Rapid Norovirus Detection Using Magnetic Beads-Based RNA Extraction and Colorimetric RT-LAMP

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Norovirus is the leading cause of gastroenteritis worldwide, causing over 685 million cases each year globally, yet rapid and sensitive detection tools remain limited. All diagnostic technologies are either very accurate but too slow and expensive, such as the RT-qPCR, or fast but not sensitive enough, like rapid antigen tests and enzyme immunoassays. Therefore, these methods prove ineffective for settings where norovirus outbreaks are the most common, such as long-term care facilities, food factories, and childcare centers. This project develops a workflow combining magnetic beads-based RNA extraction and RT-LAMP with HNB dye to fill this gap, with a goal of detecting norovirus in under an hour without losing significant sensitivity compared to RT-qPCR, the industry gold-standard. Two extraction methods were evaluated and compared for their RNA yield, purity, and time consumption. RT-LAMP was tested with a variety of primers, paired with norovirus RNA, unrelated RNA, and a blank to identify the primer in amplification optimized for sensitivity and specificity. A series of ten-fold dilutions ranging from 10^7 copies/μL to 10 copies/μL, along with a blank, were used with HNB dye, which turns from purple to blue if amplification occurs, to determine the sensitivity of RT-LAMP to be compared to other methods. The final workflow detects norovirus at around 10^3 copies/μL, providing results in 45 minutes. This low-cost, accessible approach has potential for timely outbreak management in diverse settings, offering a rapid alternative to traditional laboratory diagnostics.

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