KNOWLEDGE TRANSFER
EMERGING ZONE

UNIVERSITY OF SZEGED

RESEARCH INFRASTRUCTURE AT THE UNIVERSITY OF SZEGED

2

INSTRUMENTS OF THE UNIVERSITY

SZTE UNIVERSITY OF SZEGED

TARTALOM

03 FACULTY OF MEDICINE

12 FACULTY OF SCIENCE & INFORMATICS

23 FACULTY OF PHARMACY

30 FACULTY OF DENTISTRY

32 FACULTY OF ENGINEERING

36 FACULTY OF AGRICULTURE

KNOWLEDGE TRANSFER
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www.**med.u-szeged.hu**

UNIVERSITY OF SZEGED

FACULTY OF MEDICINE

Research is vital to our mission at the Medical Faculty of University of Szeged. The medical school has a long tradition of translating laboratory discoveries to bedside application, ultimately improving the health. Our faculty have active research programs covering virtually every aspect of basic, clinical and public health science, and they educate the next generation of scientists through our graduate training programs. In addition, our investigators are advancing medicine through collaboration with departments and schools across Hungary including life sciences.

MOTTO:

NEW DISCOVERIES SAVE LIFES

ZEISS AXIOVISION Z1

FLUORESCENT MICROSCOPE

For high quality semiquantitative analysis of Western blot results a Chemiluminescent Western Blot Scannerrel is used. For protein localization studies immunofluorescent staining is used which is visualized and documented by using a Zeiss AxioVisionZ1 fluorescent microscope (fig. 1.). FACS analysis for different applications is run by BD FACSCalibur flow cytometer. To follow cell-biological events in real time in vitro, cell cultures of primary cells or cell lines measurements based on impendency are applied using an xCelllgence system.

AUTOMATED PATCH CLAMP EQUIPMENT

PORT-A-PATCH NATION INSTRUMENT

A setup was purchased three years ago and is located in the MTA-SZTE Research Group of Cardiovascular Pharmacology a research group from the Department of Pharmacology & Pharmacotherapy. The setup is a high-throughput electrophysiological investigational method, which help the investigation of newly developed drug candidates especially designed for combating and treating and life threatening cardiac arrhythmias.

The routinely running of the setup is made possible by several national or international R&D projects. The setup suits all requirement necessary for investigation of drug candidates that exert their effects by modulating transmembrane ionic current, but is also is helpful for safety pharmacology investigation, for example the investigation of possible proarrhythmic side effects.

NEUROMETER DEVICE APPLICATION SENSORY NEUROPATHY TESTING

The Neurometer (Neurotron Inc., Baltimore, MD, USA) is an instrument designed for the overall, simultaneous, non-invasive assessment of all three types of sensory fibres. with adequate diagnostic sensitivity and specificity, to obtain reproducible numerical results. This device applies low-voltage transcutaneous electrical stimulation to the patient's skin to determine the electric current perception threshold (CPT). The intensity of the current is gradually increased to the perceptible level, and then, reduced below the sensory threshold. The test is performed on the lower and the upper extremities using three different frequencies (2 kHz, 250 Hz and 5 Hz). The CPT values measured during high frequency stimulation correlate with the conduction velocity of sensory fibres, as well as with vibratory sensation threshold. Accordingly, this setting is suitable for the assessment of large fibre function. Low-frequency stimulation yielded CPT values that correlated with the results of heat sensation testing, and thereby reflected the condition of small fibres. Values beyond the normal range suggest hypaesthesia, whereas below-normal results indicate hyperaesthesia Neurometer makes possible the non-invasive, quantitative appraisal of the functioning of small, non-myelinated fibres involved in pain sensation.

RUNNER SYSTEM LENGTH TERM TRAINING PHYSIOLOGICAL EFFECTS EXPERIMENTAL EXAMINATION

Experimental treadmill system for the assessment of physiological effects of long-term exercise training was constructed a new, especially for large animals (e.g rabbit, dog). However with smaller changes the treadmill becomes suitable for the training of smaller animals (e.g. guinea pig, rat) as well. Two animals can run simultaneously on the treadmill under the close supervision of the researchers. Nevertheless, further construction of the frame can make the treadmill be able to train even six animals at the same time. The intensity of training can be set by the speed of the treadmill at a range of 2 to 15 km/h and by the setting the treadmill to a steep incline position using a special control panel. The treadmill system can be supplied with feeding, drinking and motivation tools. To increase the effectiveness and the safety of the running sessions, straps can be used for fixing animals during exercise.

MATRIX ASSISTED LASER

DESORPTION IONISATION TIME OF FLIGHT MASS SPECTROMETRY (MALDI-TOF MS) EQUIPMENT

MALDI TOF is a new possibility for rapid identification of bacteria and fungi revolutionized the clinical microbiological diagnostics. It has an extreme importance in the routine microbiological laboratories, as identification of the pathogenic species rapidly will influence antibiotic selection before the final determination of antibiotic resistance of the isolate. This is a rapid method which is able to identify a great variety of the isolated bacteria and fungi based on the composition of conserved ribosomal proteins. The method has also been investigated such as direct identification of pathogens from positive blood cultures. There are possibilities to identify bacteria from the urine or other sterile body fluids. Using selective enrichment broth Salmonella from the stool samples or S. agalactiae from cervicovaginal samples can be identified more rapidly. The extended spectrum beta-lactamase or carbapenemase production of the isolated bacteria can be also detected by MALDI-TOF MS helping the antibiotic selection in some cases. Our Institute used a MALDI Biotyper instrument from 2012 for identification of bacteria and yeasts and for identification bacteria from positive blood culture samples. MALDITOF based methods are suitable to investigate changes in DNA or RNA, to carry out rapid antibiotic resistance determination or other proteomic analysis.

COMBINED & CONDUCT ELECTROPHYSIOLOGICAL RECORDING DEVICES

In pharmacological and toxicological work, recording physiological and behavioural responses simultaneously may be of advantage. In our novel setup, investigating open field (OF) motility is combined with recording electrical activity from the cortex (but taking electrical signals from other parts of the nervous system or from visceral organs is technically possible).

The core of the recording setup is an automated OF box working with a fine grid of infrared motion detectors. Beyond this, digital video is used for recording the animal's behaviour. A connector crown is mounted on the rats' skull by means of screws and glue. Recording electrodes are the screws, and silver wires placed epidurally. The crown allows for maximally 4 bipolar lead-offs, and is connected during recording to a spring-suspended elastic cable with built-in preamplifier. The software enables synchronous recording of digital video image, OF motility, and electrophysiological signals; and displays the motions and the electrocorticogram (ECoG) spectrum in real time. ECoG records can be analysed for pre-defined wave bands, or over the full spectrum, at 0.5 Hz/10 s resolution; and the OF records, for any defined behavioural element (ambulation, immobility, corner sitting etc.) with a resolution of 5 cm/1 min.

LASER SPOT BASED ON INTERFERENCE FLOW MEASUREMENT DEVICE

The custom made, in vivo optical neuroimaging system consists of several components. The visualization of changes in neuronal membrane potential and tissue pH relies on the use of voltage-sensitive and pH-sensitive fluorescent dyes. The brain surface loaded with a selected dye is illuminated at the dye's excitation wavelength by dedicated LED light sources. The fluorescence intensity of the dyes increases with decreasing transmembrane potential or acidosis. The optical signals are captured by CCD cameras attached to a stereomicroscope, equipped with a band pass filter centered on the emission wavelength of the specific dye. Synchronous with these changes, cerebral blood flow maps are created based on laser speckle contrast analysis. The illumination and camera exposures are synchronized by a dedicated program created in LabView environment specifically for this purpose.

454 JUNIOR ROSCH NEW GENERATION SEQUENCING PLATFORM

The first research project optimized by our research group on the 454 Junior Roche next-generation sequencing system was the targeted sequencing process of patients with amyotrophic lateral sclerosis in order to identify the underlying causative genetic mutations. First the amplicon library was prepared according to the followings: Peripheral blood samples were obtained from the patients and genomic DNA was isolated. Then, the coding regions of the investigated genes were amplified with specific primers during PCR reactions. Then a second PCR was prepared in order to link adapter regions to the products of the first PCR reactions. Then the PCR products were purified, and their quality was checked. The concentrations of the amplicons were determined using fluorometer, and then they were diluted to the same concentration and pooled together. Then the emulsion PCR was prepared and the next generation sequencing was carried out. The evaluation of the results of the sequencing was performed with programs developed for the device.

3DHISTECH MIDI PANNORAMIC

DIGITAL SCANNER

Put simply, a microscope and a digital camera as a combination imaginable tool. The traditional way into a microscope to examine tissue sections can be evaluated giant digital computer images that can simultaneously examine many users. The evaluation software programs to automate many tasks and quantification can be made more comfortable for the user.

LIMAX 120 ND:YAG

LASER EQUIPMENT

The device what we are going to present the LIMAX 120 Nd:YAG laser. The speciality of this laser light is the way how it can became. This is a new diode induced neodimium laser technique. It can create 1318nm wavelength light. The output can be changed between 1–120W so it has an extehsive use. The management is easy and logic. It has a big screen where all the datas are visible. You can connect different heads what is make it possible for the extensive use. In urology we use this head what makes it easy to treat the benign prostatic hyperplasia. The end of this laser thread bend in a small angle so it can easly vaporized, pulverized the prostata. One of the biggest advantage is there almost no bleeding. because of the big output. Se we can remove the catheter after the next day and the patient able to urinate spontaniously.

DOPPLER ULTRASOUND DEVICE

Ultrasound. A high-tech, high.resolution (20 MHz) ultrasound is in use at the Department suitable for tissue and power Doppler examination. It enables us to gain high-resolution images even from the smallest joints, and the intensity of the joint inflammation can be determined semi-quantitatively. For the examination of other structures commonly involved in systemic autoimmune illnesses, such as striated muscle, salivary gland, or vessels, is also possible with the equipment, and in this field we are now accumulating knowledge currently. The ultrasound can be used both for the more precise diagnostic work-up and for research purposes (measurement of the activity of joint inflammation).

OPS IMAGING SYSTEM

The OPS technique is a noninvasive in vivo imaging method, which was developed to visualize the microcirculation directly, without the need for contrast enhancement. This technique facilitates observation of the structural pattern of the superficial microcirculation (vascular network and vessel dimensions) and quantitative measurements of physiological parameters (RBCV and perfusion of capillaries) and pathophysiological conditions, e.g. increased permeability. The basic feature of the OPS technique is the use of linearly polarized reflected light, which results in high-contrast images of the blood in the microcirculation. 548 nm was chosen as the wavelength of the emitted light to achieve optimal imaging, because oxy- and deoxyhemoglobin absorb light equally at this wavelength. Incident linearly polarized light in one plane is emitted from the objective into the tissue. A second orthogonally oriented polarizer is used to block light reflected from the tissue surfaces with unchanged polarization before visualization. Light which is multiply deflected and scattered in deeper layers of the tissue experiences a change of in polarization direction. This light passes the second polarizer and serves as a virtual light source in the depth of the tissue. Thus, images comparable to those obtained by transillumination are created.

CLSEM

CORRELATIVE LIGHT SCANNING ELECTRON MICROSCOPY

By means of fluorescence confocal laser scanning endomicroscopy (CLSEM), in vivo real-time dynamic analyses can be achieved (McLaren et al. 2001). The main advantage of CLSEM as compared with conventional histological investigations is that virtual biopsies can be made by an optical sectioning process, and sectioning, fixation and embedding artifacts can therefore be avoided. Three-dimensional, high-resolution optical biopsies can be obtained with this technique without the physical disruption of the observed tissue integrity on the use of systemically or topically administered fluorescent agents (Kiesslich et al. 2007). CLSEM involves the use of a single-line laser with a wavelength of 488 nm to generate optical histologic sections, which can be recorded at different depths within the range 0-250 µm. The optical slices are parallel with the mucosal surface with a thickness of 7 µm and a lateral resolution of 0.7 µm, the field of view being 475 µm × 475 µm. This technology is capable of providing real-time "optical" biopsy specimens in the GI tract with a very high sensitivity and specificity. It allows targeted biopsies to be taken, potentially improving the diagnostic rate in certain GI diseases. By means of this approach, the cellular and subcellular structures of the connective tissue in the colonic epithelium (surface epithelium and crypts) can examined without physical disruption of the epithelial integrity. Another advantage of this method is that the changes in the microvascular structure and damage occurring in the microvessels can be outlined as well.

OXYGRAPH-2K

HIGH RESOLUTION AND RESPIROMETER 2 LED FLUORESCENT MODULE

The main device of the mitochondrial pathophysiology laboratory is the Oxygraph-2k high-resolution respirometer (OROBOROS INSTRUMENTS Corp, Austria), which is equipped with two Clark type electrodes capable to measure oxygen consumption of biological samples in real-time. This provides basis for the assessment of oxidative phosphorylation, which is the main mitochondrial function. Two channels allow direct comparison of different experimental groups and increase the throughput of the system. The system is suitable for the investigation of various mitochondrial preparations such as isolated mitochondria, tissue homogenate, muscle fibers, cell suspensions and precisely cut tissue slices. Assessment of the mitochondrial electron transport chain is performed by using substrate-uncoupler-inhibitor measurement protocols, which allows real time follow-up of respiratory functions. The fluorescence module can evaluate the total free radical production (H_2O_2), mitochondrial membrane potential and calcium levels during the respirometric measurements, in the same samples.

3D ULTRASOUND DEVICE

The fetal kidney and the placenta were analysed by three-dimensional power doppler (3-DPD) technique, in second and third timester, with the help of sonobiopsy, and the VOCAL program. A spherical volume biopsy with a constant volume was sampled. The spherical volume was then analyzed with the virtual organ computer-aided analysis program to determine the vascularization index (VI), the ratio between color voxels and total voxels, expressed in percentages; the flow index (FI), the sum of the color voxels' signal intensity divided by the number of color voxels, quantified as 0–100; and the vascularization flow index (VFI), the sum of color voxels' signal intensity divided by the total tissue voxels, quantified as 0–100.

www.**sci.u-szeged.hu**

UNIVERSITY OF SZEGED

FACULTY OF SCIENCE & INFORMATICS

The educational and research activities at the Faculty of Science and Informatics of the University of Szeged are organized within the six institutes according to the scientific disciplines. These institutes function as partially independent teaching and research units. The scientists operate numerous modern instruments essential for their research.

MOTTO:

DETECT AND COMPREHEND

INSTITUTE OF BIOLOGY

ANALYTICAL INSTRUMENTAL BACKGROUND

The Institute of Biology has the superior and modern analytical instrumental background which is based mainly on the following equipments:

GC-FID: HP 5890 Series II, Shimadzu 2010

GC-MS: Agilent 6890 / 5973

HS-GC: Perkin Elmer HS101 – GC8500

HPLC-UV: Jasco, Shimadzu 10 ADVp

HPLC-DAD: Hitachi Lachrom 7000

HPLC-FLD: Shimadzu 20 AD

HPLC-RID: Shimadzu 10 ADVp

HPLC-MS: Shimadzu 10 ADVp – MS 2010A

ICP-MS: Thermo Scientific XSeries II

AAS: Hitachi Z8200

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ILLUMINA MISEQ

Illumina MiSeq next-generation (NGS) DNA sequencer allows the determination of 1 – 25 million unique DNA sequences in a single run with a maximum read length of 2x300 nucleotides. MiSeq is suitable for sequencing and for the assembly of small genomes, detection of genomic variants with unmatched accuracy, and metagenomic, transcriptomic and functional genomic analysis.

Main characteristics of MiSeq:

- Using the world's most widely-published and accurate sequencing chemistry, backed by > 4,800 peer-reviewed publications.
- Integrated claster generation, sequencing and sequencing data analysis in a single equipment.
- Multiplex up to 384 samples per run for greater efficiency.
- Accurate bi-directional amplicon sequencing.
- Generation of more complete de novo assemblies.

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INSTITUTE OF PHYSICS

HIGH-INTENSITY FEMTOSECOND HYBRID DYE-EXCIMER LASER SYSTEM

The High Intensity Laser Laboratory (HILL) operates a high-intensity femtosecond hybrid dye-excimer laser system offering the best laser parameters at 248 nm in Europe. In the hybrid dye-excimer laser system the seed pulses are generated by an excimer-laser-pumped dye laser system at 497 nm, whose frequency-converted pulses are amplified in a discharge-pumped KrF excimer system. The pulse energy is 80 mJ with 600 fs duration or 40 mJ with 150 fs pulse duration. The focussed intensity can surpass 1018 W/cm2 at several Hz repetition rate with a high spatial and temporal contrast. Several research projects were initiated in plasma physics, solid-state physics and micro material processing involving researchers both from the department and from other research institutes.

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SUPER-RESOLUTION OPTICAL MICROSCOPE

The main parameters of the localization based super-resolution microscope system operates at the Department of Optics and Quantum Electronics and developed by the Advanced Optical Imaging group (AdOptIm: http://titan.physx.u-szeged.hu/~adoptim/) are the following: The system is based on an Nicon Eclipse Ti-E inverse fluorescent frame. The system can operate either in confocal (commercial C2 unit) and dSTORM super-resolution (developed by the research group) modes. The axial position of the sample can be hold via a perfect focus system with a precision of <20nm. The sample can be illuminated via TIRF, HILO and EPI modes and excited at wavelengths of 647nm, 561nm and 405nm. The spatial resolution of the dSTORM system depends on the sample. The position of the fluorescent molecules in fixed cells and slides can be determined typically with a precision of <20nm.

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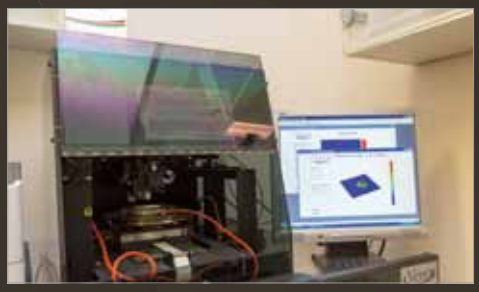
DEKTAK 8 ADVANCED DEVELOPMENT® PROFILER (VEECO)

Dektak 8 contact mode stylus profiler performs 2D or 3D mapping of various surfaces with nanometer-scale precision. On the basis of the topographical measurements, the surface curvature, roughness, the height/volume of specific surface structures, the thicknesses of thin films (on masked edges) can be determined.

Technical Specifications:
Scan Length Range: 50µm–5mm
Scan Speed Range: 3–200 s
Sampling Rate: 300 data points/s
Vertical Range: 50Å–262µm
Vertical Resolution (at various ranges): 1Å/6,55µm; 10Å/65,5 µm; 40Å/262µm
Stylus Tracking Force: 1–15 mg
Stylus Radius Options: 0,2µm; 2,5µm; 5,0µm
Sample Size (max.): 200mm × 200mm × 25,4mm
Sample Stage Rotation: 360°
Sensor Position Translation: 200mm (along x and y axis)



Options and Accessories
Dektak software (Microsoft® Windows XP®): interactive data acquisition
Vision®32 software: data processing, 2-D and 3-D image analysis
Single scan and fully automated multiple scan (>1000 scans) options
Calibration standards
Vibration isolation table with compressor

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TEWATI

FEMTOSECOND PULSED LASER AMPLIFIER SYSTEM

The laser system of the TeWaTi laboratory consists of a Ti:sapphire-based double chirped pulse amplifier (CPA). The seed beam is generated by a Femtoslasers Rainbow CEP4 Ti:sapphire oscillator, which provides carrier envelope phase (CEP) stabilized, 7 fs long ultrashort pulses with 75 MHz repetition rate and spectral range from 650 nm to 950 nm. The CEP stabilization is provided by the state-of-the-art "feed-forward" technology, which keeps the CEP-noise under 50 mrad. The seed pulses from the oscillator immediately enter into the first multi-pass CPA amplifier stage. The pulses travel through the Ti:sapphire amplifier crystal ten times, which is pumped by a diode-pumped Nd:YLF laser manufactured by Photonics Industries. This pump laser provides 20 mJ pulses at 527 nm with a repetition rate of 200 Hz; and its outstanding, 0.2% energy stability translates to the amplified short pulses as well. An acousto-optical dispersion filter (Fastlite Dazzler) is implemented in the system in order to effectively fine-tune of the dispersion of the pulses and also to compensate the spectrum narrowing, which is a side effect of the amplification. At the output of the preamplifier stage we have 1.5 mJ, 25 fs pulses at 200 Hz repetition rate.

The power amplifier stage aims to the terawatt peak power regime. In a five-pass geometry, the preamplified pulses are amplified further up to 50 mJ, pumped by 500 mJ pulses at 532 nm with 10 Hz repetition rate from a flash lamp based Spectra Physics Quanta Ray Nd:YAG. After the output of the compressor of the power amplifier stage, the pulse duration is still under 30 fs.

In the past few years besides laser development, we also updated the diagnostics inventory in the laboratory (e.g. TOF electron spectrometer, Wizzler pulse characterization device, GHz oscilloscope etc.). Furthermore, we established ISO 7 class cleanroom and expanded our safety system and equipment.

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INSTITUTE OF GEOGRAPHY & GEOLOGY

RISØ TL/OSL DA15 AND RISØ TL/OSL DA20

LUMINESCENCE DATING

As a result of environmental radioactive radiation electrons get trapped in the defects of the crystal lattice of certain minerals. The longer the radiation lasts, the more electrons get trapped. By the method the last time when the mineral was exposed to sunlight or heating can be determined, as these events reset the minerals and free electrons from their traps. Measurements are made either by stimulating the sample with heat (TL) or light (OSL) in order to determine the number of electrons trapped since resetting. The method is primarily applied to date sediments and pottery. Age limits extend from a few decades to several hundred thousand years.

100–200 g of sediment and 100–200 mg of pottery material is necessary for the measurements.

Sample preparation and measurements take 5–10 days and 2–3 weeks, respectively.

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GSSI SIR-3000

GROUND PENETRATING RADAR (ANTENNAE: 2000, 270, 1000 MHZ)

A shallow geophysical method with a variety of applications. The transmitter of the radar antenna emits electromagnetic radiation propagating in the form of waves. These waves get refracted and reflected at boundaries of geological strata and different objects, while they advance at different velocities. Modified signals detected by the receiver of the antenna allow the surveying of underground structures.

Penetration depth and resolution are depending on antenna frequency. Down to 7–8 m geological structures and underground cavities, to 4–5m utility pipelines, archaeological objects and contaminations can be mapped, using shallower penetration concrete structures can be analysed.

Ideally 8–10 km of measurement can be made in a day, i.e. approximately 1 ha can be surveyed. The processing of results takes 2–3 days.

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QUANTULUS 1220TM LSC

ATOMKOMPLEX PRYLAD BENZENE SYNTHESIS LINE FOR RADIOCARBON DATING

Radicarbon (14C) forming in the upper atmosphere as a result of cosmic radiation is incorporated by all living beings. If a living being dies its metabolism and consequently its direct or indirect material exchange with the atmosphere stops, and radiocarbon in the dead body starts to decay. The lower 14C activity is measured, the older the analysed sample is. The method can be used back to 50 000 years to date almost any type of material containing organic carbon.

In the case of different sample types the minimum quantity of material required is also different. The activity of 14C is measured by liquid scintillation using benzene, which is synthetised from the carbon content of the sample.

Sample preparation and measurements take usually 2–5 days and 1–3 days, respectively.

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FRITSCH ANALYSETTE 22 MICROTEC PLUS

LASER GRAIN-SIZE DETERMINATION

A technique for the high precision grain size analysis of soils, various industrial powders and building materials. Measurements are made after pretreatment and ultrasonic homogenisation of samples, using two linearly polarised laser beams. The determination of grain size is based on the principle of laser diffraction. The measurement range of the equipment is 0.08–2000 µm. The analysis requires 1–2 g of material.

30–50 samples can be pretreated in one day, the laser analysis of the same batch takes another day.

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SOIL AND WATER TESTING LABORATORY

PERKIN ELMER OPTIMA 7000DV ICP-OES

Atomic absorption and emission spectrophotometer for the measurement of heavy metal, potassium, sodium and calcium content.

FIA STAR 5000

UV VIS spectrophotometer with automatic sample changer various forms of nitrogen (NO_2, NO_3-, NH^{4+}), and the content of phosphorus is suitable for measuring soil and water samples.

DIONEX ICS-1100

Measuring instruments for determining the water sample (surface, subsurface) Anion content (fluoride, chloride, bromide, sulfate, phosphate, etc.).

HELIOS GAMMA UV-VIS

Spectrophotometre for the determination of phosphate, organic matter and humus content.

EIJKELKAMP

Penetrometer for the measurement of the water permeability of soils.

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INSTITUTE OF CHEMISTRY

BRUKER D8 ADVANCE POWDER DIFFRACTOMETER

Bragg Brentano geometry with Cu radiation. Variable sample stages (standard horizontal, capillary and thin film holders). The primary beam optics is upgraded with a Göbel mirror.

Structural characterization studies on powders (crystalline compounds, composites, bio-and pharmaceutical compounds). The wide range of sample stages and geometrical alignments allows for the analysis of powders, wet sediments, thick dispersions, cast or dip-coated films, membrane- or paper-like assemblies. X-ray powder diffractometry is capable for qualitative phase analysis, indexing and determination of crystallographic lattice parameters. Estimation of the average crystallite size is routinely performed, while the sample rotation module eliminates preferred orientation. The Göbel mirror provides considerable intensity gain by strong beam collimation, which is beneficial for ultrathin films and samples with low absorption such as pharmaceuticals and biomaterials.

Location: Department of Physical Chemistry and Materials Science, Bolyai Building 148

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SPECS XPS

Main characteristics

Low energy ion scattering (LEIS), angle-resolved XPS, selected area XPS, etching, depth profiling. High pressure cell (HPC) for sample treatment and reactions.

Applications

The instrument is able to characterize solid surfaces in all stages of their reactions carried out in HPC. Samples are treated in it at elevated temperatures in flowing reactants, while after evacuation and re-location they are characterized in the analysis chamber under UHV conditions.

All kinds of non-volatile and X-ray resistant solids can be examined and characterized. Spectra provide both qualitative and quantitative information on the composition of the uppermost few atomic layers of the sample surface. In a unique manner the oxidation state(s) of the constituent elements can also be determined.

Location: Catalysis and Materials Structure Group, Department of Physical Chemistry and Materials Science, Bolyai Building M31

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AGILENT 7700X

INDUCTIVELY COUPLED PLASMA MASS SPECTROMETER (ICP-MS)

Main Characteristics

A modern inductively coupled plasma mass spectrometer equipped with a low-flow nebulizer, an autosampler and a third generation helium collision cell.

Applications

This high sensitivity instrument is capable of performing fast and accurate trace analytical measurements of solution and nanosol samples in the pg/L to mg/L concentration range. Practically all elements and stable isotopes in the periodic table can be measured. The sample consumption is only 1 to 3 mL. The range of possible applications is very wide and includes, for example, chemical, environmental science, medical, biological, material science and many industrial investigations. The instrument can only handle filtered, aqueous matrix samples, but a well-equipped trace analytical laboratory is also available, where sample preparation can be done (microwave or sonication assisted digestion, filtering, extraction, etc.) if the application calls for it.

Location: Department of Inorganic and Analytical Chemistry, 7 Dóm square, Room 248.

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LC-MS AND GC-MS LAB

Reliable analytical measurements in complex samples with low concentration levels require the use of precise, reproducible and robust methods with high sensitivity and selectivity. For these purposes chromatographic systems equipped with mass selective detectors are applied. Our institute possesses a GC-MS and an HPLC-MS instrument.

Applications

The Agilent 1100 HPLC-MSD VL (1956A MSD) system is equipped with atmospheric pressure ionization interfaces (APCI and ESI), so both apolar and ionizable components can be determined. The quadrupole analyzer of the instrument has a working range of 50-1500 m/z. The single ion monitoring and scanning possibilities ensure the sensitive and selective measurements.

The Agilent 6890N Network GC system with 7683 Series automatic injector and 5973 Network MS detector is equipped with a quadrupole analyzer working in the range of 2–800 m/z. Both single ion monitoring and scanning possibilities are available thus complex samples with low concentrations can be handled.

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ELECTRON MICROSCOPE LAB

FEI TECNAI G2 20 X-TWIN 200 KV

HIGH-RESOLUTION TRANSMISSION ELECTRON MICROSCOPE

Applications

- General morphological (size, shape) characterization of nanostructures. Examination of crystal structure and lattice distortions, determination of d-spacings.
- Identification of the components of mixed samples (based on different crystal structure) by using selected area electron diffraction.
- Examination of samples showing low contrast (light elements, polymers, stable biological samples).

HITACHI S-4700

COLD FIELD EMISSION SCANNING ELECTRON MICROSCOPE

Applications

- General morphological characterization of nano-, micro and macrostructures.
- Identification of elemental composition and elemental mapping by 1 μm lateral resolution.
- Z-contrast imaging by using backscattered electron detector.
- Investigation of cathode luminescence properties of the samples.

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UNIVERSITY OF SZEGED

FACULTY OF PHARMACY

The Faculty of Pharmacy is a part of the University of Szeged, which is entitled to bear the excellent and Hungarian research university titles. In the institutes of the Faculty high-quality research and development work is going on. The highly qualified teaching and research staff of the Faculty can produce internationally recognized scientific results. In addition to basic research, there is great emphasis on innovative drug research, so the Faculty maintains close and fruitful relationships with almost all participants of the national pharmaceutical industry, national and international universities and research institutions.

On the following pages we would like to introduce the most important instruments of the Faculty of Pharmacy to our partners. Our faculty awaits its partners' orders for carrying out research, development and innovation work or implementation of instrumental measurements.

MOTTO

UNITY OF EDUCATION, RESEARCH AND INNOVATION FOR THE FUTURE OF PHARMACY

METTLER-TOLEDO

THERMOANALYTIC INSTRUMENTS

The Mettler-Toledo TGA/DSC1 system is suitable for the characterization of the thermal behaviour of the raw materials and pharmaceutical products. The analysis of the gases produced is carried out with a Pfeiffer mass spectrometer. The main performance characteristics include: temperature range from room temperature to 1100°C; heating rate: 0.01-50°K/min). The DSC stand-alone system works in the temperature range: -60 - 450 °C and is suitable for a modulated program too. The MS system applies multiple ion detection in min. 128 channels with long-lasting double filament in a mass range of 1-300 amu. It has a low detection value (<1ppm) and transfer line temperatures up to 350°C. The inclusion of TG, DSC and MS data is possible in a uniform coordinate system.

THERMO SCIENTIFIC

VIBRATION SPECTROSCOPY INSTRUMENTS

Our vibration spectroscopy instrument line contains a Thermo Scientific Avatar 330 FT-IR (for 400-4000 cm-1 spectral range), an Antaris II FT-NIR analyzer (with 3800–12000 cm-1 spectral range)-equipped with various measurement modules (transmission, diffuse reflectance or HATR (for IR) and transmission, tablet transmission, spinner (for NIR)) and a DXR Dispersive Raman Microscope instrumented with 532 and 780 nm lasers and an Olympus microscope and video camera and a hot-stage. The instrument line provides a wide range of possibilities for analysing data from the fields of solid materials (tablets, coated tablets, capsules, powders, crystals, pulverized materials etc.), semisolid materials (ointments, creams, pastes, foams, etc.), liquid materials (solutions, emulsions, suspensions, oils, etc.), food products (fruits, honey, etc.), pieces such as paintings, textiles. Amongst others, the instruments may be applied for determination of active materials, investigation of stability and aging and determination of moisture content, evaporation kinetic, fat and oil content etc. in the fields of pharmaceutical, nutraceutical or food industry, agriculture and forensic science.for Fibre optic probes enable the analysis of materials without the opening of the primary packaging, and the microscope enables the characterization and identification of small particles, and chemical mapping characterization of surface areas and subsurfaces of various samples and dosage forms.

BRUKER & PHILIPS

X-RAY ANALYTICAL INSTRUMENTS

Our X-ray analytical instrument group contains a Bruker D8 Advance powder X-ray apparatus which may be used for the identification of materials, determination of crystal structure, investigation of amorphous and crystalline mixtures, polymorph screening. As a speciality, it is instrumented with an MRI Basic hot-humidity chamber with ANS-Sycoshot combined humidity and temperature controller and VÅNTEC-1 detector. The maximum 2-Theta range simultaneously provides 12 degree in-situ measuring possibility under the following conditions: 25 – 50°C/95% RH, 50 – 90°C/temperature dependent RH and until max 200°C without the controlling of the humidity. The Philips MiniPal PW 4025 energy dispersion X-ray spectrometer may be used for elemental analysis (Na-U), homogeneity and/or impurity investigation and contents determination of solid, semisolid or liquid dosage forms, herbal extracts, foods, or in the field of forensic science.

SHIMADZU & SCIEX HPLC-MS/MS

MASS SPECTROMETER

A Shimadzu Pominance HPLC coupled with an ABSciex API2000 triple quadrupole is installed at the Institute of Pharmacognosy. The two HPLC pumps are able to perform gradient solvent mixing thus the HPLC is suitable for complex sample analysis. The UV-VIS and PDA detectors of the HPLC help to optimize sensitive and selective routine methods for identifications and quantitation while keeping cost efficiency. The mass spectrometer is very efficient in wide concentration range (5-6 orders of magnitude) due to its high sensitivity and has a good selectivity in targeted, non-targeted or unknown component analysis.

ARMEN SPOTPREP CPC

CENTRIFUGAL PARTITION CHROMATOGRAPHY

Centrifugal partition chromatography, utilized by the instrument, has many practical benefits compared to other traditional preparative LC techniques (e.g. HPLC). Instead of using a solid support, the instrument uses two immiscible solvents – one is the "column" immobilized by a strong centrifugal force, the other is the eluent, and the difference between the analites' solubility is utilized for chromatographic purposes. Thus, most of the benefits come from the lack of the solid phase: there is no irreversible adsorption on the column, the stationary phase can be evaporated allowing a 100% sample recovery, no silica waste is needed to recycle, and the solvent demand is quite low. The large number of available biphasic solvent systems ensure great optimizability, making the technique applicable on a wide scale. The instrument monitors the UV absorbance at two wavelengths, and has a built-in fraction collector programmable to collect individual chromatographic peaks separately.

BRUKER AVANCE 600

MAGNETIC NUCLEI SPEKTROSZKÓP 4 CSATORNÁS

To validate the synthetised foldamers' sequence, to identify their structure, and to analyse protein-ligand interactions, our research group uses NMR spectrometry. After dissolving our samples in a buffer, the tube is put in a homogenous field generated by a superconducting magnet, then it is irradiated by a pulse sequence. The magnetic nuclei absorb their characteristic radio frequency radiation. Detection of all resonance frequencies results in a time-domain spectra, which can be Fourier-transformed into the conventional frequencydomain form. Because the absorption frequencies sensitively depend on the chemical environment of the nuclei, the structure of the examined compound can be precisely determined. Two Bruker-manufactured apparatus are found in our laboratory, a 500 MHz and a 600 MHz. The latter is equipped with a cryoprobe, enabling us to measure in the low micromolar concentration range. The 500 MHz machine features a broand band tunable head, which can be used on a pay-per-hour basis for routine organic chemistry measurements.

ISOTHERMAL TITRATION CALORIMETRY

The isothermal titration calorimetry (ITC) is one of the newest techniques to determine the thermodinamical parameters of different interactions. Quantitative measurement of binding affinity, enthalpy changes, and binding stoichiometry of the interaction between two or more molecules can be determined with this technique. The instrument consists of two cells made of a chemically inert material with highly efficient thermal conductivity, surrounded by an adiabatic jacket. Sensitive thermometers are used to detect the differences between the water containing reference cell and the sample cell. During the experiment, precise amounts of ligand solution is titrated into the sample cell causing heat to be either taken up or evolved. To keep both cells at the equal temperature, the feedback power of the reference cell can be altered. By measuring this power throughout the titration, the thermodynamical parameters can be calculated. The MicroCal VP-ITC apparatus in our lab is used to study protein-ligand interactions.

CEM LIBERTY1

MICROWAVE SOLID PHASE PEPTIDE SYNTHESIS

Peptides play various important roles in nature. The significance of their production is justified by the need for peptide-based medicines, the importance of peptides in drug design, etc. Robert Bruce Merrifield introduced the solid phase peptide synthesis. This methodology has gradually developed, providing different resins, linkers, protecting groups, coupling agents and automated peptide synthesizers. By the utilization of microwave irradiation the long coupling and deprotection time can be reduced, yielding considerable faster synthesis, compared to ordinary manual or automated synthesis technologies. The synthesis of a decamer peptide under conventional conditions takes ~3 days. However, by the microwave assisted peptide synthesizer such peptide can be prepared in less than 10 hours. The CEM Liberty1 reactor consists of a solvent delivery unit and a mivrowave reactor unit, of which ensures the controlled heating of the reaction mixture.

BRUKER DRX-400 MHZ

MAGNETIC RESONANCE (NMR) SPECTROSCOPY

The Nuclear Magnetic Resonance (NMR) Spectroscopy is an analytical technique that is nondestructive and it is used to investigate mainly organic molecular structures. Mainly 2-20 mg material is generally sufficient for most common NMR measurements. By simple NMR experiments a waste amount of information can be gained concerning the atomic composition of the molecules, the specific environment of a given atom or functional group, the relative position and orientation of these functional groups or atoms, gaining data about the constitutional and conformational isomerization of the product. By simple NMR measurements the purity of the material can be identified too. By these facts the Bruker DRX-400 MHz NMR can be used in quality assurance and control. More advanced measurements can be used for the determination of exchange processes, reaction kinetics and reaction mechanism too.

THERMO LCQ FLEET HPLC-MS

LIQUID CHROMATOGRAPHY

The Thermo LCQ FLEET HPLC-MS consists of a high performance liquid chromatography (HPLC) and a mass spectrometry (MS) unit. The HPLC-MS is a potent technique for the analytical investigation of complex mixtures. It can be applied for the analysis of extracts of natural products, chemical intermediates, raw substances, etc. Quantitative analytical measurements can be performed with excellent analytical selectivity and sensitivity. Such examinations are the reaction kinetics measurements, metabolism measurements, anti-doping investigation, etc. The HPLC part of the instrument is mandatory for the separation of the analytes found in the mixture. It utilizes reversed phase technology, where the stationary phase is unpolar, while the mobile phase is polar. The mobile phase is passed to the MS through an interface unit, of which ensures the ionization and desolvation too.

NIKON ECLIPSE TS100

INVERTED MICROSCOPE WITH EPI-FLUORESCENT ATTACHMENT

Inverted microscope with epi-fluorescent attachment and a cooled colour digital camera is ideal for applications such as tissue culture, plaque measurement and blood typing. In our laboratory, we use it for follow up morphological changes in cancer cells induced by newly synthesized drug candidates. The microscope incorporates a LED eco-illumination system, which offers long lifetime, low power consumption and heat generation and eliminates colour temperature changes. It also possesses special, patented phase contrast objectives, which produce images with high contrast and an extensive tonal range. The magnification of the objectives are 10×, 20× and 40×. The equipment is user-friendly regarding to the application of different filters. It allows quick switch to one filter to another during the experiment. A 2-megapixel cooled colour digital microscope camera head is attached to the microscope. It offers fast, high-resolution image capture, with outstanding colour representation. Live images are displayed and updated smoothly, greatly increasing the speed of acquisition.

MDE IS-02

EIGHT CHANNEL TISSUE BATH

The isolated tissue bath system is a thermostated system with different numbers of chambers, which is suitable for in vitro contractility studies of different smooth muscle- (vessels, gastrointestinal smooth muscle, trachea, and uterus), heart muscle- and striated muscle strips and rings. Each tissue bath (total number is 16) has its own force transducer. The main components of the bath system are the tissue holders (with built in electrodes), gas bubbler, gas chamber and gas flow controller, one-plane self-adjusting manipulator with sensor clamp, buffer reservoir with volume of 10 millilitre per bath, external thermostation, force/displacement sensors and 2× eight channel bridge amplifier. Each organ chamber can be used separately. Principle of measurement: the tension of the contractile tissues are measured with a force transducer, and recorded by the computer. The saved data can be loaded into Microsoft Excel, and the curves can be analysed in any statistical program. The equipment is suitable for studies with large sample numbers within short period of time.

www.**stoma.u-szeged.hu**

UNIVERSITY OF SZEGED

FACULTY OF DENTISTRY

Prof. Dr. Janos MINAROVITS
M.D., D.Sc.

The research equipments of the Faculty of Dentistry are located at the facilities of the Department of Oral Biology and Experimental Dental Research. The tissue culture laboratory is equipped with tissue culture hood, CO_2 thermostat, centrifuge, inverted microscope and a -70°C freezer. Other instruments are available in the molecular biology laboratory (elfo boxes, power supplies, PCR machines, thermostat, ELISA reader, gel documentation system, etc.). Chemical hood, rotary-microtome, halimeter is also at the disposal of the staff. We introduce two special instruments below.

MOTTO:

RESEARCH & EDUCATION TODAY, BETTER HEALTH TOMORROW

NIKON ECLIPSE 80I MICROSCOPE,

UNIVERSAL RESEARCH MICROSCOPE REFLECTANCE, TRANSMITTANCE AND FLUORESCENCE MODES

Dry lenses:	1×, 4×, 10×, 20×, 40×.
Immersion Lens:	100×
Camera:	5.1 megapixel color digital microscope camera
Video recording and image analysis software:	Image-Pro Plus 5.1 image analysis software

PSIA XE 100

ATOMIC FORCE MICROSCOPE (AFM)

The PSIA XE100 atomic force microscope (AFM) is located at and shared with the Department of Optics and Quantum Electronics, Faculty of Science and Informatics. The equipment is a member of scanning probe microscopy family. Nanometer-resolution images can be obtained with this AFM from samples placed in air or aqueous systems. In the contact mode it is possible to record the topography, error function and friction images. The tapping mode allows to examine sensitive biological samples; in addition to the topographic and error signal images phase image can be produced, which can provide information on the material quality as well. The X-Y scan range is up to 50 micrometers x 50 micrometers,the maximum measurable height difference is 10 micrometers.

www.**mk.u-szeged.hu**

UNIVERSITY OF SZEGED

FACULTY OF ENGINEERING

The aim of Faculty of Engineering is to develop and maintain a state of the art equipped laboratories which is capable of running our research, development and innovation tasks, mainly in the field of food and environment industry. These equipments are able to serve the technical and innovation problems of the firms/companies at the South-Hungarian region. These well equipped labs meet demands for quality control measurements as well as the students become acquainted in solving practical problems (student work, thesis) procedures, test methods, which can later benefit from the operational practice.

MOTTO:

WHAT IS CALCULABLE, CALCULATE OUT, WHAT YOU DO NOT: MEASURE IT!

OXFORD X-MET 5000

AUTOMATIC COMPOSITION ANALYZERS (PORTABLE)

Mode: X-ray fluorescence testing to identify metal alloys

Applications:

- Maintenance
- Production
- Scrap Metal Recycling

Operating responsible person:

dr. István BÍRÓ *assoc. Prof.* E-mail: **biro-i@mk.u-szeged.hu**

BRINELL, VICKERS, ROCKWELL

HARDNESS

Test Force: 98N to 29kN from
The hardness sensitivity: 0.01 Rockwell, 0.1Vickers, 1 Brinell
Volume accuracy: Max <1%.

Operating responsible person:

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MALVERN MASTERSIZER

LASER DIFFRACTION PARTICLE SIZE DETERMINATION

Typical parameters: For dry sample preparation, 0.5 to 3500 microns in length weighing bench , for wet samples and for short-micron particle size range from 0.05 to 900 determined.

Application: To measure weight and particle size distribution in any solid (food, pharmaceutical) powders, agglomerates and particles suspended in a liquid (such as milk or sludge).

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AIRTOX

PORTABLE BIOGAS ANALYZER

Biogas and landfill gas flow through analytics

Typical parameters:

CO_2 (0.1–50 vol.% vol.), CH_4 (0.1–100 vol.%), O_2 (0.1–25 vol.%) and H_2S (0–200 ppm), automatic calibration.

Rapid determination Biogas and landfill major components of landfill gas generated in laboratory and field conditions.

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VSEP (LP)

VIBRATION MEMBRANE FILTRATION DEVICE

The multi-stage vibrating membrane device. The equipment effectively reduces the membrane fouling at microfiltration, ultrafiltration, nanofiltration or reverse osmosis.

Typical parameters:

Max. Amplitude = 2.54 cm , temperature range: 20–60 °C, flow rate: 7.5 to 22.5 LPM and trans-membrane pressure: 0.1–3 MPa.

Application:

In food industry to pressurize juices, whey proteins

Area of Use: Separation, water and wastewater treatment of organic substances, ions efficiently.

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HUNTER LABSCAN

LABORATORY COLORIMETER

Typical parameters: Measured reflectance spectra of the 400 nm -700 nm The device is able to determine the exact color of the samples, to express the color coordinates. Six different number system with four different CIE lighting read color coordinates and color index is possible to determine.

Area of use: Suitable powdered raw materials or products (eg. paprika, durum, semolina, flour, cocoa powder, coffee grounds, egg powder, powdered dried products) and purees, creams, juices (eg. tomato,canned meat, soft drinks) and meat, cured meat products, poultry liver, etc. color coordinates

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FLIR INFRACOM SD

THERMAL IMAGING CAMERA

Typical parameters:

Spectrum range: 7.5 to 13 microns

Sensor resolution: 120 × 120 pixels 240 × 240 pixels interpolated

Frame rate: 9 Hz

Accuracy: ± 2.0 ° C or ± 2%

Thermal sensitivity: 0.12 ° C

Subject Temperature range: -10 +350 °C

Area of use:

Building energy engineering, building engineering, mechanical and electrical equipment tests

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UNIVERSITY OF SZEGED

FACULTY OF AGRICULTURE

The Feed Testing Laboratory of the Institute of Animal Sciences and Wildlife Management of the Faculty of Agriculture in Hódmezővásárhely performs the determination of feed quality parameters with decades of practice, in the frame of regular international and domestic orders. The tested parameters are, among others: moisture, crude protein, crude fat, crude fibre, detergent fibre and fibre components, crude ash, starch and carotene content, WSC, acidity, peroxide number, lactic acid, volatile acid, pH, ammonia-N, alcohol, aerobic stability, nutritional value.

MOTTO:

SCIENCE, PRACTICE, TRADITION FOR AGRONOMISTS OF FUTURE

ACME 6100

(YOUNG LIN INSTRUMENT CO., LTD.) GAS CHROMATOGRAPH

The Acme 6100 gas chromatograph with software (Autochro 3000) control, flame ionization detector (FID) and auto sampler (HT300A Liquid GC Autosampler) is used for the analytical examination of fermented fodder. The Supelco® capillary column (Omegawax™ 320 Capillary Column, 30 m × 0.32mm × 0.25 µm film thickness) is adapted to measure the lactic acid and volatile fatty acid content of silage, as well as the butyric acid and propionic acid content representing the quality of the fermentation.

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GERHARDT VAPODEST 45

DISTILLATION SYSTEM FOR CRUDE PROTEIN DETERMINATION

The Gerhardt Vapodest 45 is an automatic distillation system for steam distillation equipped with Titro-Line Easy external titrator, with connection possibilities to Kjeldahl digestor and other distillation instruments. The system can use the Kjeldahl method of analysis of feed samples. Measuring of the Kjeldahl nitrogen (TKN) is necessary to determine the crude protein content of forage.

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GERHARDT FIBRETHERM FT12

CRUDE FIBER, ADF AND NDF ANALYZER

Gerhardt Fibretherm FT12 with automatic acid and NaOH addition, automatic rinse cycle and suction can control the complete function in the course of the analysis of 12 samples. The system enables the automation of the time consuming dosing-boiling-filtration-washing cycles required in crude fibre, ADF and NDF analysis.

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PL-1

POLARIMETER

The PL-1 optical polarimeter is a device functioning with a Nicol prism polarization system. The adjustable light source is a long-life monochromatic LED (589.3 nm). The optical polarimeter is used to measure the starch content of feed, via measuring the chromatic rotation of optically active substances (dextrose).

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KNOWLEDGE TRANSFER
EMERGING ZONE

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SZÉCHENYI 2020

HUNGARIAN GOVERNMENT

European Union
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INVESTING IN YOUR FUTURE