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From the Editor's Desk

Strategies for the Storage of DNA

There has been a spate of discussions in recent months (and years) on the topic of methods necessary to optimize the storage of DNA. This discussion is of paramount importance to epidemiological, genetic, and clinical databases and to the forensic sciences. DNA, while generally considered a relatively stable macromolecule when purified and stored dry, is also very susceptible to water (even moisture) that may cause hydrolysis, to sample and environmentally derived DNAses, ionizing radiation including ultraviolet light, free radicals, and a host of other destabilizing conditions (i.e., thermal cycling).

Four strategies of DNA preservation are common: (1) room temperature storage on a "dry" solid matrix, (2) −20°C, (3) −80°C, and (4) −196°C, but with some notable variations. Two of these storage conditions share a common "mechanism of protection" in that both the "dry state" preservation and cryopreservation at −196°C maintain the DNA in the glassy or vitreous state. In the glassy state, molecules lose translational motion (the ability to diffuse) such that the movement of a proton (the hydrogen ion) has been estimated to be approximately one atomic diameter in 200 years. In other words, chemical reactions are improbable in a time frame of centuries. However, if either moisture is added to the "dry state" or temperatures cycle above the glass transition temperature of water (nominally −135°C), reactivity is reestablished and not necessarily at infinitesimally slow rates (recall that hydrogen ions travel more rapidly through ice than through an aqueous liquid).

Storage at elevated subfreezing temperatures (−20°C to −80°C) may well provide adequate conditions depending on the quality and quantity of DNA desired and the time frame in which the sample will be stored. Neither of these conditions will, however, provide long-term storage quality equivalent to maintenance at liquid nitrogen temperatures.

There are few studies that provide definitive answers to the question of optimal storage conditions for DNA. The National Cancer Institute and the National Institute of Standards and Technology have published some data on comparative storage outcomes, which suggest that "colder is better." We recognize this generalization from our understanding of the principles of cell cryopreservation, which by definition requires a high degree of DNA preservation. However, we are faced with a broader set of variables when discussing *ex vivo* DNA storage optimization protocols. These variables relate to isolation methodologies, the integrity of storage conditions, and sample testing techniques. When combined, these variables render comparisons difficult. Without a comprehensive, multicenter analysis of process standardization, it is unlikely that we will arrive at a determinative optimization strategy. One can mitigate many of these variables by faithfully adhering to protocols that provide for highly stable storage conditions. Dry matrix storage should be dry and devoid of changes in moisture content. Cryopreservation conditions must rely on stable, noncycling temperatures. With stability, sample integrity will be optimized for the storage condition of choice.

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