TITLE: Detection of Pharmaceutical Product Freezing History using Water Proton NMR

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Field
Pharmaceuticals

Technology
NMR
Quality Control
Vaccine
Drug Manufacturing
Freeze-Thaw

Advantages
Contact-free, non-destructive
Fast and Reliable
In Situ testing

Status
Available for licensing

Patent Status
US Patent Appl. 17/436,169

UMB Docket Reference
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External Reference
Yu, Y.B., Briggs, K.T., Taraban, M.B., Brinson, G.B., Marino, J.P. (2021) Grand challenges in pharmaceutical research series: Ridding the cold chain for biologics. Pharm. Res. 38, 3-7.

Briggs, K.T., Taraban, M.B., Yu, Y.B. (2020) Quality assurance at the point-of-care: Noninvasively detecting vaccine freezing variability using water proton NMR. Vaccine, 38, 4853-4860

Summary
Researchers at UMB have created an innovative method that employs water proton nuclear magnetic resonance (NMR) spectroscopy to detect the freezing history of pharmaceutical products. This technology compares the solvent NMR of a suspected product to a reference sample to determine whether the product has been exposed to freezing conditions. The application of this technology has the potential to significantly enhance drug safety by identifying products that may have been compromised during freezing. Moreover, this method could also be implemented in quality control and forensic investigations of drug counterfeiting, further strengthening its utility in the pharmaceutical industry.

Market
Ensuring the safety and effectiveness of pharmaceutical products is a crucial aspect of public health, and pharmaceutical manufacturers are held to stringent quality control standards. A significant challenge in the pharmaceutical industry is to maintain the product's integrity during transportation and storage, where temperature variations can impact the drug's stability and compromise its therapeutic properties. An innovative method developed by UMB researchers has various potential applications in the pharmaceutical industry, particularly for continuous monitoring during production to detect if the product has been subjected to freezing.

This method is simple, reliable, and suitable for monitoring drugs during transport and storage, providing assurance that the product's quality has not been compromised. This technology is particularly valuable for products that require cold chain storage, such as vaccines and biologics, as they are highly sensitive to temperature fluctuations. The economic impact of vaccine wastage due to cold chain lapses is significant, with billions of dollars lost globally due to the cost of wasted vaccines, storage, transportation, and handling. Reports suggest that the COVID-19 vaccine wastage alone could cost up to $5 billion globally.

In addition to the financial impact, vaccine wastage can also have a significant effect on public health, leading to increased risks of disease outbreaks and potential deaths. The WHO estimates that around 1.5 million children die each year from vaccine-preventable diseases, with inadequate vaccine storage and transportation contributing to a significant portion of these deaths. Reducing vaccine wastage due to cold chain lapses can help utilize more vaccines effectively, potentially reducing the incidence of vaccine-preventable diseases and saving lives.

Technology
The invention presents a novel method for detecting freeze-induced damage in aqueous-based pharmaceutical products, such as vaccines, peptides, proteins, nucleic acids, and other biologics or small molecules. The method relies on measuring the transverse relaxation rate of the solvent R2,m in the frozen or suspect product and comparing it to a reference transverse relaxation rate of solvent R2,r, which serves as an acceptable range for non-frozen products. This approach offers a simple, non-invasive, and reliable means for quality control of pharmaceutical products during storage, handling, and distribution.

The method has several advantages over traditional techniques for detecting freeze-induced damage, such as visual inspection or chemical assays. Firstly, the NMR-based method does not require the opening of the vial containing the product, thereby minimizing the risk of contamination or loss of potency. Secondly, the method can be performed rapidly and

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reproducibly, providing an accurate and quantitative measure of the extent of freeze-induced damage. Thirdly, the method can be applied to a broad range of pharmaceutical products that contain various types of excipients, surfactants, or organic solvents, making it highly versatile and applicable to different stages of drug development and manufacturing.

The ability to detect freeze-induced damage in pharmaceutical products is of utmost importance for ensuring product safety, efficacy, and compliance with regulatory standards. Freeze-induced damage can lead to protein denaturation, aggregation, or degradation, which can compromise the product's stability, potency, and immunogenicity. Moreover, the presence of freeze-damaged products in the supply chain can pose a significant risk to public health, as it may result in vaccine failures, drug resistance, or adverse events. The NMR-based method developed by the inventors provides a valuable tool for pharmaceutical manufacturers, regulatory agencies, and healthcare providers to monitor and maintain the quality of pharmaceutical products, ultimately enhancing patient safety and health outcomes.

Technology Status

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