An Innovative Method of Room Temperature Biospecimen Preservation via Tetramethyl Orthosilane (Sol-Gel) Encapsulation and Polyethylene Glycol Extraction

Boylan, Jack (School: duPont Manual High School)
Koneru, Kavya (School: duPont Manual High School)

The storage and transport of sensitive proteins is highly expensive and challenging due to the need for refrigeration and cryopreservation. This makes it difficult for impoverished areas to send specimens and samples to labs in order to be tested for various blood deficiencies. In this research study, we introduced a new and innovative method of protein preservation based off sol-gel technology which allows for the transport of specimens at normal (nonrefrigerated) storage conditions. Using hemoglobin and fibrinogen as model proteins, we created a preservation mechanism using the two-step sol-gel process with a few alterations for faster and cheaper production. Tetramethyl orthosilane was hydrolyzed via microwave radiation (30 seconds) and was then condensed to form a silica-cage structure. Upon the addition of polyethylene glycol, the pores of the silica structure expanded allowing for the extraction of the protein. Overall, the sol-gel was able to successfully increase the shelf life of hemoglobin from 48 hours to 31 days, and fibrinogen from 4 hours to 5 days. This innovative method allowed for over 72 samples to be created in under 30 minutes and cost only $6 to produce. Lastly, over 91% of the hemoglobin was extracted from the gel upon the addition of polyethylene glycol. Our sol-gel method will revolutionize the medical industry, due to the demonstrated compatibility with multiple types of proteins. In addition, this method will lead to a substantial cost reduction for the global pharmaceutical industry and provide the opportunity for easier diagnosis in impoverished areas of the world.

Awards Won:
Drug, Chemical &amp
Associated Technologies Association (DCAT): Award of $3,000.
Second Award of $1,500