



## Equipment Inventory at the Pre-Pilot Plant facilities of DTU Biosustain

Pre-Pilot Plant, The Novo Nordisk Foundation Center for Biosustainability

Actualized 08-08-2022

Equipment Type	Manufacturer Name	Model Name	Description From Manufacturer's Website
<b>Upstream Processing:</b>			
Microfluidic Microbio-reactor	M2P Labs	Robolector XL	The disposable 48 well microtiter plate of the BioLector® Pro features online measurements of biomass, fluorescence, pH and DO and simultaneously controls the pH and feeding rates through microvalves and microfluidic-channels. This unique microfluidic plate allows continuous feeding and pH control in standard MTP formats. The RoboLector® provides a unique automated cultivation platform combining the high-throughput fermentation and the online monitoring capability of the BioLector® with the very accurate and reproducible pipetting of a liquid handling robot. The system is used for media preparations, automated sampling and dosing steps, inductions and fed-batch processing. Only aerobic processes possible at Cfb.
Automated Multi-Parallel Bioreactor	Sartorius	ambr® 250	ambr® 250 high throughput is an enhanced parallel microbial or cell culture system using 100 - 250 mL single-use bioreactors with a fully automated liquid handling platform. The system provides a high precision environment that supports the demands of microbial fermentation and mammalian cultures. ambr® 250 high throughput provides an efficient and rapid scaledown system to explore a wide range of conditions and strains with scalability to both bench top and larger stirred tank bioreactors. Setup with 24 bioreactors available at Cfb.
1 L Bioreactor	Sartorius	BIOSTAT® Qplus	The BIOSTAT® Qplus is a fermenter/bioreactor designed for screening applications in early development and multivariate process optimization studies. Manual operation is reduced to a minimum. Three 1L bioreactors available at Cfb. One Numera (Lucillus) autosampler for 1L bioreactor available.
30 L Bioreactor	Sartorius	BIOSTAT® Cplus	The BIOSTAT® Cplus is a Sterilizable-In-Place (SIP) fermenter/bioreactor developed for the cultivation of microorganisms and cell cultures. With more than a thousand installations worldwide, the BIOSTAT® Cplus is the most successful stainless steel bioreactor of its class and is now available in the revised 3rd generation with DCU controller. Two 30 L bioreactors available at Cfb. The 30 L bioreactors have the option to add head pressure. Off-gas mass spectrometry and a customized biosampler are available.

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**DTU Biosustain**  
The Novo Nordisk Foundation  
Center for Biosustainability

Kemitorvet  
Building 220  
2800 Kgs. Lyngby  
Denmark

Dr. Andreas Worberg  
Chief Commercial Officer  
Tel. +45 9351 8900

[www.biosustain.dtu.dk](http://www.biosustain.dtu.dk)  
[andwor@biosustain.dtu.dk](mailto:andwor@biosustain.dtu.dk)



100 L Bioreactor	Frings	PROREACT P15	PROREACT P laboratory and pilot fermenters are used both for research and development as well as the preliminary stages within a production fermenter cascade of ascending size. For this reason, the systems are constructed in a comparable way to the industrial plants so that the automation structure and maintenance have the same philosophy in the procedural management sector as in the production processes. One 100 L bioreactor available at CfB. The 100 L bioreactor has the option to add head pressure and our biosampler
Growth Profiler	EnzyScreen	Growth Profiler 960	Generates growth curves of up to 960 microbial cultures (10 MTPs) in microtiter plates. Image analysis software (included) quantifies the cell density, and produces growth curves for all 960 strains. Biomass concentrations can be quantified up to 20 g dry wt / L (corresponding to approx. OD600 = 60) using a previously prepared calibration curve) when grey or black-walled MTPs are used. Biomass levels down to OD600 values of 0.05 or 0.1 (below 0.05 g dry wt/L) can be measured when white-walled MTPs are used. One Growth Profiler available at CfB.
Microbial Cell Counter	Logos Bio	QUANTOM Tx™ Microbial Cell Counter	In less than 30 seconds, the QUANTOM Tx™ scans up to 10 fields of view to produce accurate single bacterial cell counts. One QUANTOM Tx™ available at CfB. The QUANTOM Tx™ at CfB can be used to count total cells. However, counting of stained (viable) cells could not have been validated, yet.
BioWelder	Sartorius	Total Containment	The BioWelder® TC is a fully automated welder for sterile connection of thermoplastic tubing. This innovating technology allows sterile connection of dry or liquid filled TPE tubing up to 1 inch outer diameter. The BioWelder® TC produces TPE tubing welding through a thermal connection of tubing from 1/4' to 1' OD and ensures an extraordinary level of stability and guarantees a sterile connection.
Off-gas Mass Spectrometer	Thermo Scientific	Prima BT Bench Top Process Mass Spectrometer	The Thermo Scientific Prima BT Bench top Mass Spectrometer is an industrial laboratory gas analyzer based on scanning magnetic-sector mass spectrometry. Designed for continuous operation in a laboratory environment, the Prima BT mass spectrometer is simple to operate and easy to maintain. At CfB, two units are available that are used to detect CO <sub>2</sub> , N <sub>2</sub> and ethanol in the off-gas of the 30L bioreactor. The usage on the 1L and 100L bioreactor is planned.

Equipment Type	Manufacturer Name	Model Name	Description From Manufacturer's Website
<b>Downstream Processing - Lab scale</b>			
Rotary Evaporator	Büchi	Rotavapor® R-300	The Rotavapor® R-300 is a rotary evaporator with the aid of which single-stage distillation can be carried out quickly without unduly stressing the product. The basis of the process is the evaporation and condensing of solvents in a rotating evaporating flask under vacuum. Distillation under vacuum is more efficient and gentler on the product. One Rotavapor® R-300 available at CfB. Used for removal and recovery of solvent. Excellent recovery efficiency of 97% on average.
Filtration	MMS Membrane Solutions	Triple System	The MMS Triple System is a batch laboratory membrane device for microfiltration, ultrafiltration, nanofiltration and reverse osmosis operations. Applications such as fractionation, purification and concentration of molecules can be tested. The Triple System is based on a unique designed flatsheet cell for crossflow membrane testing up to 40 bar. Feed volume 200 to 700 mL. One Triple System available at CfB.
Jacketed Reactor	Syrris	Orb Jacketed Reactor (100 mL and 1000 mL)	Orb is a compact bench-top jacketed reactor system combining excellent value and high quality construction with unique user-friendly features and reliable performance for batch reactions. The system can be used over a wide range of temperatures and is a true chemistry lab workhorse. Available at CfB with either a working volume of 100 or 1000 mL. Used for crystallization and temperature-controlled reactions.
<b>Downstream Processing - Pilot scale</b>			
Disc-Stack Centrifuge	GEA Westfalia	Separator FSC 1-06-177	GEA clarifier for pilot scales is the reliable solution to set up new processes. They offer two key advantages: maximum scale-up reliability with minimal installation work input as well as optimum process safety for every process with only low capital expenditure. Fully equipped with the renowned GEA technology features, they are the best technical and economic solution to start a new process. This clarifier has been designed for applications

Rotary Evaporator	Büchi	Rotavapor® R-220 Pro	<p>on a pilot respectively small production scale for batches between 15 to 300 litres. One GEA separator available at CfB. Used for cell separation.</p> <p>The Rotavapor® R-220 Pro is designed to fulfill a wide range of distillation applications in the industrial environment. Safety, robustness and easy handling are the key benefits of this system. Seven different glass configurations and a wide range of accessories guarantees the perfect setup for maximum performance. One Rotavapor® R-220 Pro available at CfB. Used for solvent recovery.</p>
Spray dryer	GEA Niro	Mobile minor Spray Dryer	<p>The conventional Spray Dryer turns liquid into powder in a highly efficient manner. It is used within fields as diverse as the dairy, food and chemicals industries where it has won renown for its performance. Designed for the specific product to be dried in compliance with a given industry's standards and requirements, the conventional Spray Dryer produces a fine powder with particle sizes between 20-300 my. It is primarily applied in the chemical industry, but it has also proved valuable in the production of food and dairy products. One Nero Spray Dryer available at CfB.</p>
Homogenizer	GEA	Pandaplus 2000	<p>Table-top Homogenizers are compact machines ideal for the treatment of nanoparticles, nanodispersions and nanoemulsions. Table-top units are suitable for cell disruption, but they can also be used successfully for processing milk and dairy products, fruit juices and food in general. These devices offer the possibility of performing tests with small amounts of sample (minimum volume of 100 mL.), with a guarantee of achieving equal quality results compared to those achievable with industrial homogenizers. Max pressure 2000 bar. Flowrate 9L/h. One homogenizer available at CfB. Used for cell disruption.</p>
Liquid-Liquid Extraction	Koch Modular	KARR® Column	<p>Laboratory scale extraction columns to screen solvents, evaluate feed variables and determine the feasibility and scalability of liquid-liquid extraction for specific applications. One KARR® Column available at CfB. Used for solvent extraction.</p>
Chromatography	MionTec	4 columns Chromatography system	<p>Customizable 4-column chromatography system for purification processes. Depending on the type of product and purification process, different resins such as ion-exchange resins or activated carbon can be used. The four columns can be operated in series or parallel. Used for separation of compounds at CfB.</p>



Filtration system	MMS Membrane Solutions	SW25	The MMS SW25 System is a scalable membrane device for microfiltration, ultrafiltration, nanofiltration and reverse osmosis operations. Applications such as fractionation, purification and concentration of molecules can be tested. The pilot system SW25 can be equipped with different types of modules for test applications up to 40 bar. Feed volume 10 to 100L. One SW25 filtration system available at CfB.
Cleaning-In-Place unit	PTI	Mobile CIP	PTI A/S produces and delivers CIP Plants to the food industry and other industries in which major demands to cleaning, corrosion constancy and minimal maintenance is required. One Mobile CIP available at CfB.
Chromatography	Büchi	Pure C-850 FlashPrep	The Pure chromatography instruments are extremely compact, ensure safety on the highest level and are easy to use for any application. With the platform it's possible to combine different techniques without sacrificing features or functionalities: Flash & prep HPLC and UV & ELS detection. This gives the chemist highest flexibility and helps to achieve the best purification results. One Pure C-850 FlashPrep available at CfB.
Freeze dryer	Martin Christ	Epsilon 2-10D LSCplus	Freeze-dryers from Martin Christ are high-performance universal units for freeze-drying solid or liquid product in a wide variety of vials, trays, and other containers.



Equipment Type	Manufacturer Name	Model Name	Description From Manufacturer's Website
<b>In Process Control IPC Analytics:</b>			
Dionex Ultimate 3000 HPLC System	Thermo Fisher	Dionex Ultimate 3000 (3x)	With support for pressures up to 620 bar (9,000 psi) at flow rates of up to 10 mL/min, detector data collection rates up to 100 Hz, and injection cycle times as low as 15 s, the Thermo Scientific™ Dionex™ UltiMate™ 3000 standard systems fully support conventional methods while offering compatibility with UHPLC applications. One system with Diode Array Detectors (DAD) and Corona® Charged Aerosol Detectors (CAD®) determination and two systems with DAD and fluorescence detection (FLD) determination available at CfB. Used to separate, identify, and quantify each component in a mixture.
Vanquish Dual HPLC System	Thermo Fisher	Vanquish Dual System	For any application-whether HPLC or UHPLC, small or large molecules, simple or complex mixtures-the Vanquish platform was designed to handle it all. Regardless of the configuration you choose, you will get a highly integrated solution with optimal fluidic connections, providing unsurpassed retention time and peak area precision. You will also benefit from the industry-leading, easy-to-use, and compliant Thermo Scientific Chromeleon Chromatography Data System (CDS) with eWorkflow method setup, dedicated ePanels, Open Access, and smart tools. HPLC (2 system) with 2 DAD and 2 Refractive Index detectors available at CfB. Used to separate, identify, and quantify each component in a mixture.
ColorFlex EZ Spectrophotometer	Hunter Lab	ColorFlex EZ	The ColorFlex EZ spectrophotometer is a versatile color measurement instrument that can be used on products of virtually any size, and in industries as diverse as paint, food, and textiles. Used to measure the reflected colour of solids. One ColorFlex EZ spectrophotometer available at CfB.
VISTA Spectrophotometer	Hunter Lab	Vista	Vista is a transmittance-only color measuring instrument capable of measuring color and haze of transparent and translucent liquid, films, and plaques and transparent extruded or formed blanks. All samples will be measured by placing in the transmission compartment, either at the sphere port or receptor port. The size and nature of the sample will determine how the sample is presented and the type of sample handling device that is deployed. Sample handling will include cuvette, cells, and ampules for liquids and film holders for sheets and films. One Vista spectrophotometer available at CfB.



Biochemistry Analyzer (YSI)	YSI	2950	The 2900 Series Biochemistry Analyzer is a laboratory instrument intended for use in research, food-processing and bioprocessing applications. The 2900 Series can be set up to measure up to 6 different analytes in a sample. The total number of analytes depends on the number of sample modules installed (up to two analytes per module) and the number of different buffers required (up to three buffers). One 2950 Biochemistry Analyzer available at CfB.
Total Organic Carbon and Nitrogen Analyzer	SHIMADZU	TOC-L & TNM-L	The TOC-L series can accurately measure a variety of samples, even those containing suspended solids. This model improves on this capability through the development of a new sequence of the sampling and injection motion. This makes it possible to measure a sample that contains suspended solids that have higher sedimentation rates. Consequently, measurement of a highly suspended solution, such as fluid for microscopic algae biomass, without any pretreatment is possible. One unit with additional total nitrogen unit (TNM-L) available at CfB.
Total Kjeldahl Nitrogen (TKN) Analyzer	Büchi	KjelFlex K-360	The KjelFlex K-360 is suitable for determining nitrogen using the Kjeldahl (TKN; Total Kjeldahl Nitrogen) and Devarda methods as well as for other distillations of steam-volatile substances (e.g. of alcohol, SO <sub>2</sub> , volatile acids). One KjelFlex K-360 available at CfB.
TKN Digester	Büchi	SpeedDigester K-425	Set new standards in terms of digestion speed, flexible use and result reproducibility with the IR SpeedDigester. Achieve an increased sample throughput for nitrogen determination by Kjeldahl digestion and multiply instrument functionality whenever needs are changing. One SpeedDigester K-425 available at CfB.
Melting- and Boiling Point Determination	Büchi	Melting Point M-565	The Melting Point M-565 is an instrument for automatic and visual (manual) determination of melting point, melting range, and boiling point at ambient temperatures +10 °C up to 400 °C. The melting point of three samples can be determined at the same time. The boiling point can be determined for one sample. Samples can be observed through the lens or on the color display. One Melting Point M-565 available at CfB.
Liquid Chromatography	ÄKTA	ÄKTA pure 150 M	ÄKTA™ pure is a flexible and intuitive chromatography system for fast purification of proteins, peptides, and nucleic acids from microgram levels to tens of grams of target product. ÄKTA™ pure is a reliable system where hardware and UNICORN™ software are designed to work together with columns and chromatography resins to meet purification challenges. ÄKTA™ pure 150 is well-suited for optimizing resource utilization and productivity in routine large-scale preparative purification. The system supports a wide range of chromatography techniques and meets the automation requirements needed to deliver high purity.

DTU



Mass Spectrometry

Agilent

7850 ICP-MS

ICP-MS uses an argon (Ar) plasma – the ICP – to convert the sample into ions that are then measured using a mass spectrometer – the MS. ICP-MS is similar to inductively coupled plasma optical emission spectroscopy (ICP-OES), but ICP-OES uses an optical spectrometer to measure the light emitted from elements as they pass through the plasma, whereas ICP-MS measures the elements (ions) directly. Both techniques provide fast analysis of multiple elements in a sample, but ICP-MS provides much lower detection limits than ICP-OES, so it's a better choice for trace element analysis.