

## Abstract

# Colorimetric Methods of Magnesium Detection for Point-of-Care Heart Failure Management <sup>†</sup>

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Heart failure (HF) continues to represent a leading cause of hospitalization and mortality worldwide, with an increasingly high prevalence as a result of population growth and ageing [1]. HF patients are at higher risk of sudden cardiac death (SCD), which is frequently associated with the cardiac arrhythmias that can stem from electrolyte imbalances such as magnesium ( $Mg^{2+}$ ) and potassium ( $K^+$ ) deficiencies. Therefore, the regular monitoring of electrolyte levels can enable a timely identification of these depletions, improving patient management and outcomes [2].

In this work, calmagite (1-(1-hydroxy-4-methyl-2-phenylazo)-2-naphthol-4-sulfonic acid) was employed as a direct dye-complexing method to determine the concentration of  $Mg^{2+}$  in a sample. In an alkaline medium, calmagite is blue but, in the presence of  $Mg^{2+}$ , it forms a metallized reddish complex, whose color is concentration dependent [3]. This method provided a fast response, which was determined using both a UV–Vis spectrophotometer and a smartphone camera for RGB (Red, Green, Blue) analysis. With an increasing  $Mg^{2+}$  concentration (0.005–0.3 mM), the ratio between the light absorbance at 620 nm and at 520 nm decreased, while the Red value increased, enabling detection. The specificity of the assay was tested using different ionic solutions that are present in body fluids, namely sodium chloride, calcium chloride and potassium chloride, with EGTA (ethylene glycol-bis( $\beta$ -aminoethyl ether)-N,N,N',N'-tetraacetic acid) used to dampen calcium interference.

This research paves the way for this method's application at the point of care to monitor  $Mg^{2+}$  levels by demonstrating its rapid response, low limit of detection and simple instrumentation, aiming to improve HF management and prevent SCD.

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