Analyzing Serum Electrolyte Fluctuations: The Influence of Short-Term Dietary Changes on Sodium Concentration and Mineral Balance

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Figure 1 ***The soup and salt that were prepared for consumption of a high sodium meal.***

INTRODUCTION

Maintaining precise concentrations of electrolytes in the blood is a very important task for the regulation of cellular function and maintaining body fluid balance. Disruption of the normal electrolyte balance can occur, which may cause several health problems, thus underscoring the need for understanding and monitoring electrolyte homeostasis. The goal of this investigation was to explore the blood serum concentrations of sodium, potassium, calcium, and magnesium using atomic absorption spectrometry, as well as their sensitivities to short-term dietary modification. Through the careful tracking of electrolyte levels with controlled dietary consumption, this study determined the degree of body electrolyte regulation that was allowed within 2 hours after consuming a high sodium meal.

METHODS

Sample Collection: This research began by preparing a bowl of *Maruchan Ramen Noodle Soup* and adding an additional 6g of salt (1 teaspoon) to prepare a soup with a total of 9.86 g of salt **(Figure 1)**. A blood sample was collected moments before the soup was consumed and every 30 minutes for 2 hours after it had been consumed. The blood from these samples was collected by fingerstick into several microcentrifuge tubes. The microcentrifuge tubes were allowed to sit refrigerated overnight to allow the blood to clot and begin separation.

Sample Analysis: The day after sample collection, the blood samples were fully clotted and centrifuged at 2,000 rcf for 10 minutes to ensure full separation of serum and blood cells. The serum from each sample was aspirated from the microcentrifuge tube and diluted 100-fold to make a stock sample. This sample was then diluted to varying concentrations to allow each electrolyte concentration to be within the detection limits of the instrument. Each electrolyte was analyzed using an Atomic Absorption Spectrometer **(Figure 2)** and plotted on a standard curve with an $R^2 \geq 0.996$ to determine the concentration.

RESULTS

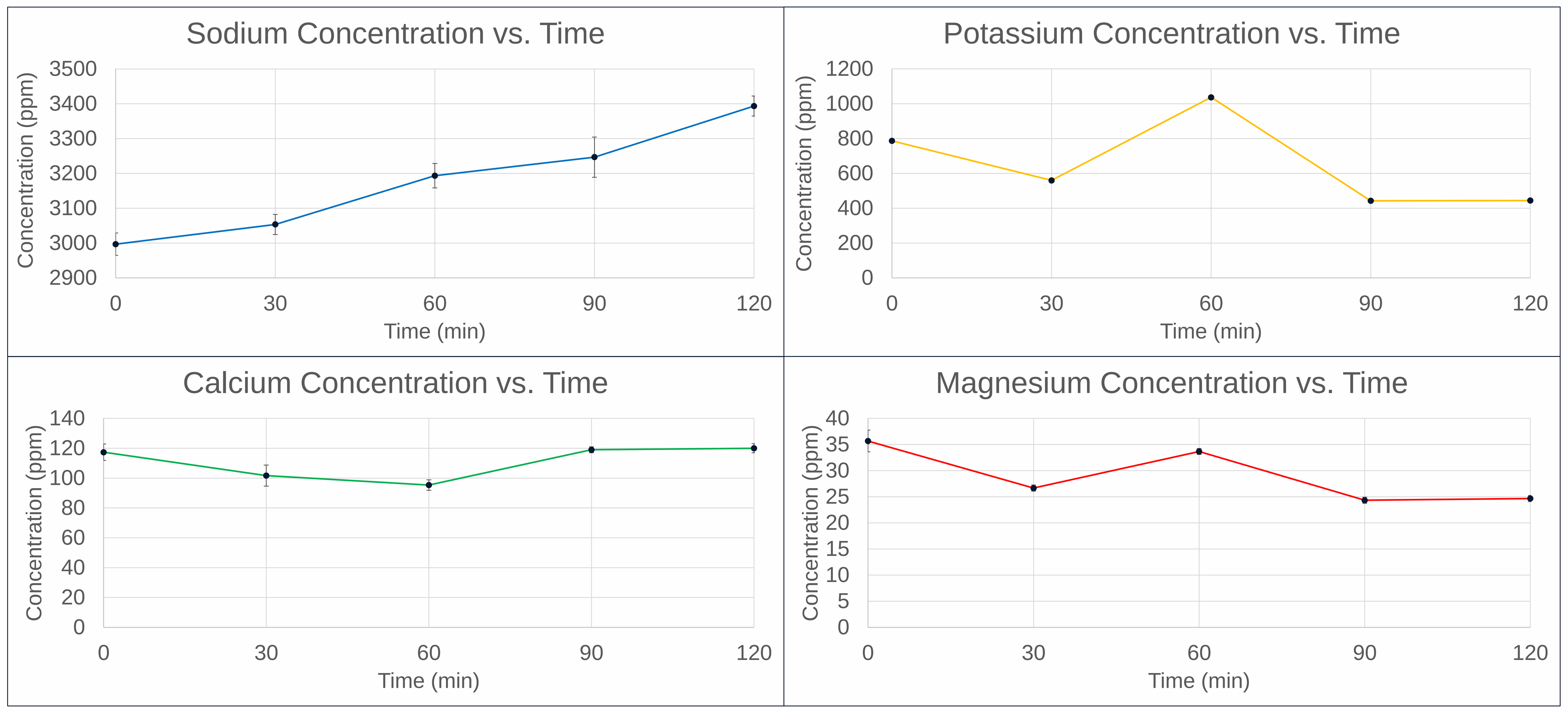

Figure 3 ***Varying concentrations of electrolytes after consuming the high sodium meal over a timespan of two hours with sampling intervals every thirty minutes. Note difference in concentration scales.***

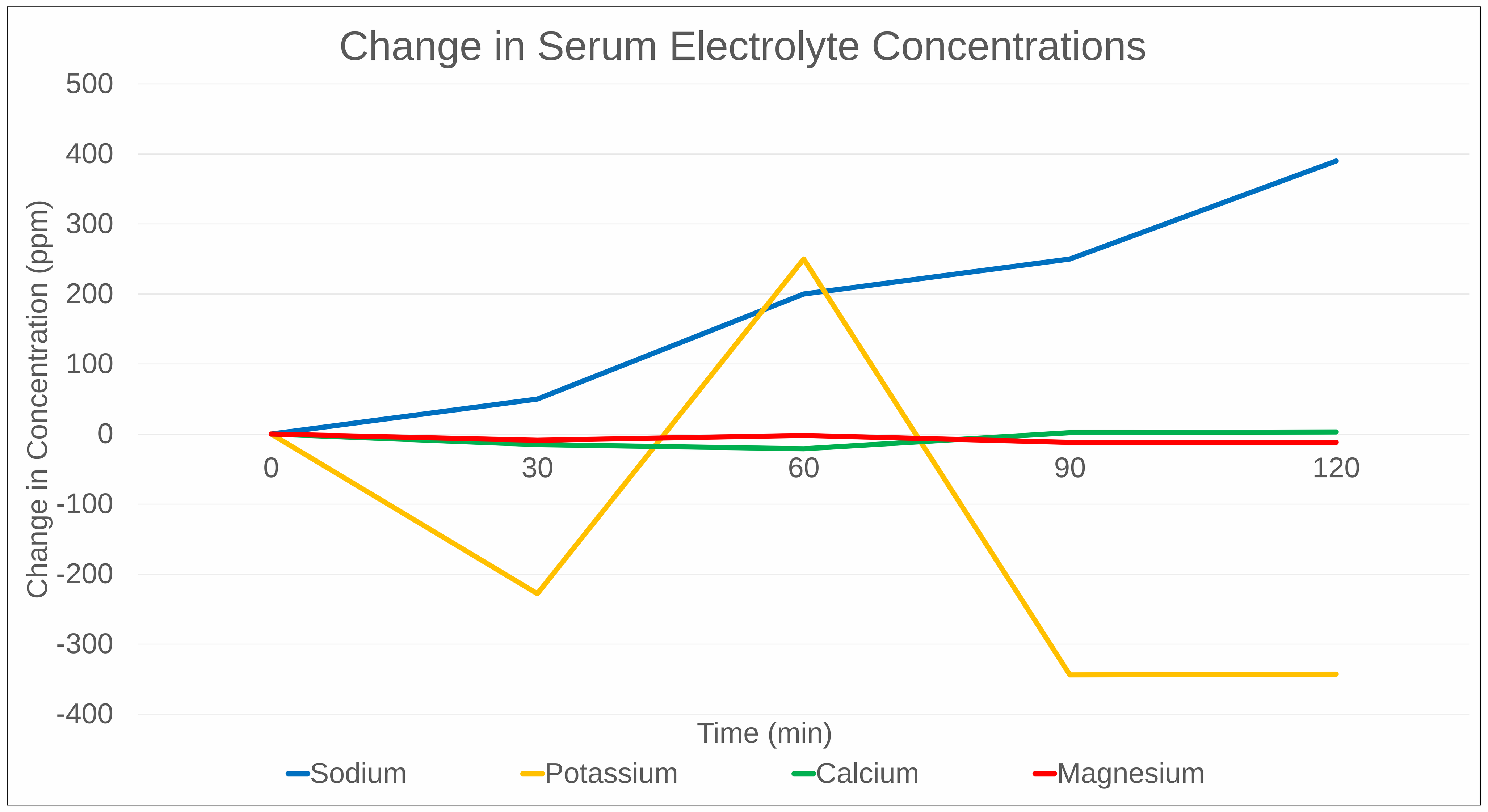

Figure 4 ***The relative changes in electrolyte concentrations when compared to the concentrations moments before consuming the high sodium meal.***

DISCUSSION

In this study, a soup containing a total of 9.86g salt, a number not too far off the FDA's daily average sodium intake for Americans, was shown to immediately increase serum sodium concentration. The sodium concentration at T_0, before the soup was consumed, was on the lower end of the 'normal' homeostatic concentration stated in numerous sources. Even after just 30 minutes, the sodium concentration had begun to rise and had increased by 50 ppm **(Figure 3).** For every 30-minute interval, the concentration of sodium continued to rise and had the largest increase between the 30- and 60-minute intervals. By the end of the 2-hour period at T_{120}, the serum sodium concentration peaked at 3390 ppm, a level on the higher side of the 'normal' homeostatic concentration. This study also displayed the varying concentrations of several other electrolytes including potassium, calcium, and magnesium. The concentration of potassium was very unsteady with peaks both much higher and lower than the T_0 concentration. Even at T_0, the potassium was highly elevated to a level that would be of concern. This elevation in potassium concentration has not been explained and would have to be investigated further to determine the cause. The concentration of calcium was very steady and had a range of only 24 ppm which indicated that the higher concentration of sodium had little effect on the concentration of the calcium **(Figure 4**). If this study were to continue it would be of interest to consume a high calcium meal to determine if the calcium level would vary further. The concentration of magnesium was also very consistent and unaffected by the increased concentration of sodium. A further study attempting to alter the concentration of magnesium would also be of interest. This study had several limitations that should be taken into consideration. By collecting blood through a fingerstick, there is not a very large volume to work with and the serum was difficult to aspirate without disturbing the cells. Time was also a very large restraint. With more time, the procedure would be more consistent and further analysis could be done to improve the results, as well as address any concerns with the original data.

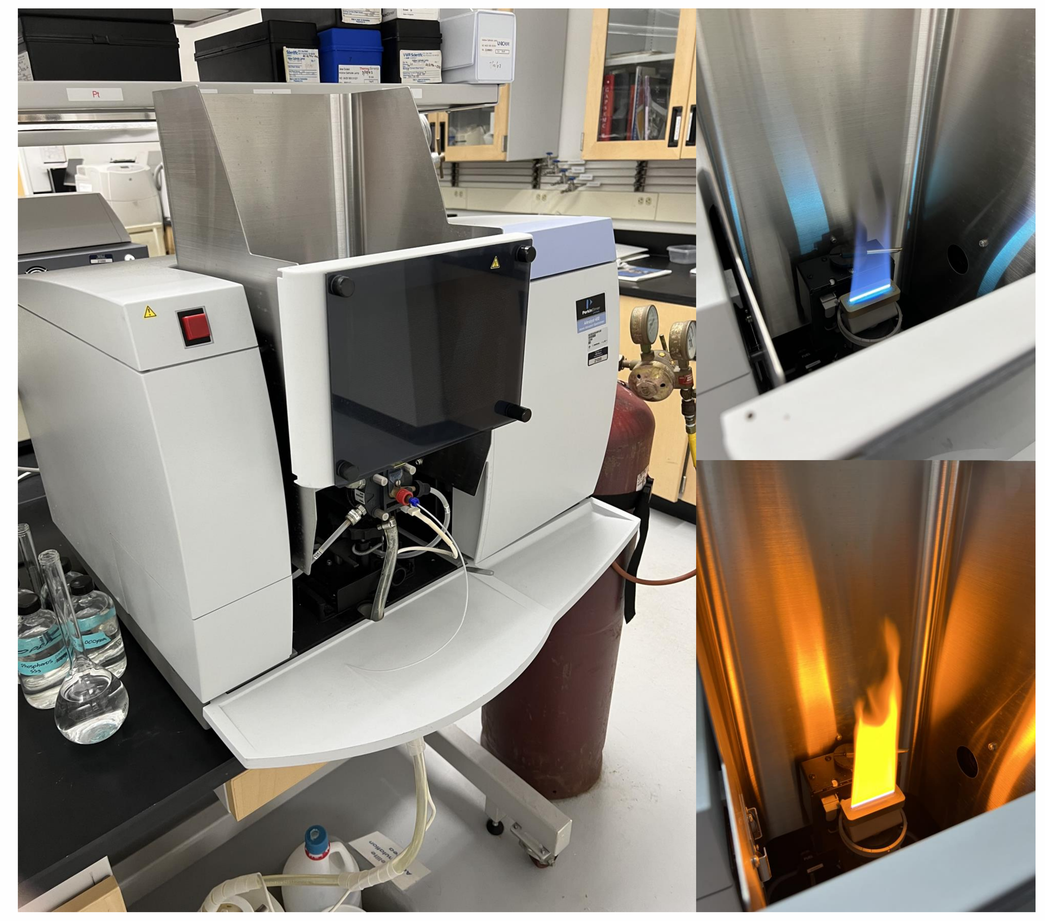

Figure 2 ***Atomic Absorption Spectrometer, with different analytes going through, creating different colored flames.***

CONCLUSIONS & RECOMMENDATIONS

- The concentration of sodium in blood plasma is highly variable and greatly affected by short-term dietary intake of salt.
- The concentrations of calcium and magnesium were very consistent and unaffected by the increased concentration of sodium.
- Further research should investigate the short-term effects of potassium, magnesium, and calcium intake.

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CONTACT

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