

## **Analytical application of ion selective electrode in the determination of magnesium in real samples**

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### ***Abstract:***

*In this study, a novel method is used for the determination of magnesium in food samples. The method involves the use of a potentiometric magnesium ion selective electrode. Graphite coated ion – selective electrode with the composition of 33.0% PVC, 57.0% o - NPOE, 6.0% NaTPB, 2.0 % MWNT and 2.0% 2-hydroxymethyl-15-crown-5 was used to determine the amount of magnesium in spinach and broccoli. The results obtained were compared by ICP-AES method.*

***Keywords:*** *Ion selective electrode, magnesium, graphite, potentiometry.*

### **1. INTRODUCTION**

Magnesium, an alkaline earth metal is involved extensively in various physiological and metabolic processes<sup>1</sup>. It also plays vital role in important functions of the body like protein synthesis, blood pressure regulation, muscle and nerve function and blood glucose control<sup>2-4</sup>. Deficiency of magnesium in the body causes various disorders like osteoporosis, hypocalcaemia, migraine, hypertension, neuromuscular defects and coronary heart disease<sup>5-7</sup>. Hence, it becomes important to include magnesium in the diet. Spinach and broccoli in routine diet act as good sources of magnesium. This makes it essential to determine the level of magnesium in dietary sources.

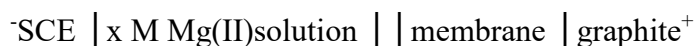
Analytical methods used for the estimation of magnesium like atomic absorption spectroscopy<sup>8</sup>, neutron activation analysis<sup>9</sup> inductively coupled plasma - atomic emission spectroscopy<sup>10</sup> are time consuming, require sample pretreatment and expensive for most analytical laboratories. This provides scope for the development of simple, rapid and low-cost method based on the use of ion – selective electrode for the determination of magnesium. Literature study suggests formation of stable complex of magnesium with 15-crown-5 and its

related compounds<sup>11,12</sup>. In this study, 2-hydroxymethyl-15-crown-5 has been used as an ionophore for the fabrication of magnesium selective graphite coated electrode.

## 2. METHODOLOGY

### 2.1 Fabrication of electrode

Membrane with composition of 33.0% PVC, 57.0% o - NPOE, 6.0% NaTPB, 2.0 % MWNT and 2.0% 2-hydroxymethyl-15-crown-5 was fabricated<sup>13</sup>. This was used for potentiometric measurements using the cell assembly:



The cell potential was measured for the vegetable samples and standard solutions of  $\text{Mg}^{2+}$  against the reference saturated calomel electrode (SCE) using the developed electrode.

### 2.2 Sample preparation

Two samples each of spinach and broccoli were prepared for estimation of magnesium. The vegetable samples were dried in an oven at 65°C. 0.5 g of dried vegetable was extracted with distilled water. It was filtered in a 100 cm<sup>3</sup> standard flask, spiked with known amounts of magnesium nitrate. The dilution made up to the mark with distilled water<sup>14</sup>.

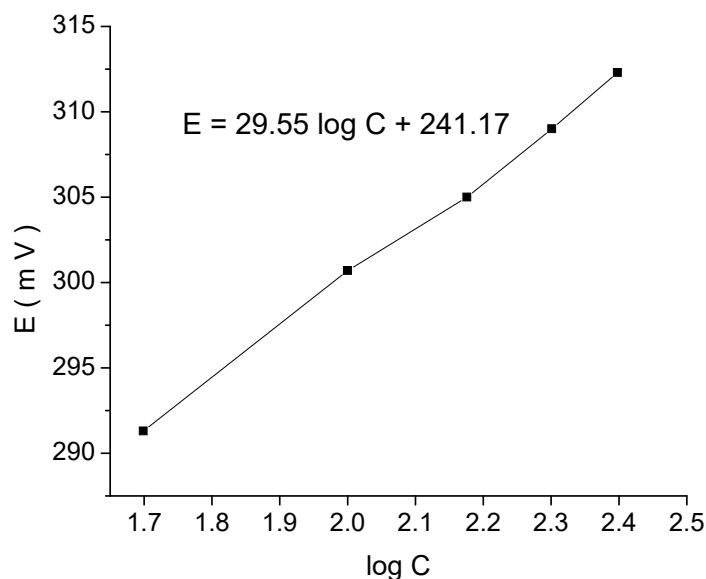


### 2.3 Quantitative analysis

Calibration curve i.e. plot of  $E_{\text{cell}}$  against logarithm of the concentration of  $\text{Mg}^{2+}$  in standard solutions was plotted. ICP – AES analysis of the samples was also carried out.

## 3. RESULTS AND DISCUSSION

Potential measured for the standard solution is plotted against logarithm of the concentration of standard solution of  $\text{Mg}^{2+}$  to obtain the calibration curve (Figure 1).



**Figure 1** Calibration curve for analysis of  $\text{Mg}^{2+}$  in vegetable samples.

Results obtained with the magnesium selective electrode is compared with the ICP – AES method in (Table 1). The results obtained indicates good agreement between the two values.

**Table 1** Determination of magnesium in vegetable samples by potentiometric method using fabricated electrode and by the ICP – AES method.

Vegetable Samples	Amount of $\text{Mg}^{2+}$ (ppm)	
	Magnesium ISE	ICP – AES
Spinach Sample 1	182.81	184.386
Spinach Sample 2	225.42	225.943
Broccoli Sample 1	159.96	160.466
Broccoli Sample 2	218.78	218.594

#### 4. CONCLUSION

The developed PVC membrane sensor based on 2-hydroxymethyl-15-crown-5 provides a simple, cost – effective and efficient method for the determination of  $Mg^{2+}$  in food samples. Thus, providing a more convenient substitute to methods like AAS or flame AAS which have been used for the determination of magnesium in vegetable samples.

#### 5. ACKNOWLEDGEMENTS

Author is thankful to the Management and Department of Chemistry, Royal College for constant encouragement and support. Author is also thankful to SAIF, IIT Mumbai for ICP – AES analysis.

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