

-70 is the new -80

The report

The idea

Chilling up your ultra-low freezer from -80°C to -70°C has two major benefits: it can reduce energy consumption by 30%, and in doing so it can prolong the life of your freezer. This means less down time, and less chance that your samples will be compromised.

But is it safe to store my samples at -70?

In the majority of cases the answer is a resounding YES. Nucleic acids can be safely stored at -20°C, and most proteins can be safely stored at -70°C. Bacteria and viruses are also generally safe at -70°C. In fact, fifteen years ago *all* ultra-low freezers were set to -65°C or -70°C. The drive to continually lower freezer temperatures has more to do with marketing and selling freezers than it has to do with science.

Has anyone else tried this?

YES. CU-Boulder has 60% of their ultra-low freezers set to -70°C. UC Davis, Harvard, Dartmouth, UCSB and UPENN are among several universities that have participated in the freezer challenge to reduce energy consumption of ultra-low freezers by chilling them up to -70°C. In addition, the CDC Centers for Disease Control recently raised the temperature on 60 of their freezers, reducing energy use by ~40%. On the following link, you will find a list of research from CU Boulder and UC Davis who set up their freezer at -70°C:

<https://docs.google.com/spreadsheets/d/13UvBeoXAhwSHshSYoUDHwxcWiW7qYLnUb-eLwxJbCYs/pub?hl=en&hl=en&single=true&gid=0&output=html>

But why -80?

<https://www.youtube.com/watch?v=T4EKaijADl>

What do you usually store in your ULT freezer?

- Plant tissue to be used for RNA isolation, DNA isolation, metabolite isolation, protein isolation
- Isolated RNA, primer
- Cells
- Specimen
- Enzyme
- Protein, plasmid
- Reagent, chemical, stock solution, buffer
- Bacteria with cloned DNA (various types of libraries)

Supportive literature:

Stability of Genomic DNA at Various Storage Conditions

Wu J. et. al., Stability of Genomic DNA at Various Storage Conditions. Poster Presentation, QACO3 ISBER Meeting (2009).

This study found that genomic DNA stored at both -20°C and -80°C remained stable over 24 months and 19 freeze thaw cycles. There was no appreciable difference in the quality of the DNA and degree of degradation was very similar. The study further found that for short term studies, DNA can be stored at 4°C or even room temperature for periods less than 3-6 months.

Stability of Extracted RNA at Various Storage Temperatures and through Multiple Freeze-Thaw Cycles
Wu J. et. al., Stability of Extracted RNA at Various Storage Temperatures and through Multiple Freeze-Thaw Cycles. Poster Presentation, QACO3 ISBER Meeting (2011).

This study demonstrated that the stability of purified RNA is the same when stored at either -20°C or -80°C. In both cases the RNA was stable over 10 freeze-thaw cycles and showed no change in quality in storage for one month. There was no difference in stability between -20 and -80°C.

Long-term stability of parameters of antioxidant status in human serum

Jansen EH. et. al., Long-term stability of parameters of antioxidant status in human serum. *Free Radic Res.*, Jul (2013) 47(6-7):533-40.

This study examined the temperature stability of antioxidants for 12 month sample storage. The antioxidants were applied to human serum samples and stored at -20, -70, and -196°C. The study concluded that there is no statistically significant difference in the samples stored at different temperatures. The author claims that storage at -20°C is sufficient to maintain assay outcome for most antioxidant assays, though suggests that -70/80°C may be preferred for storage times over 1 year..

Long-term Stability of Viral Markers in Plasma

Garrett PE, Miller L, Anekella B, Manak MM, Long-Term Stability of Viral Markers in Plasma. Poster Presentation, Clinical Virology Symposium (2008).

This study examined the temperature storage stability of minimally processed plasma panels. The tests were conducted for anti-HIV, anti-HCV, and HBsAg over 11 to 20 years using PCR methods. Samples were stored in -20°C in cycling frost free freezers, and saw no detectable deterioration and no downward trend in reactivity.

Twenty Year Stability Study of HIV, HBV, and HCV Antibodies, Antigen and Nucleic Acids in Plasma

Miller L, Anekella B, Manak MM, Garrett PE, Long-Term Stability of Viral Markers in Plasma. Poster Presentation, TTID1L Testin gIssues (Virology), AABB Annual Meeting and TXPO (2008).

This is a study of frozen human serum and plasma samples. Seroconversion panels containing HIV and HCV antibodies, HBsAg, and viral RNA and DNA were evaluated. Samples were collected between 1981 and 2000. The findings report that the Antibodies are stable in plasma stored at -20°C for 13-20 years. The RNA however has significant degradation in these storage conditions over several years, while DNA is possibly degrading.

All samples are stable for at least 10 years in long term storage at -70°C.