Research. Int J Orofac.Bio.2023; 7(2):21-25.

DOI: *https://doi.org/10.56501/intjorofacbiol.v7i2.1058*

Received: 27/09/2023 *Accepted:05/10/2023* *Web Published:02/11/2023*

Abstract

Saliva has recently emerged as a valuable biological fluid in scientific research due to its rich biochemical composition and non-invasive accessibility. This article aims to provide a comprehensive guide to saliva collection methods in scientific research, covering procedures, materials, contamination prevention, storage protocols, collection methods, clinical trial considerations, and sample stabilization. By adhering to meticulous protocols, researchers can ensure the accuracy and reliability of their findings, thus maximizing the potential of saliva as a biospecimen for various research applications. The detailed exploration of each aspect of saliva collection methods in this article will help researchers optimize their collection and handling techniques, ensuring accurate and reliable results that will contribute to scientific knowledge.

Keywords: saliva, drooling method, storage, biomarker.

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INTRODUCTION

Saliva has recently emerged as a valuable biospecimen in scientific research due to its complex biochemical composition and non-invasive nature [1]. Its potential for various research endeavors and clinical applications is immense. This article aims to comprehensively explore saliva collection methods in scientific research, mainly focusing on its clinical applications.

Saliva has gained increasing attention as a diagnostic fluid due to its unique composition and ease of collection. Saliva contains a wide range of biomolecules, including proteins, nucleic acids, hormones, and metabolites, which reflect the physiological and pathological states of the body [2]. As such, saliva has emerged as a promising source of biomarkers for various health conditions, ranging from infectious diseases to systemic disorders.

One critical advantage of saliva in clinical research is its noninvasive collection process, which offers distinct advantages over traditional biospecimens such as blood or tissue samples[3]. This makes it particularly suitable for vulnerable populations such as children, elderly individuals, and patients with medical conditions that preclude invasive procedures [4]. Additionally, saliva collection can be performed in multiple settings, including clinical offices, community settings, and even in the comfort of patients' homes, enhancing accessibility and convenience.

The clinical applications of saliva collection are manifold, spanning various medical disciplines and research domains [5]. Saliva has emerged as a valuable tool for detecting and monitoring viral and bacterial pathogens in infectious diseases. Salivary biomarkers have been identified for diseases such as HIV/AIDS, hepatitis, and COVID-19, enabling rapid and non-invasive screening strategies in both clinical and community settings [6]. Moreover, saliva-based tests offer cost-effectiveness, scalability, and ease of implementation advantages, particularly in resource-limited settings where access to traditional diagnostic modalities may be limited.

Beyond infectious diseases, saliva has also demonstrated promise in the diagnosis and management of systemic conditions such as cancer, autoimmune disorders, and metabolic diseases [7]. Salivary biomarkers have been identified for various cancers, including oral, breast, pancreatic, and prostate, offering potential avenues for early detection, prognostication, and monitoring of treatment response. Similarly, saliva-based assays have been developed for autoimmune conditions such as Sjögren's syndrome, rheumatoid arthritis, and systemic lupus erythematosus, providing valuable insights into disease pathogenesis and progression [8]. Furthermore, saliva has been studied as a source of biomarkers for metabolic diseases such as diabetes and obesity, with studies highlighting correlations between salivary analytes and metabolic parameters such as glucose levels, insulin resistance, and adipokine profiles.

In addition to diagnostic applications, saliva collection holds promise for monitoring treatment efficacy, disease progression, and therapeutic response in clinical settings [9]. Salivary biomarkers can serve as surrogate endpoints in clinical trials, providing real-time insights into drug pharmacokinetics, bioavailability, and target engagement. Moreover, longitudinal monitoring of salivary biomarkers enables personalized medicine approaches, optimizing treatment regimens based on individual patient profiles and disease trajectories.

Despite its vast potential, saliva collection's clinical utility is contingent upon rigorous standardization of collection protocols, sample processing techniques, and analytical methodologies. Standardized protocols ensure the reproducibility and reliability of research findings, facilitating the translation of saliva-based

biomarkers into clinical practice [10]. Interdisciplinary collaborations between researchers, clinicians, and industry partners are also essential for advancing saliva-based diagnostics and therapeutics, driving innovation, and accelerating the adoption of saliva collection methods in clinical settings.

This article aims to provide researchers with a comprehensive exploration of saliva collection methods in scientific research. By elucidating the nuances of collection protocols, we aim to equip researchers with the knowledge necessary to obtain high-quality saliva samples and unlock the full potential of this biological fluid.

In recent years, there has been a noticeable surge in the development and availability of various saliva-collecting devices, which reflects an increasing interest and investment in saliva-based research and diagnostics. These devices offer researchers and healthcare providers efficient and convenient ways of collecting saliva samples while ensuring sample integrity and minimizing participant discomfort [11]. Among the most commonly used saliva-collecting devices are saliva collection tubes, which come in different forms, such as plain tubes, preservative or stabilizer-containing tubes, and tubes tailored for specific downstream applications. The selection of the appropriate tube type depends on factors such as the intended use of the saliva sample, storage conditions, and compatibility with subsequent analyses.

In addition to saliva collection tubes, specialized collection devices such as saliva collection kits or devices designed for passive drool collection are available. These kits offer comprehensive packages that include all the necessary components for saliva collection, processing, and storage, making them a convenient option for large-scale research studies or clinical trials requiring standardized sample collection procedures [1]. Some devices feature absorbent materials, such as sponges, cotton swabs, or filter paper, designed to collect saliva through absorption. These devices offer a straightforward and user-friendly alternative to traditional saliva collection methods and are often used for point-of-care testing or remote sample collection.

Saliva collection systems are automated devices facilitating high-throughput saliva collection in research or clinical settings [3]. These systems often incorporate features such as robotic sample processing, barcode tracking, and customizable collection protocols to streamline the sample collection process and improve efficiency. Passive drool devices are specialized containers or devices designed to collect saliva through natural drooling or spitting without stimulation [4]. These devices are commonly used in research studies requiring unstimulated saliva samples, as they minimize participant discomfort and ensure sample consistency.

Moreover, saliva collection devices are specifically designed to stimulate saliva production in individuals with reduced salivary flow or dry mouth conditions. These devices may incorporate mechanical, taste, or electrical stimulation mechanisms to promote saliva secretion and facilitate sample collection. Additionally, saliva collection devices are tailored for specific research or clinical applications, such as collecting saliva for DNA analysis, RNA extraction, proteomic profiling, or biomarker discovery. These devices may incorporate specialized features or coatings to optimize sample quality and yield for downstream analyses.

Preventing Contamination:

Preventing contamination during saliva collection is extremely important to maintaining the accuracy of research findings. This can be achieved by taking appropriate measures such as documenting pre-collection behaviors, screening for oral health, and timing the collection correctly [11]. Adhering strictly to the protocols for contamination prevention is critical to ensuring consistent and replicable results.

Storage Protocol:
Adherence to proper storage protocols is crucial for preserving the integrity of saliva samples after collection. Immediate freezing at -80°C is considered the gold standard for maintaining biomolecular stability [11]. It is imperative to carefully consider storage conditions and avoid thawing and refreezing cycles to prevent sample degradation. This is particularly critical to ensure the integrity of research outcomes. By following these guidelines, we can maintain the quality of samples and achieve reliable and accurate results for further analysis.

Collection Methods:
Numerous techniques are available for collecting saliva, each with benefits and drawbacks. Passive drool and absorbent materials are two frequently employed methods that offer noninvasive and user-friendly options for sample collection. Standardizing collection techniques and considering participant comfort is crucial to obtaining high-quality saliva samples.

Clinical Trial Considerations:
In clinical trials, adherence to standardized saliva collection protocols is a crucial component that ensures data accuracy and integrity. Reliable research outcomes can only be obtained when there is minimal variability, careful consideration of participant behaviors, and robust documentation of adherence to collection protocols. In addition, the design and execution of clinical trials that include saliva collection must carefully consider the selection of participants and sample size to ensure reliable results. These essential factors are critical to the success of clinical saliva collection trials and are necessary for obtaining valuable insights to drive research forward.

Sample Stabilization and Storage:
Maintaining the stability of saliva samples is crucial in ensuring the accuracy and integrity of the downstream analysis [7]. To prevent the degradation of biomolecules, it is vital to use appropriate stabilizing agents and store samples at optimal temperatures. Additionally, meticulous documentation and strict adherence to sample handling protocols are necessary to guarantee the maintenance of sample quality throughout the storage and analysis process.

CONCLUSION

The saliva collection is a crucial aspect of scientific research, as it offers a non-invasive and easily accessible means for discovering biomarkers, diagnosing diseases, and monitoring patients. Researchers can obtain high- quality saliva samples by adhering to meticulous protocols and standardized procedures, allowing them to unlock this biological fluid's full potential. Ongoing advancements in saliva collection methodologies will continue to improve research outcomes and pave the way for innovative applications in diverse fields of study.

Financial support and sponsorship:
Self-funded

Conflicts of interest

There are no conflicts of interest

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