



## Review Article

# Emerging electrochemical, optical, electrochemiluminescence and photoelectrochemical bio(sensing) approaches for detection of vitamins in the food, pharmaceutical, and human samples: A review on recent advancements

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## ARTICLE INFO

## Keywords:

Advanced nanomaterial  
Biomedical analysis  
Biotechnology  
Diagnostic methods  
Nanotechnology  
Vitamins

## ABSTRACT

Vitamins are types of natural compounds that help cell growth and body metabolism. Living organisms, especially humans, need a small number of vitamins for their survival and health. Accepting the fact that when the concentration of vitamins in the body becomes more or less than normal, it causes the emergence of various diseases. Due to the required vitamins of humans bodies supply from pharmaceutical supplements and food, the measurement of them in medicines, foods, and biological fluids can consider an important matter. In other words, their accurate and fast monitoring is considered an essential requirement for monitoring the level of human health. Different types of vitamins have been identified using different techniques. To elaborate, selectivity and sensitivity are the indicators that diagnostic techniques should have these features. Recently, in order to achieve ideal sensitivity and selectivity probes in various determination techniques (including, electrochemical (EC), optical, photoelectrochemical (PEC), electrochemiluminescence (ECL), and piezoelectric, numerous types of nanomaterials (NMs) such as silica-NMs, carbon-NMs, hybrid-NMs, and metallic nanoparticles and biological elements like aptamer, antibody, enzyme, gene, and peptide are used. In this review, the impact of various diagnostic methods, biological factors, and NMs will be examined. In addition, limitations and research gaps in the field of vitamin detection will be discussed. It should be noted that this is the first comprehensive review in the research field of vitamin measurement that discuss the role of NMs and bioreceptors.

## 1. Introduction

Vitamins are organic and nutritious compounds that humans bodies need to some extent [1]. In many cases, people should use food and pharmaceutical supplements to enjoy direct and indirect position effects

of them [2]. In detail, the role of vitamins in the well-being immune system, and the growth of organs, tissues, and cells is undeniable [3], and alongside that, they help promote a healthy lifestyle, convert food into energy, and reduce the risk of disease [4]. Particularly, their continuous and appropriate supply is very necessary for the body for

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<https://doi.org/10.1016/j.microc.2023.109766>

Received 13 July 2023; Received in revised form 1 December 2023; Accepted 2 December 2023

Available online 3 December 2023

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