CONTAINER DEVICE DESIGNED FOR THE SAFE TRANSPORT OF BIOMACROMOLECULES

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(Status: patent pending)

Abstract
This invention is a useful container device that protects biological materials during their transport by land, sea or air. Its design and technology prevent changes in pressure and temperature that could affect the stability of biomacromolecules. The device is able to keep samples isolated even on long intercontinental trips.

Background

The biological systems exhibit metastability, which is a long time weakly stable thermodynamic equilibrium state in the bonds between the constituent elements of polymers such as DNA, RNA and proteins. When these samples are transported, it is very necessary to take care of the transport conditions in order to preserve their structure and physicochemical properties.
The Dewar vessel is a container designed to provide thermal insulation and reduce heat losses by conduction, convection or radiation. It has been widely used to isolate, protect and transport samples but its construction makes it very sensitive to the blows and overpressures on the outside of the container.

Dewar's advantages	Dewar's Disadvantages
✓ Facilitates transportation.	× Fragile.
✓ Protects the samples at low temperature.	× High construction cost.
✓ Isolates the system from vibrations, agitations, oscillations etc.	× Not so easy to handle.
✓ Ensures the sample's thermodynamic stability.	× Loss of isolation due to bad manipulation.

There are other options, like the containers made of thermoplastic polymers, but these do not avoid external disturbances like the Dewar container.
The other attempts of isolation and transportation systems are not designed for materials that need to avoid the temperature changes and external disturbances, in order to maintain their stability, for example, protein crystals and other huge amount of biological samples of macromolecules.

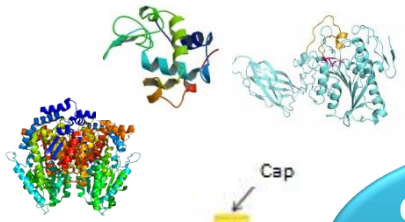
Stage of research

The researchers have designed and developed a device capable of isolating biological macromolecules from external perturbations.
The design, as showed below, includes a container with holes in which a glass tube (NMR tube) is inserted, and into which the capillary tubes are placed with the biological samples. It has a closed system that prevents spills or leaks.

In addition, an insulating gel is added to the container in which these capillaries are immersed or inserted. This gel, allows to completely isolate the sample from external disturbances.

This device has been successfully tested with protein crystals:

- ✓ **Lipases** have been used as a thermal sensor since their crystals dissolve when there are changes in their crystallization temperature (which is 18 ° C and variations within a range of ± 2 ° C can affect them considerably). In intercontinental trips, with changes in atmospheric pressure and temperature, it has been possible to verify that the lipase remains in crystalline phase unchanged when transported with this device.
- ✓ Samples of **glucose isomerase** and **lysozyme** were transported in this device to two different synchrotons, each located in Trieste, Italy (Elettra) and SLAC in Stanford, California, USA. In both cases the crystals diffracted X-rays at a very high resolution, which implies that there was no structural damage in the transport.



Container device for safe transport of biomacromolecules

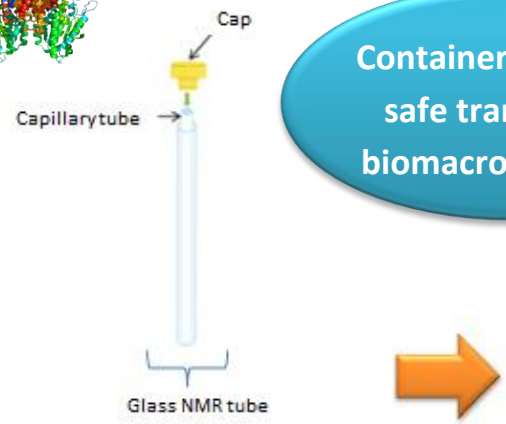


Figure B

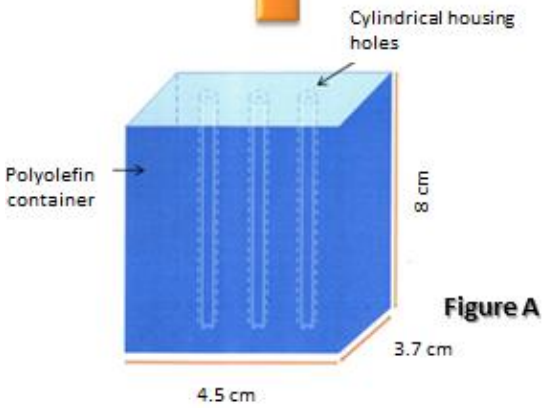


Figure A

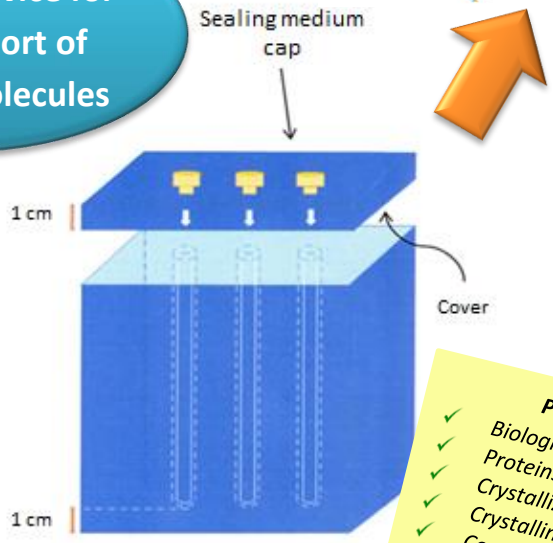


Figure C

Protected materials:

- ✓ *Biological macromolecules*
- ✓ *Proteins*
- ✓ *Crystallized proteins,*
- ✓ *Crystalline compounds,*
- ✓ *Cocrystals, polymorphs,*
- ✓ *Hydrated polymorphs,*
- ✓ *Solvated polymorphs,*
- ✓ *Salts,*
- ✓ *Powders,*
- ✓ *Powdered proteins,*
- ✓ *And / or materials sensitive to changes in temperature.*

Applications

The invention may be applied - without its scope limitation - to the protection and transport in general of any material which must be isolated from changes in temperature and / or external disturbances.

A very useful application is for those people who use synchrotrons.

Advantages

The materials and design of this device isolates the sample from external changes. The main container is made of polyolefin, which is useful and suitable for material transport and protection devices because it allows thermal insulation, avoids external disturbances, such as vibrations, agitation, blows or oscillations that affect thermodynamic stability of the sample, preventing it from losing its properties, especially those that have to do with its solid state, such as crystals.

Moreover the gel, in which the capillaries are submerged or inserted, will isolate the sample transported from external disturbances such as vibrations, shaking, shocks and / or oscillations, as well as temperature changes.

To summarize, this device:

- ✓ **Protects** against temperature and pressure changes.
- ✓ Avoids **external disturbances** (vibrations, agitation, shaking, oscillations, etc.)
- ✓ **Practical** device.
- ✓ **Easy** to handle.
- ✓ Designed (but not limited to) for **biomacromolecules** transport.

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