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OPTIMIZING MAGNESIUM QUANTIFICATION IN HUMAN SERUM: A COMPARATIVE EVALUATION OF XYLIDYL BLUE-BASED REAGENTS

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Abstract

Background: Magnesium (Mg^{2+}) is a vital mineral essential for numerous physiological and biochemical processes. Accurate quantification of serum magnesium is clinically imperative for diagnosing electrolyte imbalances and managing chronic health conditions. While the Xylidyl Blue method remains a standard technique for magnesium measurement, its reliability is highly dependent on reagent composition and specific analytical conditions. This study aimed to optimize this methodology by evaluating various reagent formulations to enhance diagnostic accuracy.

Methods: A systematic assessment was conducted on twelve distinct reagent formulations to determine their efficacy in measuring magnesium concentrations in human serum. Each formulation was rigorously evaluated for accuracy, precision, stability, and sensitivity using a standardized analytical protocol. Following initial screening, the optimal formulation, designated as Reagent R7, was selected for comprehensive validation. Its performance was benchmarked against a recognized commercial magnesium quantification kit (ELITech) using Bland-Altman analysis to assess clinical agreement.

Results: Reagent R7 demonstrated superior analytical performance, consistently aligning with target control values. Precision analysis revealed a low coefficient of variation ($CV = 2.2\%$), indicating high reproducibility. Sensitivity testing established a Limit of Detection (LoD) of 0.02 mg/dL , ensuring the assay's capability to detect trace concentrations. Furthermore, specificity assessments confirmed minimal cross-reactivity and interference from calcium ions, a common challenge in magnesium assays. Comparative analysis via Bland-Altman plots showed strong statistical agreement with the ELITech kit, confirming the robustness and reliability of the R7 formulation. Conclusion: The study identifies Reagent R7 as the most effective formulation for serum magnesium measurement, offering enhanced precision, sensitivity, and stability compared to alternative compositions. The strong correlation with established commercial



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Methods: suggest that R7 is a viable and robust candidate for routine clinical application. These findings provide a solid foundation for future assay optimization and the enhancement of diagnostic methodologies in clinical biochemistry.

Key Words: Serum Magnesium Xylidyl Blue Method Reagent Optimization Analytical Performance Bland-Altman Analysis Clinical Biochemistry Precision and Accuracy Interference Testing.