CORRESPONDENCE/

Questions of Stability

To the editor:

The article by Roser et al. ("Extraordinary Stability of Enzymes Dried in Trehalose: Simplified Molecular Biology" *Bio/Technology* **10**:1007-1012, September) touting trehalose as unique in its ability to stabilize dried enzyme preparations contains some questionable assertions. In particular, the general statement that "all monosaccharides tested, whether reducing or non-reducing, were ineffective as were polymers such as insulin, ficoll and dextran" is, we feel, erroneous.

We have demonstrated unequivocally (*Biotechniques*, in press) that a variety of enzyme formulations can be stabilized using alternative carbohydrates and carbohydrate polymers. Furthermore, the process and materials have withstood the rigorous quality control protocols for reproducibility and long shelf-life (Figure 2 in our paper in *Biotechniques*) necessary to make our approach a commercial reality (Ready-To-Go). In our paper, we describe, for example, stabilized DNA sequencing formulations which contain *all* the necessary reagents. It is not clear to me whether Roser et al. have succeeded in this endeavor from the abbreviated experimental protocol section.

I am enclosing a copy of our pre-publication referred to above to substantiate our claims and clarify the situation. There are other, better-characterized approaches to select when one is interested in preparing stabilized, simplified molecular biology reagents which are equally "extraordinary" to those in the Roser et al. article.

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The Authors Reply:

Burdick in his letter questions our assertion that trehalose is unique in its ability to stabilize dried enzyme preparations. However, the sole paper he cites in support of his claim (*Biotechniques*, in press) contains no data comparing trehalose to any other carbohydrate or carbohydrate polymer in the stabilization of any enzyme preparation. Moreover, the paper contains no data on the use of any other carbohydrates and does not even reveal the nature of the carbohydrate polymers used in the experiments reported therein.

Burdick clearly misunderstands our paper, as our claim is not that trehalose alone can stabilize dried enzymes. Indeed we specifically reported the modest degree of stabilization achievable with alternative carbohydrates (see Table 1 and relevant results section). The crucial point we make is that the stability conferred by trehalose far exceeds that observed with any of the other carbohydrates or polymers under identical conditions of prolonged storage at high temperatures.

As stated in our paper, we think that the Maillard reaction between reactive or unstable sugars and the protein product is the most likely cause of progressive deterioration as has been well-documented in food chemistry. However, even by the dogma of the glassy state theory, all carbohydrates cannot be equivalent in their abilities to stabilize dried enzymes as they all have unigue Tg values!

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Stem Cells in Space

To the editor:

I noted with interest the article by Stephen Edgington which included a section on the use of specialty bioreactors and the microgravity environment of space to expand hematopoietic stem cell populations ("New Horizons for Stem-Cell Bioreactors" *Bio/Technology* **10**:1099-1107, October). This feature presents an excellent overview on the potential use of bioreactors for selective culture of the hematopoietic precursors from heterogenous populations of bone marrow cells in a reduced shear environment balanced by adequate mixing to ensure nutrient supply, removal of metabolic wastes, and factors modulating lineage differentiation.

The cover depicting the space shuttle and a micrograph of cells is an outstanding presentation of the potential and direction of basic and biotechnological research in specialty bioreactors and space. Indeed, the first experiment showing that stem cell expansion could be achieved using the low-shear bioreactors developed by NASA was conducted by B.D. Lawless and M.L. Lewis in 1989 and reported at the American Society for Cell Biology (B.D. Lawless, M.L. Lewis, L.S. Neale, and S.R. Gonda, *J. Cell. Biol. Abstracts* **109**:332a, Abs # 1824). We proved the hypothesis that the combination of low-shear, spatial separation of cells suspended in the culture medium and the environment of the bioreactor provided an advantage to stem cell expansion. Based on our preliminary investigations with stem cells in bioreactors, we are now investigating cellular-level adaptation in space as a means of "natural selection" for desired cell types, that is, hematopoietic stem cells on the space shuttle. Our precursor experiments flown on shuttle flight STS-43 in 1991 identified a significant mouse bone marrow population of SCA-1 and Thy-1 positive cells post-flight. Bone marrow cells will be flown again on STS-52 (October, 1992) as a continuation of this research.

Currently, NASA supports commercial development of space, a fact of which many private sector biotechnology companies are unaware. Biotech companies can access space by two routes, one through a value exchange in

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