

Report

Introduction

Proteinuria happens when there's too much protein in urine, and it's often one of the first signs of kidney damage. Usually, healthy kidneys prevent large protein molecules, such as albumin, from entering the urine. But if the kidney's glomerular filters are damaged, some of that protein leaks through. That's why testing for protein in urine is a valuable way to test for kidney problems. For this project, I created a model of proteinuria using safe artificial urine and explored how protein levels can be detected and measured using a chemical precipitation method.

Purpose

The goal of my project was to develop an artificial urine model that mimics proteinuria and to determine whether I could use alcohol to cause dissolved protein to clump so I could measure it. I wanted to see whether the amount of protein I added would affect the amount of solid precipitate formed when I added alcohol.

Hypothesis

If I add more protein to the artificial urine, then I think the mass of protein that clumps together after adding 99% isopropyl alcohol will increase. This is because alcohol reduces protein solubility, causing them to stick together and form clumps.

Methods

To make artificial urine, I used salt water and added different amounts of egg white protein to model various levels of proteinuria. Every sample had the same total volume and salt concentration. I added the same amount of 99% isopropyl alcohol to each one to precipitate the protein from the solution. Then, I filtered out the clumps using coffee filters, let them dry, and weighed them. To determine how much protein had come out, I subtracted the mass of the empty dry filter from that of the filter with the dried protein clumps.

Conclusion

What I found in this experiment is that you don't always need fancy, expensive equipment to get results. Dipsticks are fast and affordable for screening, and the precipitation method lets you measure the protein. Together, they model how real-life diagnostic tools work, using materials anyone can get. It was pretty amazing to realize that introductory chemistry can help us understand and even help solve real medical problems.

When it comes to accuracy, I feel like the alcohol test gave me a clearer picture of what was really going on in the "urine." Unlike urinalysis strips, which mainly depend on how I interpret colour changes (which can be pretty subjective), the alcohol method lets me measure protein levels by weighing them. This makes the results more reliable, since numbers on a scale are a lot

less open to personal bias than judging colours. In my experiment, using weight to estimate protein amount helped reduce errors and made the data feel more solid.

Proteinuria is a warning sign that the kidneys might be in trouble, and catching it early could make a huge difference for someone's health. Not everyone has access to advanced medical tests, especially in places with fewer resources. Additionally, some governments have to spend thousands of dollars on these tests, which takes away from their societies and hinders economic growth. Having these materials commercially available means they can be taken further and, if appropriately tested, can make a huge difference. That's why it feels important to show that you can use simple, low-cost methods to detect and confirm protein in urine. If this approach could be further developed, it might someday help more people get the care they need, no matter where they live. I'm proud that my project proves how science—when you really think about it—can be both creative and practical, and I hope it inspires more solutions that make a real impact.