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Radiocarbon Dating and Historiography of Early Quranic Manuscripts: An Interdisciplinary Perspective

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Abstract

The increasing application of radiocarbon dating in the study of early Quranic manuscripts has created new opportunities for reconstructing the history of the Quranic codex while simultaneously generating debates regarding its validity in determining the chronology of textual production. This article aims to examine the role of radiocarbon dating in Quranic manuscript studies and to evaluate its contributions and limitations in the historiography of early Quranic codices. The study employs a qualitative approach using content analysis as its research design. Data sources consist of scholarly books, peer-reviewed journal articles, archaeological reports, and studies of early Quranic manuscripts, particularly the Ṣana'a, Tubingen, and Birmingham fragments. Data were collected through documentation techniques and analyzed systematically to identify, interpret, and compare radiocarbon dating findings with codicological, paleographical, orthographic, and textual evidence. The findings indicate that radiocarbon dating is an effective tool for estimating the age range of parchment materials and assessing their possible association with specific historical periods. However, it cannot independently determine the date of textual inscription, nor can it fully explain the processes of textual transmission and canonization of the Quran. Therefore, the interpretation of radiocarbon results requires integration with broader interdisciplinary approaches. This study argues that radiocarbon dating should be positioned as a complementary instrument rather than a sole determinant in the historiography of early Quranic manuscripts.

INTRODUCTION

The study of Quranic manuscripts plays a significant role in the fields of Quranic Sciences and Exegesis because it provides material evidence that is not always found in normative sources (Firmansyah, 2026). While the history of the collection and codification of the Quran elucidates aspects of transmission, authority, and textual legitimacy, manuscripts offer physical data that can be directly verified through writing materials, ink, page layout, script style, verse markers, surah separators, illumination, *rasm*, *qira'at*, scribal corrections, and even the history of ownership and preservation. In the Indonesian context, manuscripts are primary

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sources of great importance in humanities research and Islamic studies, particularly in efforts to reconstruct intellectual history, copying traditions, and the development of religious texts (Hakim et al., 2020; Rohmah et al., 2026). However, the study of Quranic manuscripts in Indonesian academic circles has not yet developed optimally compared to the number and diversity of available manuscript collections. Therefore, discussions regarding radiocarbon dating in the study of Quranic manuscripts cannot be understood merely as a technical laboratory issue but must be situated within the framework of interrelated fields such as philology, codicology, paleography, historiography, and Quranic studies.

Advances in radiocarbon dating technology have opened up new dimensions in the study of early Quran manuscripts (Nisa et al., 2025). Academic and public interest in this method has increased significantly following the announcement of the dating results for the Birmingham fragment, which indicated an age range of 568–645 CE, thereby sparking various claims regarding its status as one of the oldest Quran manuscripts still in existence today (Masruchin & Rahmat, 2025). A similar phenomenon has occurred with the Ṣanʿāʾ, Tübingen, Parisino-Petropolitanus, Leiden, Topkapi, and Samarkand manuscripts, which have been the subject of various international studies. These findings have elicited a range of responses. Some view the results of radiocarbon dating as confirmation of the authenticity and early transmission of the Quran, while others use them as a tool to critique traditional narratives regarding the history of the codification of the mushaf (Caronge et al., 2025). This situation demonstrates that laboratory results never exist in a neutral academic space but are always intertwined with theological, historical, and apologetic discourses, as well as public polemics.

The academic concern addressed in this article stems from a fundamental question regarding what can and cannot actually be proven by radiocarbon dating in research on Quranic manuscripts. This question is important because radiocarbon dating is often perceived as a scientific method capable of providing chronological certainty, whereas the results it yields are, in fact, statistical probability ranges. Furthermore, the object tested in parchment manuscripts is the animal skin used as the writing medium, not the ink that forms the Quranic text itself (Anggraini & Makmun, 2022). Thus, radiocarbon dating results essentially indicate an estimated time of death for the animal from which the parchment originated, not directly the time of copying or writing the text on that medium. It is this conceptual distinction between the age of the material and the age of the text that is often overlooked in various popular news reports as well as in some academic interpretations that place too much emphasis on laboratory results.

From a methodological perspective, various studies indicate that radiocarbon dating has a number of limitations that must be critically considered. Dating accuracy is greatly influenced by sample quality, the risk of contamination, isotope fractionation, the calibration process, and the storage conditions of the material being tested. These complexities become even greater when applied to ancient manuscripts that have undergone a long historical journey, including changes in ownership, restoration, changes in storage environments, and the possible reuse of materials (palimpsests) (Nurpratama, 2025). Therefore, radiocarbon dating results cannot serve as the sole basis for determining the historical age of a manuscript without considering other supporting data such as codicology, paleography, orthography, rasm analysis, textual criticism, and historical context.

A number of previous studies have made significant contributions to our understanding of early Quran manuscripts. Studies of the Ṣanʿāʾ manuscripts have revealed the complexity of textual transmission and the existence of different layers of copying. Research on the Birmingham and Tübingen fragments has shown that radiocarbon dating results must be interpreted in conjunction with paleographic and

orthographic evidence. Meanwhile, studies of the Parisino-Petropolitanus, the Leiden Fragments, the Topkapi and Samarkand Mushafs, the Codex Mashhad, the Mingana Collection, and the Corpus Coranicum project Marx & Moss, (2011) underscore the importance of integrating material and textual evidence in determining the chronology of manuscripts. These findings indicate that the historical reconstruction of the Quranic mushaf has never relied on a single method but rather requires a multidisciplinary approach capable of simultaneously linking archaeological, philological, textual, and historical data.

Nevertheless, most previous studies have still addressed radiocarbon dating and textual analysis of manuscripts as relatively separate fields. Radiocarbon studies generally focus on determining the age of the parchment, while philological and historical research places greater emphasis on aspects of transmission, textual variants, and the development of the mushaf's writing. Consequently, a research gap persists in the form of the lack of a comprehensive study that specifically integrates the results of radiocarbon dating with codicology, paleography, orthography, rasm, textual criticism, and the historiography of the mushaf within a single analytical framework. This gap leads to radiocarbon dating results often being simplistically interpreted as the sole determinant of a manuscript's chronology, without considering the complex relationship between the age of the material, the age of the text, and the historical context of its copying.

Given this gap, the novelty of this article lies in its effort to present a critical and interdisciplinary analysis of radiocarbon dating in the historiography of early Quranic manuscripts. Unlike previous studies, which tend to treat radiocarbon results as technical findings or standalone chronological evidence, this article comprehensively analyzes the relationship between the age of the parchment, the age of the text, textual criticism, and the historiography of the mushaf through a comparative study of the Ṣanʿāʾ, Birmingham, and Tübingen manuscripts. This approach allows for a more balanced evaluation of both the contributions and limitations of radiocarbon dating in reconstructing the early history of the Quran.

The implications of this study are that it provides a more comprehensive theoretical and methodological foundation for understanding radiocarbon dating results of Quranic manuscripts. Academically, this study contributes to strengthening the integration of scientific and humanistic approaches in Quranic studies and enriches the global discourse on the historiography of early Quranic manuscripts. Practically, this study can improve public literacy regarding the interpretation of radiocarbon dating results, thereby reducing tendencies toward sensationalism, oversimplification, and polarization in understanding the early history of the Quran. Thus, this study is expected to make a tangible contribution to the development of research methodologies for Quranic manuscripts and to encourage the emergence of more in-depth interdisciplinary studies in the future.

METHODS

This study employs a qualitative approach to critically examine the role, contributions, and limitations of radiocarbon dating in the study of early Quranic manuscripts. The qualitative approach was chosen because the study focuses on the analysis of documents, ideas, arguments, and academic findings that require an in-depth interpretation of the phenomena under investigation. Through this approach, the study seeks to understand the relationship between radiocarbon dating results and aspects of codicology, paleography, orthography, textual criticism, and the historiography of the *mushaf*, thereby yielding a more comprehensive understanding of the chronology and transmission of early Quranic manuscripts (Amir et al., 2023; Creswell, 2014; Engkizar et al., 2026; 2025; Iphofen & Tolich, 2018; Muhlasin et al., 2026).

Method and Type

This study employs a qualitative method, specifically content analysis. Content analysis is a method used to systematically and objectively identify, categorize, interpret, and evaluate the meanings contained within documents or texts (Aryasutha et al., 2025; Engkizar et al., 2025; Kaema & Ulwi, 2025; Krippendorff, 2022; Mursyid, 2022). In the context of this study, content analysis is used to examine various literature discussing radiocarbon dating, early Quranic manuscripts, codicology, paleography, orthography, and the historiography of the *mushaf* in order to identify patterns, trends, and conceptual relationships between the age of the parchment and the age of the text (Fauziyah et al., 2026).

Data Sources

The research data sources consist of primary and secondary data. Primary data consists of articles from reputable international journals, academic books, research reports, manuscript catalogs, and scientific publications that specifically discuss radiocarbon dating and early Quran manuscripts, such as studies of the Ṣanʿāʾ manuscript, the Birmingham manuscript, Tübingen, Leiden, and the Corpus Coranicum project. Secondary data were obtained from supporting literature related to philology, codicology, paleography, archaeology, Islamic historiography, and contemporary Quranic studies (Fahmi, 2023).

Instruments

The primary instrument in this study is the researcher (human instrument), who plays a role in determining the research focus, selecting data, conducting interpretations, and drawing conclusions based on the research findings (Mills et al., 2013). To support this process, auxiliary instruments were used, including documentation sheets, data cards, and a data categorization matrix designed to group information based on research themes, such as radiocarbon dating, parchment age, text age, codicology, paleography, orthography, *rasm*, textual criticism, and the historiography of the *mushaf* (Bowen, 2009; Engkizar et al., 2024; 2025; Faizin, 2016; Jaafar et al., 2025; Lestari, 2017; Rohmana, 2018).

Data Collection and Analysis

Data collection was conducted using documentation techniques by searching for, reading, recording, and classifying various documents relevant to the research focus (Bowen, 2009; Syaifuddin, 2014; Sz & Ari, 2021; Wisjachudin et al., 1997). Data analysis refers to the interactive analysis model developed by Miles, (2015), which comprises three stages: data reduction, data display, and conclusion drawing and verification. Subsequently, the data were analyzed using qualitative content analysis and comparative analysis techniques to identify patterns, relationships, similarities, and differences between the results of radiocarbon dating and the codicological, paleographic, orthographic, and textual evidence found in early Quranic manuscripts. Through these techniques, this study offers a critical interpretation of the contributions and limitations of radiocarbon dating in reconstructing the historiography of early Quran manuscripts from an interdisciplinary perspective.

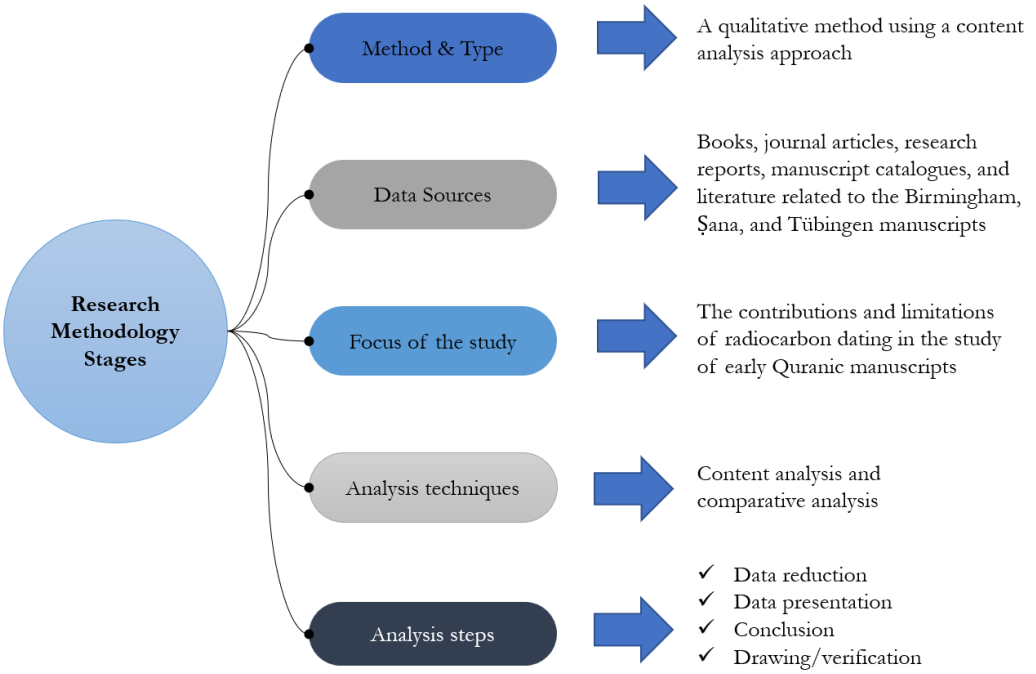


Fig 2. Stages of the Research Methodology

RESULT AND DISCUSSION

Based on an analysis of various literature on radiocarbon dating and a study of early Quran manuscripts particularly the Birmingham Fragment, the Ṣan'ā' Palimpsest, and the Tübingen Manuscript this study finds that the use of radiocarbon dating has made a significant contribution to the development of the historiography of Quranic manuscripts. This method offers a scientific approach that allows researchers to obtain chronological estimates of the organic materials used as writing media, thereby opening new opportunities in efforts to reconstruct the history of early Quranic manuscripts. From the overall data analyzed, the author identified five main themes that constitute the findings of this study.

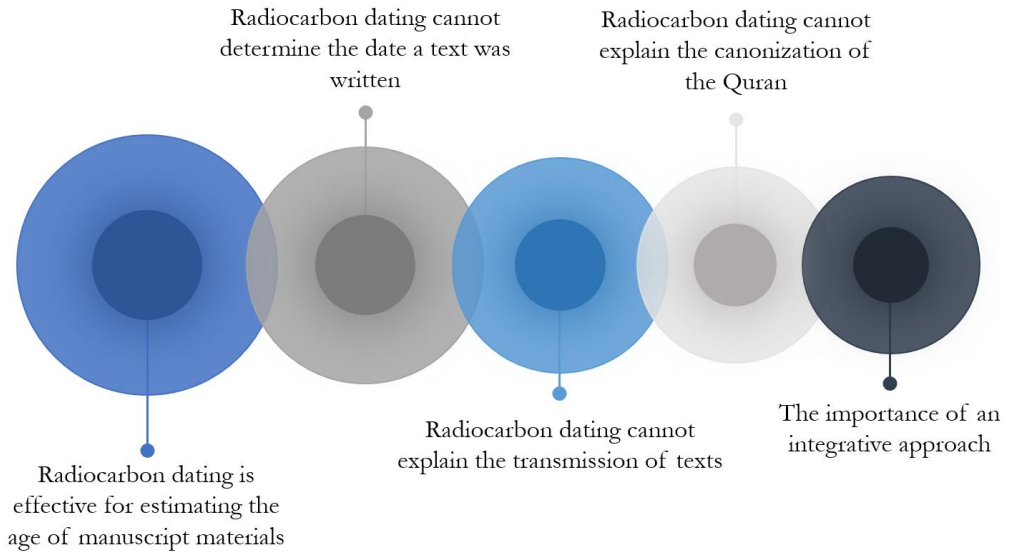


Fig 2. Radiocarbon Dating and the Historiography of Early Quran Manuscripts

Radiocarbon Dating Is Effective for Estimating the Age of Manuscript Materials

The first finding shows that radiocarbon dating is an effective method for estimating the age range of organic materials used as writing media in manuscripts, particularly parchment. Testing for radioactive carbon (C-14) content allows researchers to obtain a chronological estimate of when the organisms that formed the basis of the parchment ceased to live. In the context of early Quran manuscripts, this information is crucial because it can help determine whether a manuscript fragment likely dates from the early Islamic period or from a later era. Test results from several well-known manuscripts, such as the Birmingham and Tübingen manuscripts, demonstrate that radiocarbon dating can provide a chronological range that serves as a starting point for reconstructing the history of a manuscript (Faizin, 2017). Thus, radiocarbon dating is a valuable tool for verifying the authenticity of materials and estimating a manuscript's connection to a specific historical context.

These findings indicate that radiocarbon dating makes a significant contribution to overcoming the limitations of traditional dating methods, which often rely on colophons, historical records, or paleographic characteristics. Not all Quran manuscripts contain internal information regarding the date of copying or the identity of the scribe. In such cases, radiocarbon dating serves as a tool that allows researchers to establish an initial chronological framework more objectively based on the material characteristics of the manuscript (Mursyid, 2022). Therefore, this method is particularly useful when researchers are dealing with manuscript fragments that lack complete historical information.

Furthermore, research findings indicate that the primary value of radiocarbon dating lies in its ability to narrow down the possible chronology of a manuscript (Kaharudin, 2019). Although this method does not yield an exact date, the age range obtained helps researchers place a manuscript within a more specific historical context. In the study of early Quran manuscripts, this capability is crucial because it helps distinguish between manuscripts that may date from the early Islamic period and those that are copies from later periods. Thus, radiocarbon dating serves as a material verification tool that strengthens the process of reconstructing the history of manuscripts.

Radiocarbon Dating Cannot Determine the Date of Composition of a Text

Nevertheless, this study also found that radiocarbon dating results cannot be interpreted as a direct indicator of the date of composition of a text. Radiocarbon dating measures only the age of the organic material being tested, not the time when the text was written on that material. The distinction between the age of the material and the age of the writing is one of the most significant methodological issues in the study of Quranic manuscripts (Nisa et al., 2025). Once produced, parchment can be stored for a certain period before being used, traded to other regions, or even reused after previously containing a different text. In the case of a palimpsest, a single sheet of parchment may contain more than one layer of writing from different periods. Therefore, the age range yielded by radiocarbon dating does not automatically indicate when the Quranic text was written, copied, or circulated within a community.

Research findings indicate that this issue is one of the most common sources of misunderstanding when interpreting radiocarbon results. In many popular news reports, the age range of a parchment is often directly associated with the age of the text written on it. Methodologically, however, these two aspects fall under different levels of analysis. Radiocarbon dating provides information only about the material, whereas the date of composition is a historical matter requiring additional evidence from paleography, codicology, and philology.

These findings also demonstrate that the relationship between the age of the

material and the age of the text can vary significantly. In some cases, the gap between the two may be relatively short, so that the age of the material is close to the age of copying. In other cases, however, this time gap may be longer due to the storage of the material, the reuse of parchment, or the transfer of the material from one region to another. Therefore, radiocarbon results should be understood as a chronological boundary for the material that aids the interpretation process, not as direct evidence of when a particular Quranic text was written.

Radiocarbon Dating Cannot Explain the Transmission of Texts

The third finding indicates that radiocarbon dating cannot account for the process of the transmission of the Quranic text. Text transmission is a complex process because it involves activities such as copying, teaching, recitation, the dissemination of *qira'at*, textual correction, and the relationships between manuscripts that developed over a long period of time (Ulya et al., 2023). The entire process takes place at textual and social levels that cannot be discerned through the analysis of carbon in the writing medium. The case of the Ṣan'ā' palimpsest provides a very clear example of this limitation. Radiocarbon dating can estimate the age of the parchment used, but it cannot explain the relationship between the underlying text and the overlying text, when changes were made, or how these textual variations emerged within the Quranic copying tradition. To understand these issues, an interdisciplinary approach is required combining philology, paleography, codicology, and the study of early Islamic history that can trace the development of textual traditions in greater depth.

These findings confirm that the transmission of the Quran is a historical phenomenon related not only to the existence of manuscripts as material objects, but also to human activities involving the use, copying, and teaching of the text. Radiocarbon dating cannot identify who copied a manuscript, from which source the copying was done, or how a manuscript relates to a particular recitation tradition. Thus, this method cannot answer questions related to the social and intellectual dynamics in the history of the Quran's dissemination.

Furthermore, the research findings indicate that reconstructing the transmission of the text requires an analysis of recitation variations, orthographic features, the structure of the *mushaf*, and inter-manuscript relationships. These elements are part of the textual history that cannot be captured by laboratory analysis. Therefore, radiocarbon dating serves only as supporting information that helps determine the general chronological context, while the process of transmission must be reconstructed through humanities-based methods focused on text and history.

Radiocarbon Dating Cannot Explain the Canonization of the Quran

The fourth finding relates to the issue of the canonization of the Quran. The research findings indicate that radiocarbon dating cannot be used as the sole basis for determining when a particular version of the Quranic text attained canonical status or was widely accepted by the Muslim community. The age of a parchment does not directly indicate the process of textual standardization, the dissemination of a standardized *mushaf*, or the establishment of religious authority underpinning the acceptance of a particular recitation. Canonization is a historical process involving religious, social, political, and intellectual factors that are far more complex than merely the material age of a manuscript (Ulfa, 2024). Therefore, studies on the canonization of the Quran must consider other evidence such as *rasm, qiraat, mushaf* structure, transmission traditions, and relevant historical sources. In this context, radiocarbon dating serves only as supporting data that helps place a manuscript within a specific time frame.

These findings show that the early age of a manuscript does not automatically indicate that the text it contains represents the final or standard form of the Quran

that is widely accepted. A manuscript may date from a very early period, but its position in the history of the *mushaf's* development still requires analysis of its content and textual characteristics (Khaidir, 2025). Thus, the relationship between the material's age and the process of canonization is neither direct nor linear.

This study also found that debates regarding canonization often arise when radiocarbon dating results are used to support overly broad conclusions. In fact, the canonization process involves the development of institutions, religious authorities, reading practices, and community acceptance factors that cannot be measured through radiocarbon dating. Therefore, the use of radiocarbon dating in the study of canonization must be approached with caution to avoid making claims that exceed the method's methodological capacity.

The Importance of an Integrative Approach

The fifth finding indicates that the use of radiocarbon dating will yield more significant results when combined with other approaches in manuscript studies. Analysis of various cases shows that radiocarbon results gain clearer historical significance when interpreted alongside paleographic, codicological, philological, and *rasm* data. If all these data point to a relatively consistent chronological direction, the level of confidence in a manuscript's historical dating becomes stronger. Conversely, if there is a discrepancy between radiocarbon results and paleographic or codicological evidence, this discrepancy should not be viewed as an error in either method. Such discrepancies may, in fact, suggest the presence of other historical factors, such as long-term storage of materials, the reuse of parchment, the movement of manuscripts between regions, or changes that occurred during the transmission of the text.

Research findings indicate that an integrative approach is the most appropriate way to understand Quranic manuscripts as objects possessing both material and textual dimensions. Radiocarbon dating can provide information about the age of the material, but only paleography can explain the evolution of script forms, only codicology can explain the physical characteristics of manuscripts, and only philology can trace the relationships among textual variants. Each method has its own strengths and limitations, so they cannot function in isolation (Fadli, 2025; Meinapuri et al., 2026).

Furthermore, an integrative approach enables researchers to construct a more comprehensive and balanced historical reconstruction. When various types of evidence support one another, historical interpretations become more robust. Conversely, when discrepancies exist among these data, researchers gain the opportunity to identify previously unseen historical issues. Thus, this study affirms that radiocarbon dating should be understood as part of a multidisciplinary framework that connects science, philology, codicology, paleography, and Quranic historiography in an effort to understand the history of manuscripts more holistically.

This finding is also supported by research on Quranic manuscripts in Indonesia. Studies of Nusantara *mushafs* show that the age of the material is not always identical to the age of the text's copying. Determining the chronology of a manuscript typically requires a combination of various indicators, such as the material, watermarks, illumination, *rasm, qiraat*, colophons, and paleographic characteristics. This experience demonstrates that manuscript research relying solely on a single type of evidence risks producing overly simplistic conclusions. Therefore, a multidisciplinary approach is an unavoidable methodological necessity in the study of Quranic manuscripts (Abiyusuf et al., 2025; Hakamah, 2022).

Overall, the results of this study confirm that radiocarbon dating is a very useful tool for estimating the age range of parchment materials and testing their possible connection to specific historical periods. However, this method has methodological limitations that must be clearly understood. Radiocarbon dating

cannot directly determine the time of a text's composition, is unable to reconstruct the process of the Quran's transmission, and cannot explain the process of the *mushaf's* canonization. Therefore, radiocarbon results must be interpreted critically and integrally alongside other evidence derived from codicology, paleography, philology, the science of *rasm, qiraat,* and Quranic historiography. With such an approach, radiocarbon dating can make a significant contribution to the study of Quranic manuscripts without giving rise to claims that exceed the capacity of the data it produces.

CONCLUSION

This study demonstrates that radiocarbon dating is a valuable scientific tool for investigating early Quranic manuscripts, as it provides chronological estimates for the organic materials used as writing supports. However, radiocarbon analysis cannot directly determine the date of textual inscription nor fully explain the processes of textual transmission and canonization of the Quran. The examination of the Birmingham, Ṣanʿāʾ, and Tübingen manuscripts confirms that the age of the parchment does not necessarily correspond to the age of the text written upon it. Consequently, radiocarbon results should not be interpreted in isolation but rather integrated with codicological, paleographical, orthographic, *rasm*, provenance, and textual-critical evidence. This interdisciplinary approach offers a more reliable framework for reconstructing the historiography of early Quranic manuscripts and avoids overly deterministic interpretations of laboratory-based findings.

The findings highlight the need for a comprehensive methodological framework that combines scientific dating techniques with humanities-based manuscript analysis. Future research should develop standardized protocols that incorporate digital manuscript cataloguing, systematic codicological descriptions, paleographical and *rasm* analysis, conservation records, and transparent laboratory testing procedures. Such an integrated approach would enhance the reliability of manuscript dating, facilitate scholarly verification, and contribute to a more nuanced understanding of the history of the Quranic text. Ultimately, radiocarbon dating should be regarded as a complementary instrument within a broader interdisciplinary research framework rather than as a sole determinant of the chronology and historiography of early Quranic manuscripts.

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Author contribution

Husni Rizqi Mubarokah: data curation, writing-original draft preparation, analysis, conceptualization, methodology, visualization, and editing.

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The data and the grammatical structure in this article have been validated and verified by English language experts and no AI-generated sentences are included in this article.

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