



New Publication: Sterilization of Lung Matrices by Supercritical Carbon Dioxide.
Balestrini *et al.*, *Tissue Eng. Part C* 22:260-9.

A group including Laura Niklason at Yale University completed a study further demonstrating the unique value of the Nova scCO₂ sterilization process in preserving the structure of extremely sensitive ECM scaffolds for tissue engineering. Lungs are naturally exposed to a large number of micro-organisms and great care in sterilizing donor lungs is required. Full sterility and long-term storage capability remain the main challenges to lung transplants, but γ -radiation, e-Beam, ethylene oxide and PAA perfusion are damaging to ECM matrices. In this study, decellularized rat lungs were shipped to NovaSterilis for Nova scCO₂ sterilization, and samples were returned to Dr. Balestrini for an independent assessment of the sterile products, in a direct comparison with PAA perfusion

Sterilization tests were completed with 2mL NovaKill™ PAA additive added in a 20-Liter Nova2200 vessel, with preconditioning and scCO₂ exposure times optimized to achieve full bioburden inactivation and SAL6 endospore inactivation. For comparison, decellularized lungs were also sterilized with 1,000ppm PAA perfusion

Histological evaluation showed no significant damage to the lung ECM post-sterilization. After 6-month storage, Nova scCO₂ sterilized samples retained their integrity whereas PAA-sterilized samples showed evidence of significant damage. Mechanical testing showed no effect of PAA perfusion or Nova scCO₂ sterilization at typical strain levels, while both methods resulted in stiffer tissue under high strain. After six months of storage, PAA-sterilized tissue failed under low strain deformation, whereas the stiffness of Nova scCO₂ -sterilized samples remained unchanged.

Biochemical analyses and tissue staining comparing decellularized and sterilized tissue showed that neither sterilization method affected the total content in collagen or sulfated glycosaminoglycans (sGAG), two key components of the ECM. However, PAA perfusion lead to a significant reduction in desmosin levels, important for tissue elasticity. Desmosin level were unchanged with Nova scCO₂. Staining did not show any evidence of Nova scCO₂ affecting the architecture of type I collagen, laminin, sGAG and elastin.

Finally, successful attachment and elongation of both epithelial and endothelial cells onto Nova scCO₂ -sterilized decellularized lungs after 6 months of storage demonstrated the biocompatibility of the produced tissue over an extended period of time.

Overall, the success of this approach further demonstrates the value of the NovaSterilis process in producing non-damaged sterilized tissue, confirming the recent findings in a separate study on the sterilization of amniotic membranes (LINK to amnion paper press release on our website – which is not there, I need to make it)

Current scCO₂ applications

The NovaSterilis technology is being utilized by both US and International Tissue Banks to produce sterile allograft tissue in final packaging ready for transplantation. To date over 90,000 scCO₂ sterilized allograft transplants have been performed with no adverse reports. This sterilization technology is currently employed for sterilization of 2 medical devices with regulatory approval. NovaSterilis is now offering a larger 80 liter scCO₂ sterilization unit, the Nova8800, to meet the high throughput needs of larger tissue processors and medical device manufacturers. NovaSterilis' scCO₂ process provides the medical materials industry with a safe and effective, in house, low cost terminal sterilization alternative.

About NovaSterilis

NovaSterilis currently markets terminal sterilization technology and equipment related to their supercritical carbon dioxide platform. The supercritical or fluid phase of CO₂, occurs at low pressure (72.9 atm) and moderate temperatures (31.1 °C). ScCO₂ retains advantageous properties of the gas and liquid phases of carbon dioxide making it an ideal fluid for manufacturing processes. The company currently markets the Nova 2200 (20 liter) and Nova8800 (80 liter) fully automated scCO₂ terminal sterilization equipment. NovaSterilis is a privately held biotechnology company located in Lansing, New York. NovaSterilis is the recipient of a 2007 Presidential Green Chemistry Challenge Award presented by the Environmental Protection Agency.

For more information on NovaSterilis and supercritical carbon dioxide visit www.novasterilis.com or call 607-330-2772.