

# A Review on Anti-bacterial Properties of Zinc-Implants

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## Abstract

Zinc is a metal having high antibacterial properties. The review analysis had been conducted to understand the active authors, organizations, journals, and countries involved in the research domain of “antibacterial properties of Zinc-implants”. All published articles related to “antibacterial properties of Zinc-implants” from “Scopus”, were analyzed using the Meta Analysis to develop analysis tables and visualization maps. This article had set the objective to consolidate the scientific literature regarding “antibacterial properties of Zinc-implants” and also to find out the trends related to the same. The leading Journals were Material Science and Engineering and Acta Biomaterialia. The most active country was China. The leading organization engaged in the research regarding antibacterial properties of Zinc-implants was the Chinese Academy of Sciences, China. The most active author who had made valuable contributions related to antibacterial properties of Zinc-implants was Liu X.

**Keywords:** Zinc-implants, Antibacterial properties, Material engineering, Review analysis, Meta Analysis,

## 1. Introduction

Zinc is having antibacterial properties and this feature enhances the applicability of Zinc based implants. The Bio-compatibility of Zinc and its biodegradability had been helpful for diversified medical applications (Chen *et al.*, 2011). Similarly, the high concentration of metals in body fluids, toxicity, and allergy of metals should also be considered in the cases of bio-implants. Corrosion is a threat to Zinc implants, however, the Zinc coating of implants can resist corrosion.

The anti-bio-film properties of Zinc, make it a biocompatible option for surface-coating of dental implants; Moreover, many nanocomposites of Zinc are having antibacterial features bio-absorbable properties. Zinc phosphate-calcium phosphate composite coatings on pure iron for biodegradable implant applications; zinc phosphate coating for biodegradable implant applications. Similarly, antibacterial properties of Zinc-doped calcium silicate cement as bone filler had been successfully proved in the research. There is evidence for the antibacterial properties and cytotoxic effects of zinc oxide nanoparticles; antibacterial and wound healing effects of zinc ferrite nanoparticles; anti-bacterial properties of Zinc-copper based implants.

Material engineering and surface engineering can play a significant role in improving the performance and life of Zinc based-implants along with measures for reducing toxicity and hypersensitivity of the metal implants. Future research can also be on surface coatings by using, metal implants using Zinc. This review analysis will be a useful platform for future researchers by realizing the top researchers, organizations, and countries involved in research regarding Zinc-implants.

This article is arranged into four sections. The first section is the introduction, followed by the discussion of the methodology by which the research was conducted. The third section deals with results and discussion. The fourth section deals with the conclusion. The following research objectives and research questions were framed for conducting review analysis systematically.

## 1.1 Research Objectives

- a) To consolidate the literature regarding antibacterial properties of Zinc-implants
- b) To find out the trends related to research in antibacterial properties of Zinc-implants

## 1.2 Research Questions

- a) Who are the active researchers working on the antibacterial properties of Zinc-implants?
- b) Which are the main organizations and countries working on antibacterial properties of Zinc-implants?
- c) Which are the main journals on antibacterial properties of Zinc-implants?

## 2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS (Zinc antibacterial-implant). All the tables in this paper were created by using Microsoft Excel and Meta Analysis. Grammarly was used for spelling and grammar checks. Mendeley was used for article review and citation. This paper had been inspired by review analysis in its presentation style, analysis, and methodology from the works.

## 3. Results and discussion

### 3.1 Results

This first round of search produced an outcome of 163 documents, in two languages, out of which 155 documents were in English. The classification of document categories is shown in Table 1. For improving the quality of the analysis, we had selected only the peer-reviewed articles and all other documents had not been considered. Thus after using filters “Article” and “English” the second round search produced an outcome of 126 English articles (both open access and others) and had been used to conduct review analysis and visualization using Meta Analysis. The English research articles in this domain since 2006 had been shown in Table 1. Co-authorship analysis of top authors had been shown in Table 1. For a better presentation of the analysis, the parameters used were the minimum number of documents of an author as four and the minimum number of citations of authors as one. This combination plotted the map of 19 authors, in four clusters. The overlay visualization map of co-authorship analysis plotted in Table 1, points out the major researchers with their strong co-authorship linkages and clusters involved. The citation analysis of top authors had been shown in table 1, along with co-authorship links. For the citation analysis, the parameters used were the minimum number of documents of an author as one and the minimum citations of an author as one.

Table 1: Highlights of most active authors

| Description                                                | Authors | Documents | Citations | Average citations per documents | Link strength |
|------------------------------------------------------------|---------|-----------|-----------|---------------------------------|---------------|
| Authors with the highest publication, citations, and links | Liu X   | 14        | 1213      | 86.6                            | 83            |

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as 25. This combination plotted the map of 20 thresholds, in two clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Table 2. The leading organizations engaged in research on “antibacterial properties of Zinc-implants” had been found out by the volume of publications and citation analysis, the parameters used are the minimum number of documents of an organization as one and the minimum number of citations of organizations as one. The leading organizations in the research regarding “antibacterial properties of Zinc-implants”, with the

highest number of publications and citations, were the Chinese Academy of Sciences, China (Refer to table 2).

Table 2: Highlights of the most active organization

| Organizations               | Country | Documents | Citations | Average Citations per document |
|-----------------------------|---------|-----------|-----------|--------------------------------|
| Chinese Academy of Sciences | China   | 19        | 1252      | 66                             |

Co-authorship analysis of the countries engaged in the research on “antibacterial properties of Zinc-implants” had been shown in Table3. The overlay visualization map of co-authorship analysis plotted in Table3, points out the main countries with their strong co-authorship linkages and clusters involved. The citation analysis of top countries had been shown in table 3, along with co-authorship links. For the citation analysis, the parameters used were the minimum number of documents of a country as one and the minimum citations of the country as one.

Table 3: Highlights of Active Countries

| Description                                                                  | Country | Documents | Citations | Link strength |
|------------------------------------------------------------------------------|---------|-----------|-----------|---------------|
| The country with the highest publication, citations, and co-authorship links | China   | 63        | 1925      | 24            |

The most active country in this research domain was the United States of America, with the highest number of publications, links, and citations.

Link analysis and citation analysis were used to identify the most active journal in this research domain. We have taken the parameters of the minimum number of documents of a journal as one and the minimum number of citations of a journal as one for the link analysis and citation analysis. Highlights of the most active and relevant journals related to “antibacterial properties of Zinc-implants” are shown in table 4. Table 4 shows the journal activity of this research domain through parameters of publication volume, citations, and co-authorship linkages.

Table 4: Analysis of journal activity

| Description                              | Journal details                  | Documents | Citations | Average citations per documents | Links |
|------------------------------------------|----------------------------------|-----------|-----------|---------------------------------|-------|
| Journal with the highest publications    | Material Science and Engineering | 12        | 290       | 24.1                            | 18    |
| Journal with highest citations and links | Acta Biomaterialia               | 8         | 603       | 75.4                            | 49    |

From the above discussion regarding the review patterns in the research regarding antibacterial properties of Zinc-implants, this research had observed a gradual increase in research interest regarding antibacterial properties of Zinc-implants from the starting of the millennium, and the momentum is going on positively. This points out the relevance and potential of this research domain (Refer to Table 2). The most active author in this research domain was Liu X with the highest publication, citations, and co-authorship links (Refer to table 1). The overlay analysis of top countries researching antibacterial properties of Zinc-implants indicates that China was the

leading country relating to the highest number of publications, citations, and co-authorship links(Refer to Table 5). The top journals of this research domain were identified as Material Science and Engineering and Acta Biomaterialia. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding antibacterial properties of Zinc-implants.

#### 4. Conclusion

Antibacterial properties of Zinc-implant was an interesting research domain and the most active journals related to this research domain were Material Science and Engineering and Acta Biomaterialia. The most active country was China. The leading organization engaged in the research regarding antibacterial properties of Zinc-implants was the Chinese Academy of Sciences, China. The most active author who had made valuable contributions related to antibacterial properties of Zinc-implants was Liu X with the highest publication; and co-authorship links, and citations respectively. This research domain offers a new avenue for researchers and future research can be on innovations in antibacterial properties of Zinc-implants.

#### References

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