The first point-of-care genetic test for lactose intolerance: A compact, lab-on-phone diagnostic assay

By Dr. Chinta Sidharthan

Reviewed by Lily Ramsey, LLM

Sep 4 2023

In a recent study published in *The Journal of Applied Laboratory Medicine*, researchers evaluated the performance of a compact diagnostic assay that can accurately and rapidly diagnose lactose intolerance using capillary blood and buccal swab samples.

Study: A Genetic Lab-on-Phone Test for Point-of-Care Diagnostic of Lactose Intolerance near Patient and in less than 90 Minutes. Image Credit: KomootP/Shutterstock.com

Background

A decrease or absence in the synthesis and activity of the lactase-phlorizin hydrolase enzyme (LPH), commonly known as lactase, results in lactose

intolerance. Lactase, or LPH, is essential for breaking down lactose, and the expression of LPH is genetically programmed to be downregulated during adulthood.

The ancestral state in humans for the processing of lactose is the lactase non-persistence (LNP) phenotype, also known as adult-type hypolactasia, and individuals who have retained this ancestral phenotype experienced bloating, intestinal cramps, flatulence, and diarrhea upon consuming lactose.

However, while most adults can tolerate small quantities of lactose without much discomfort, some can consume lactose without any symptoms of lactose intolerance.

The minichromosome maintenance complex component 6 (MCM6), an upstream transcriptional enhancer, regulates the expression of the *LCT* gene that codes for lactase.

Single nucleotide polymorphisms (SNPs) or single base-pair mutations in the MCM6 region have resulted in an alternate phenotype called lactose persistence or LP, which enables individuals to digest lactose throughout adulthood.

A quick and efficient method to diagnose lactose intolerance based on these two phenotypes would help lactose-intolerant individuals formulate or modify dietary strategies.

About the study

In the present study, the researchers evaluated the performance of a pocket-sized, compact diagnostic assay that uses capillary blood samples or buccal swabs to detect the presence of the -13,910 C/T SNP, where the cytosine on the 13,910th position of the minus strand of the gene has been replaced by a thymine nucleotide.

While this diagnostic assay is designed to process the samples within 90 minutes, one of the shortcomings of this method is that the different SNPs in the enhancer region of the lactase gene are specific for other races and ethnicities, and the -13,910 C/T SNP is indicative of lactose intolerance only among Caucasian individuals.

The existing methods for detecting the -13910 C/T SNP are largely polymerase chain reaction (PCR)-based, but other methods such as microarrays, Sanger sequencing, restriction fragment length polymorphism, and pyrosequencing have also been used.

However, these methods are all resource and time-intensive and require experienced personnel. The loop-mediated isothermal amplification method, or LAMP, offers similar performance with the added advantages of being isothermal, not requiring a thermocycler, and being able to amplify ribonucleic acid (RNA) or deoxyribonucleic acid (DNA) templates in less than an hour.

Here, the researchers compared this lab-on-phone isothermal lactose intolerance diagnostic assay called STAB VIDA Lda performed using capillary blood samples and buccal swabs with the Sanger sequencing assay that tested for the -13,910 C/T SNP in blood samples.

The limit of detection was also calculated at varying concentrations of samples. The STAB VIDA assay is economical and is based on the LAMP method, costing about 30 times less than the common quantitative PCR-based methods.

It is also housed in a reusable and portable device and can be operated and managed using a mobile application.

Results

The results indicated that the STAB VIDA Lda isothermal lactose intolerance assay was able to efficiently detect the -13910 C/T SNP with a five cells per assay limit of detection and 98.41% and 100% accuracies for buccal swab and capillary blood samples, respectively.

Furthermore, the entire process, from sample collection to obtaining the results, was completed in 90 minutes, with the hands-on time being just 2 minutes. The detection limit obtained for the STAB VIDA Lda assay is comparable to the existing gold-standard methods of Sanger sequencing and PCR-based assays.

In addition to the high efficiency and accuracy, the ease and affordability of this pocket-size lab-on-phone lactose intolerance detection assay make it a highly useful tool for managing symptoms of individuals with lactose intolerance.

Circumventing the need to send samples to a specialized facility helps reduce the processing time.

Furthermore, it also helps distinguish between primary and secondary forms of hypolactasia, where the primary form is due to genetic mutations in the enhancer region, and the secondary form is due to injuries to the small intestine. It does not require the same dietary restrictions as the primary form.

Conclusions

Overall, the findings suggested that the pocket-sized STAB VIDA Lda lactose intolerance diagnostic assay efficiently detected the -13,910 C/T SNP within the Caucasian population.

It also provided a time-saving and cost-effective option to distinguish between primary and secondary adult hypolactasia to manage therapies and dietary interventions.

Journal reference:

- Conceição, M. et al. (2023) "A Genetic Lab-on-Phone Test for Point-of-Care Diagnostic of Lactose Intolerance near Patient and in less than 90 Minutes", *The Journal of Applied Laboratory Medicine*. **doi:** 10.1093/jalm/jfad052. https://doi.org/10.1093/jalm/jfad052

Written by

Dr. Chinta Sidharthan

Chinta Sidharthan is a writer based in Bangalore, India. Her academic background is in evolutionary biology and genetics, and she has extensive experience in scientific research, teaching, science writing, and herpetology. Chinta holds a Ph.D. in evolutionary biology from the Indian Institute of Science and is passionate about science education, writing, animals, wildlife, and conservation. For her doctoral research, she explored the origins and diversification of blindsnakes in India, as a part of which she did extensive fieldwork in the jungles of southern India. She has received the Canadian Governor General's bronze medal and Bangalore University gold medal for academic excellence and published her research in high-impact journals.