Innovative Peptide Solutions

Immunology

Peptide Tools for

- Immunotherapy
- Immune Monitoring
- Vaccine Development
- Neo-Epitope Identification and Validation
- Antibody Signature Profiling
- Biomarker Discovery

jpt
Innovative Peptide Solutions

History

JPT Peptide Technologies is a service provider located in Berlin, Germany that has achieved worldwide credibility for its commitment to rigorous quality standards and a reputation for developing and implementing innovative peptide-based services and research tools for various applications.

Together with its US-subsidiary in Boston, Massachusetts, JPT serves its clientele in the pharmaceutical and biotechnology industries as well as researchers in universities, governmental and non-profit organizations.

Technology & Application

Over the past decade JPT has developed a portfolio of proprietary technologies as well as innovative products and services that have helped to advance the development of new immunotherapies, proteomics and drug discovery.

Quality Assurance

JPT is DIN EN ISO 9001:2015 certified and GCLP audited.

TÜVRheinland CERTIFIED
Management System
ISO 9001:2015
www.tuv.com
ID 9105022388

JPT's key technologies are:

PepMix™

Defined antigen spanning peptide pools to stimulate $CD4^+$ and $CD8^+$ T-cells.

PepTrack™

Peptide libraries offering various specifications and optimization for different types of assays.

GxP Peptides

Custom peptides for the stringent requirements of cellular therapy, vaccine and drug development.

TERS™

Technology to produce TCR-engineered reference samples for performance control of T-cell assays.

PepStar™

Peptide microarrays for epitope discovery, humoral immune monitoring and protein-protein interactions studies.

SPOT

High-throughput peptide synthesis for T-cell epitope and neo-epitope qualification and discovery.

SpikeTides™

Light and stable isotope-labeled or quantified peptides for mass spectrometry based proteomics assays.

Custom & Specialty Peptides

We are peptide experts and offer the largest variety of peptide chemistries, formats and modifications.

MITTELSTAND GLOBAL
HEALTH MADE IN GERMANY

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JPT – Specialists for Immunology

We are a regulated and innovative service and tool provider for all peptide related projects in immune and cellular therapy, vaccine development and immuno-monitoring. Our proprietary technologies help to advance novel diagnostic and therapeutic approaches for cancer, infectious and autoimmune diseases as well as allergies.

Selected Application Notes by our Customers

- *"Developing Multi-HIV Antigen Specific T Cells as a Component of a Cure Strategy"*
  S. Lam, C. Russell Cruz and C. Bollard
- *"Peptide-Stimulated Expansion of Virus-Specific T-Cells for Preventative Treatment after Allogeneic Stem Cell Transplantation"*
  R. Gary, M. Aigner, A. Moosmann and A. Gerbitz
- *"Strategy for Identification of CD8 T-cell Epitopes in a Viral Protein"*
  R. Holtappels
- *"Multiple Sclerosis and Epstein-Barr Virus Infection – An Epitope Mapping Study"*
  U. Reimer, B. Wunderlich, C. Scheibenbogen and K. Ruprecht
- *"Characterization of the Aspergillus-Specific T-Cell Response by Using Crf1 and Catalase1 Overlapping Peptides"*
  H. Jolink and M.H.M. Heemskerk
- *"PepMix™ Peptide Pools for Clinical Applications: T-Cell Therapy for Viral Infections after Hematopoietic Stem Cell Transplant"*
  J. M. Keirnan, C. M. Rooney, and A. M. Leen
- *"Rapid Mimotope Optimization for Pharmacokinetic Analysis of the Novel Therapeutic Antibody IMAB362"*
  M. Daneschdar, HU. Schmoldt, L. M. Plum, Y. Kühne, M. Fiedler, A. Masch, K. Schnatbaum, J. Jansong, J. Zerweck, H. Wenschuh, U. Reimer, Ö. Türeci and U. Sahin
- *"BioTides™ as High Throughput Screening Tool for the Identification of Antibody Binding Sites"*
  Y. Kühne, T. Rösler, C. Fleig-Krämer, C. Haarstrich, K. Cappel, R. Hipfel, A. Rothermel and U. Sahin
- *"Qualification and Use of Peptide Libraries for Clinical Trial Immunomonitoring"*
  J.H. Cox and P. Hayes

Download full text at:
www.jpt.com/application-notes/

Our Technologies & Products

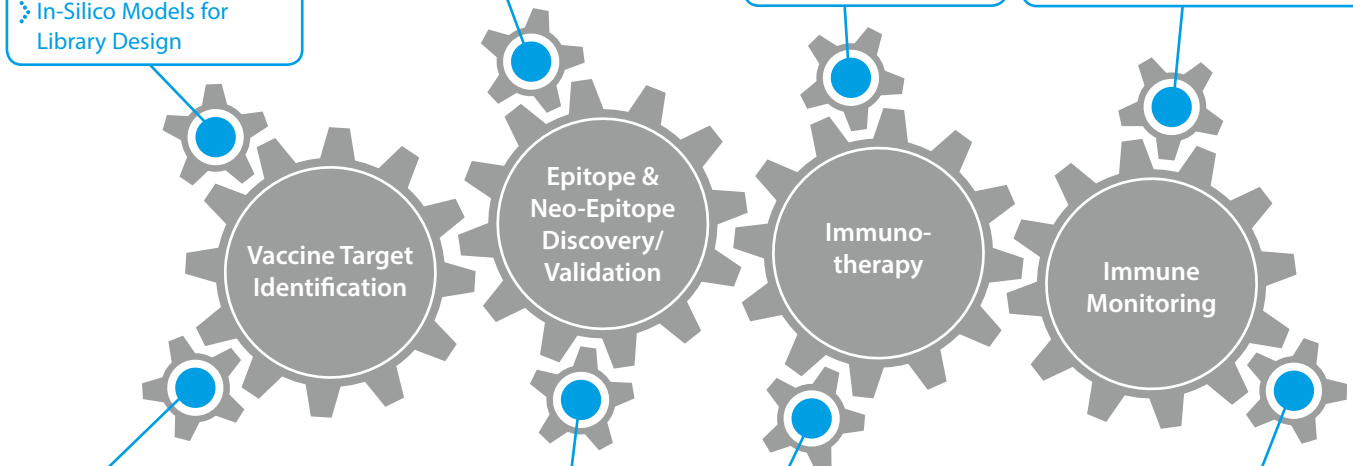
Cellular Immunity

PepMix™ Peptide Pools & PepTrack™ Fast Track Peptide Libraries
deep, antigen- and proteome spanning target identification
In-Silico Models for Library Design

Matrix Pools & PepTrack™ Research Track Peptide Libraries
fast (neo-) epitope qualification

GxP Peptides & Pools
adoptive cell transfer, dendritic cell pulsing and vaccination
In-Silico Peptide Selection

PepTrack™ Trial Track Peptide Libraries & PepMix™ Peptide Pools & Dextramer™ Multimers & Universal T-Cell Assay Standard TERS™ Kit
clinical T-cell assays



PepStar™ High Content Peptide Arrays
deep antibody signature profiling
In-Silico Models for Library Design

RepliTope™ Peptide Microarrays & Peptide ELISA
B-cell epitope and seromarker qualification

Antigen Peptides & MAP Peptides & Peptide Conjugates
to proteins, adjuvants, PEG and more for antibody generation

Modular Humoral Immune Profiling
using various platforms, peptide arrays, peptide ELISA and more
Bioinformatic Data Evaluation

Humoral Immunity

Cellular Immunity

JPT offers the widest range of products and services to address cellular immunity. Those include PepTrack™ high content peptide libraries enabling fast target discovery and neo-epitope qualification, PepMix™ Peptide Pools for reliable clinical immune monitoring, GxP Peptides for cell- and immunotherapy and TERS™ to develop robust and validated T-cell assays.

Let's talk about peptides for T-cell assays!

Peptide & Pool Design

There are many ways to design your peptide libary or pool. Ask us for support!

Peptide Purity

Even small impurites may create huge problems in T-cell assays. However, the impact depends strongly on the application. Let us help to select your specification.

Solubility

Ever had the problem to dissolve a peptide or having limited solvent choices? We help to predict the solubility of a peptide and select the peptide sequences that work best.

Stability & Storage

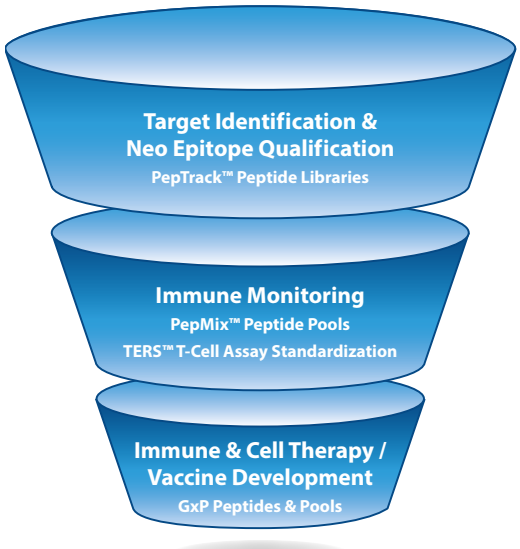
About 20 % of all peptides show a limited shelf stability. How do you recognize and handle potentially unstable peptides? We will support you.

Peptide Content & Net Weight

In addition to side products analyzed by HPLC, peptides contain non-peptidic components. The quantification of those is essential to accurately adjust peptide concentration.

Cross Contamination

Contamination with other peptides, causing false positive T-cell responses, represents a challenge for immunology products. Learn about our offers to warrant line clearance.



Benefit: Lowest cost per peptide, ultra fast turnaround

Benefit: $CD4^+$ and $CD8^+$ detection, robust responses and assay validation

Benefit: Regulated production and know-how for clinical applications

Universal T-Cell Assay Standard TERS™ Kit

We offer an innovative, easy-to-use kit to produce TCR-engineered reference samples (TERS) for antigen-specific T-cell assays. A lack of standard control reagents for immunological T-cell assays has been limiting the comparability of antigen-specific test results. With the Universal T-Cell Assay Standard TERS™ Kit test results can be quantitatively compared across time points, platforms, or laboratories.

The TERS™ Technology

The TERS™ technology is based on a simple and efficient protocol for T-cell-receptor-engineered PBMC samples with a defined number of antigen-specific T-cells. These cells can be used in combination with MHC-multimer staining, ICS or ELISPOT assays and represent an ideal tool for validating and monitoring assay performance. TERS was developed in collaboration with TRON (Translational Oncology at the University Mainz).

Select Your TERS™ Kit

When used as an independent, internal reference standard, TERS specificity is immaterial. However, depen-ding on the reagents that you already have (for example peptides for stimulation or MHC multimers) you may have a preference for one or the other. Please choose between these different T-cell receptor specifications: CMV, Influenza, Tyrosinase or NY-ESO1.

Applications

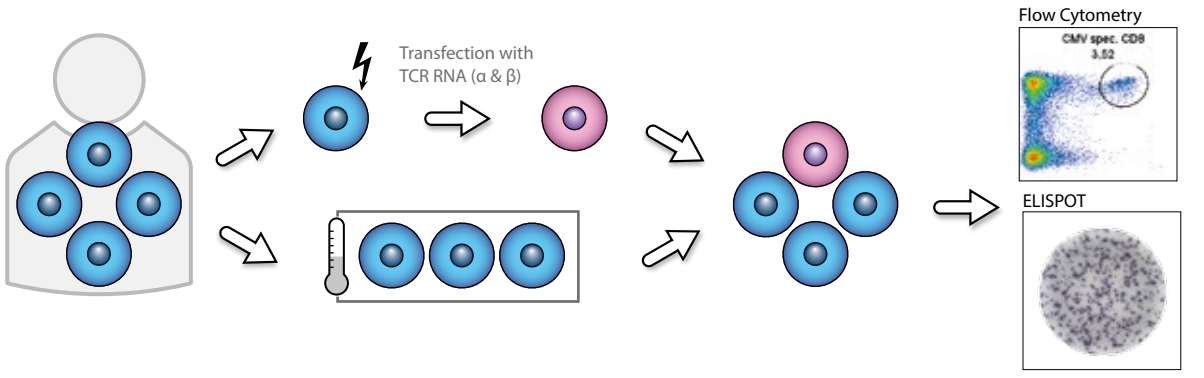
- Standardization of T-cell assays (ELISPOT, ICS, multimer staining)
- Performance control of T-cell assays
- Calibration of antigen-specific assays

Benefits

- Compare test results across time points, platforms or laboratories
- Quantify assay performance
- Scalable and robust
- Test one or more specificities per batch
- Easy production of TERS
- All required reagents in one kit

Selected Reference

"Generation of TCR-Engineered T Cells and their Use to Control the Performance of T Cell Assays" Bidmon et al., J. Immunol. (2015)



PBMCs from buffy coat donor

Cultivation and storage of transfected and native cells

Pooling as required

Performance control of assays

PepMix™ Peptide Pools for T-Cell Assays

JPT's PepMixes™ are synthetic peptide pools containing overlapping peptide scans through antigens or selected MHC restricted epitopes. PepMixes™ are used to stimulate antigen-specific T-cells in vaccine development, cell and immunotherapy and for immune monitoring.

Benefits

For reliable and validated T-cell assays such as ELISPOT, appropriate positive and negative controls are essential to confirm proper functionality of the assay and viability of the cells. Compared to commonly used controls like PHA, ConA or full length antigens, synthetic peptide pools offer the advantage of a high batch-to-batch reproducibility, application of reliable chemical and biochemical QC/QA measures, longer stability and extremely efficient immunostimulation.

Applications

Efficient *in vitro* stimulation of antigen-specific $CD4^+$ and $CD8^+$ T-cells

- For monitoring of cellular immune responses
- For vaccine efficacy testing
- For cell therapy approaches
- As positive and negative controls
- For vaccine target identification
- For T-cell epitope mapping

Specifications

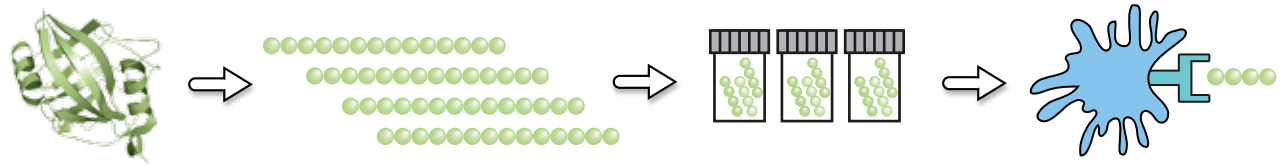
- Length/Overlap: 15/11 aa (for pooled peptide scans)
- Purity: 70 % to 95 % (LC-MS)
- Amount: 25 tests/vial

Selected References

- *"Protective Efficacy of Multiple Vaccine Platforms Against Zika Virus Challenge in Rhesus Monkeys"* Abbink et al., Science (2016)
- *"Self-Amplifying mRNA Vaccines Expressing Multiple Conserved Influenza Antigens Confer Protection against Homologous and Heterosubtypic Viral Challenge"* Magini et al., PloS one (2016)
- *"A Phase I Study of Recombinant (r) Vaccinia-CEA (6D)-TRICOM and rFowlpox-CEA (6D)-TRICOM Vaccines with GM-CSF and IFN-α-2b in Patients with CEA-Expressing Carcinomas"* Duggan et al., Cancer Immunology, Immunotherapy (2016)
- *"Prognostic Impact of High Levels of Circulating Plasmacytoid Dendritic Cells in Breast Cancer"* Bailur et al., Journal of Translational Medicine (2016)

The new CEFX Ultra SuperStim Pool is the most efficient positive control across all populations!

Production and use of PepMix™ Peptide Pools. Peptides are synthesized, purified and pooled according to a validated pooling method ensuring presence of all the peptides in the mix.



Antigen Sequence ID — *Overlapping Peptide Scan through Antigen Sequences* — *Pooling & Aliquoting* — *Stimulation of T-cells, e.g. for Immune Monitoring or Cell Therapy*

Select Your PepMix™

Cancer

Breast Cancer Burkitt's Lymphoma Gastric Cancer Genital Cancer Glioma Hodgkin's Lymphoma Leukemia Liver Cancer Melanoma Merkel Cell Carcinoma Nasopharyngeal Carcinoma Ovarian Cancer Prostate Cancer Testicular Cancer

Controls

CEFX Ultra SuperStim Pool CEF Pool CEF (ext.) Pool CEFT Pool EF Pool HCMV (pp65) HCMV (IE1) HCMV (IE2) Human (Actin) Human (MOG)

Infections

AAV BKV Candida CyCMV EBV F. tularensis HAdV HBV HCMV HEV HHV HHV2 HIV HPV Influenza A L. monocytogenes RLCV RSV VACV VZV YFV Zaire ebola virus Zika virus

Customized PepMix™

We offer fast and low priced production of tailored PepMixes™ from your specific antigen, neo-epitopes or peptide library. We help choose the appropriate peptide purity, specifications and pool layout.

Matrix Pools

Matrix pools offer an efficient way to map epitopes by presenting each peptide in two different pools. Have a look at the figure below! Our customer support team will assist you with the design.

A full up-to-date list can be found on: www.shop.jpt.com

"[...] we utilised the CEF Pool (extended) as well as a custom synthesized PepMix™ spanning the core region of HBV genotype D. [...] Our entire experience with JPT, from ordering/delivery to use in the lab was excellent. [...] JPT will remain our "go-to" company for purchasing peptides."

L. Pallett, Infection and Immunity, University College London, UK

Customized Matrix Pools enable the fast and minimal material consuming identifcation of the epitope(s) within an antigen. Each peptide is present in only two Matrix Pools. In the example shown, 64 peptides are pooled into 16 Matrix Pools. Pools V and XIII elicit a T-cell response. Only peptide 37 is present in both pools and therefore is the peptide containing the epitope.

Pool No.	I	II	III	IV	V	VI	VII	VIII
IX	1	2	3	4	5	6	7	8
X	9	10	11	12	13	14	15	16
XI	17	18	19	20	21	22	23	24
XII	25	26	27	28	29	30	31	32
XIII	33	34	35	36	37	38	39	40
XIV	41	42	43	44	45	46	47	48
XV	49	50	51	52	53	54	55	56
XVI	57	58	59	60	61	62	63	64

Master Pool contains all 64 peptides.
Matrix Pool I contains peptides 1, 9, 17, 25, 33, 41, 49 and 57.
Matrix Pool II contains peptides 2, 10, 18, 26, 34, 42, 50 and 58.
...
Matrix Pool IX contains peptides 1, 2, 3, 4, 5, 6, 7 and 8.
Matrix Pool X contains peptides 9, 10, 11, 12, 13, 14, 15 and 16.

PepTrack™ Peptide Libraries

Our customized peptide libraries offer unlimited flexibility. They are optimized for antigen-specific stimulation of T-cells in immune monitoring, T-cell epitope identification, and development of cellular therapies. We implemented specific parameters for synthesis, purification and analysis of peptide libraries that are important to avoid false positive T-cell responses or toxic inhibition of T-cells and increase shelf-life of peptides.

Specifications

- Tailored peptide libraries
- Different quality grades *(see table)*
- Optimized for cellular assays
- PTMs and labeling available
- Production ISO 9001:2015 certified

Benefits

- Post-translational modifications available
- Detection of $CD4^+$ and $CD8^+$ responses
- Full coverage of sequence diversity
- Fast: 10 000 peptides/3 weeks
- Low cost: from USD 4/peptide

Selected References

- *"Identification of a A naturally Processed HLA-A*02:01-Restricted CTL Epitope from the Human Tumor-Associated Antigen Nectin-4"*
  Lopez et al., Cancer immunology, immunotherapy (2016)

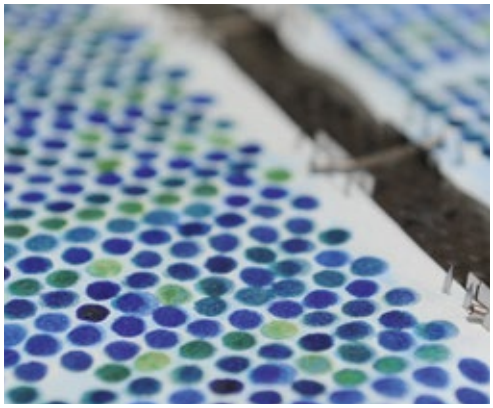
- *"Deletion of A44L, A46R and C12L Vaccinia Virus Genes from the MVA Genome Improved the Vector Immunogenicity by Modifying the Innate Immune Response Generating Enhanced and Optimized Specific T-Cell Responses"*
  Holgado et al., Viruses (2016)

"For reliable monitoring of tumor and virus specific T-cell responses, we have a permanent need for peptides and peptide pools that are produced in a regulated environment for application in a clinical environment. JPT has been a long term and dedicated partner in this regard which continuously works on improving it's peptide based services."

C. Scheibenbogen, Charité Berlin, Berlin, Germany

Left: PepTrack™ Peptide Libraries are delivered freeze-dried in multiwell plates or tube racks (micronics).

Below: Automated synthesis of PepSpots™ membranes.

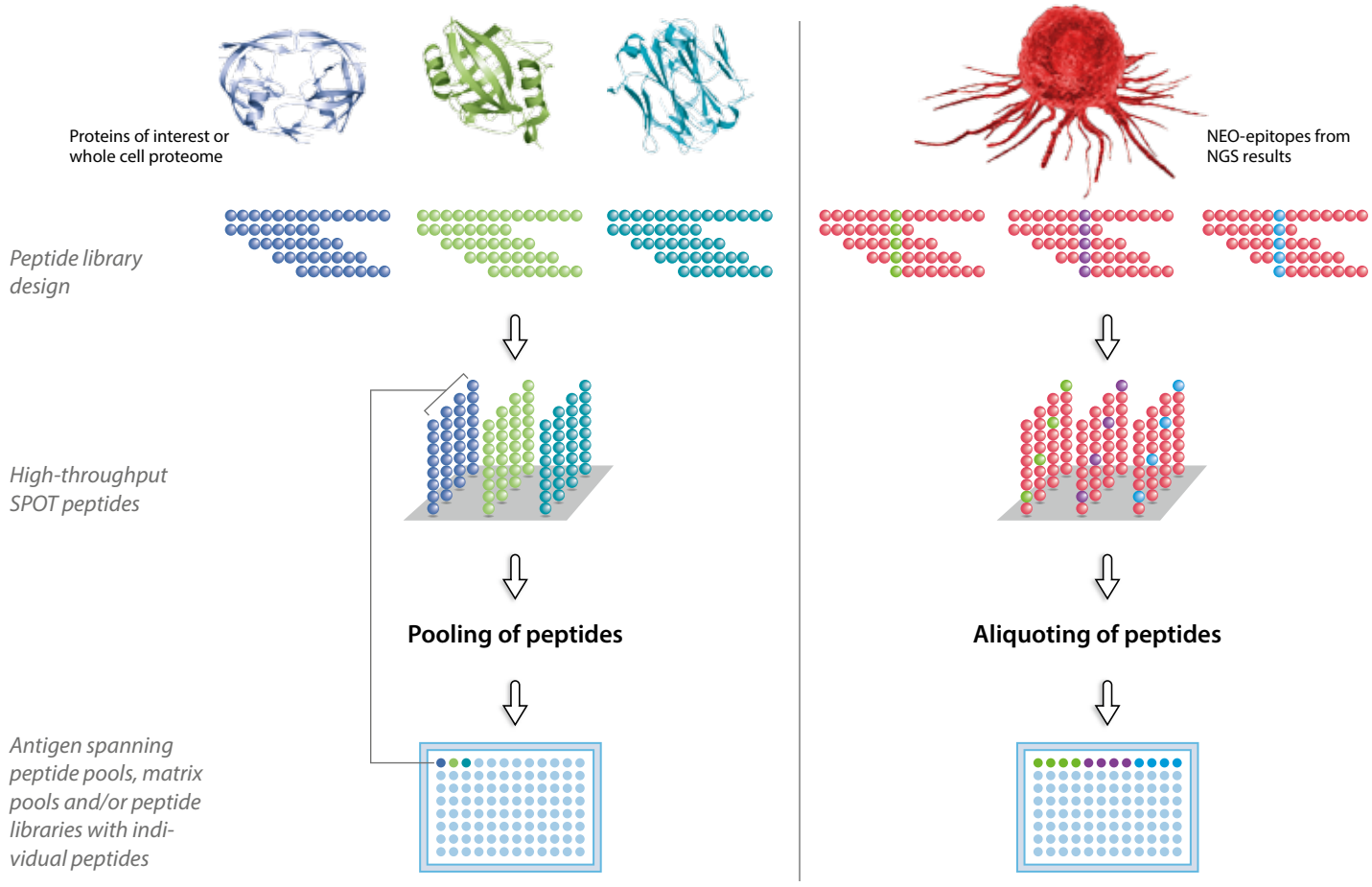


PepTrack™ Options

	Purity	Scale	Applications	JPT's Throughput
Fast Track	Unpurified	10-100 nmol	• Neo-epitope prioritization • Antigen target identification • Pathogen-spanning T-cell epitope discovery	10 000 peptides / 3 weeks
Research Track	Unpurified or main product = target peptide	1-5 mg	• T-cell epitope discovery • Immunogenicity testing • Identification of immuno-dominant antigens	1000 peptides / 3 weeks
Discovery Track	> 70 %	1-5 mg	• Immune monitoring • T-cell epitope mapping	500 peptides / 4 weeks
Trial Track	> 80 % > 90 % > 95 % > 97 %	1-5 mg	• Clinical Immune monitoring • Development of immuno-therapy	500 peptides / 6 weeks

Please inquire for larger scales and further options!

Provision of high-content Fast Track peptide libraries or pools by SPOT technology.
Left: Overlapping peptide scan through one or several antigens. Right: Neo-epitope library from NGS results.



GxP Peptides

Our enhanced production environment for GxP Peptides goes beyond ISO 9001:2015 regulations to meet the more stringent product requirements of immunotherapy as well as vaccine and drug development. Thus, the resulting GxP Peptides and GxP Peptide Pools have been approved for several clinical trials in immuno and cellular therapy.

Why choose JPT for GxP projects?

- More than 20 years experience on peptides as drugs, vaccines and for cell therapies
- Comprehensive know-how and dedicated staff make us the peptide experts
- QC beyond ISO 9001:2015 regulations
- Publication record of clinical trials using JPT

Quality Assurance and Control

- Line clearance
- Cleaning validation
- Full traceability
- ADCF policy
- Incoming material inspection
- Vendor qualification
- QC/QA documentation
- Batch release control

Optional Chemical Analyses

- Residual solvent determination
- Water determination
- Peptide content determination
- Amino acid analysis
- UPLC measurement
- Stability and solubility testing
- Peptide sequencing

Optional Microbiological Analyses

- Bacterial endotoxin determination
- Sterility testing
- Bioburden determination
- Bacteriostatic and fungistatic effect of products

"We recently demonstrated the feasibility and clinical benefit associated with the infusion of rapidly generated single-culture VSTs, manufactured using JPT's GxP PepMix™ Peptide Pools covering 12 immunogenic antigens from five viruses (EBV, AdV, CMV, BK, and HHV6). When administered to 11 allogeneic stem cell transplant recipients, 8 of whom had up to four active infections, these VSTs produced an overall 94 % response rate."

A. M. Leen, Baylor College of Medicine, Houston, TX, USA

Quality Levels

Specification	ISO 9001:2015 RuO	ISO 9001:2015 ISO PLUS	ISO 9001:2015 GxP
Applications	**Target/Epitope Discovery & Immune Monitoring**	**Clinical Immune Monitoring & Immune Diagnostics**	**Immuno- & Cell Therapy**
Incoming Material Inspection	x	x	x
Dedicated Raw Materials			x
Vendor Qualification	x	x	x
Order-Dedicated Personnel			x
ADCF Policy	x	x	x
Batch Release	x	x	x
Certificate of Analysis	x	x	x
Document Management & LIM-Systems	x	x	x
Documented Cleaning & Calibration			x
Batch Documentation & CoA based on IND Requirements		x	x
Line Clearance		x	x*
Delivery in Certified Vials		x	x
Impurity ID & Qualification			report only (optional)
Optional Services: Residual Solvents; Sterility, Endotoxin; Monitored Storage…	x	x	x

* spatial separation of processes

Selected References

- *"Human Parainfluenza Virus-3 can be Targeted by Rapidly Ex Vivo Expanded T Lymphocytes"* McLaughlin et al., Cytotherapy (2016)
- *"Peptide-stimulated Expansion of Virus-specific T cells for Preventative Treatment After Allogeneic Stem Cell Transplantation"* Gary et al., AppNote (2015)
- *"Broadly-specific Cytotoxic T Cells Targeting Multiple HIV Antigens Are Expanded From HIV+ Patients: Implications for Immunotherapy"* Lam et al., Molecular Therapy (2015)
- *"Expanded Cytotoxic T-cell Lymphocytes Target the Latent HIV Reservoir"* Sung et al., Journal of Infectious Diseases (2015)
- *"Ex vivo Expansion of Human T cells for Adoptive Immunotherapy Using the Novel Xeno-free CTS Immune Cell Serum Replacement"* Smith et al., Clinical & Translational Immunology (2015)
- *"Activity of Broad-Spectrum T Cells as Treatment for AdV, EBV, CMV, BKV, and HHV6 Infections After HSCT"* Papadopoulou et al., Sci Transl Med. (2014)

Custom & Specialty Peptides

The exceptional quality and reliability of our service has been appreciated by customers worldwide for many years. JPT is the premier provider of custom peptides and specialty peptides, such as phosphopeptides, immunogenic peptides, cyclic peptides or peptide conjugates.

Options and Specialties

- Fluorescent and chromogenic peptides
- Internally quenched peptides (Abz/nitroTyr, EDANS/DABCYL, MCA/DNP) guaranteed without flourescent impurities
- Immunogenic peptides (MAPs, palmitinylation, Pam3Cys labeling, etc.)
- Phospho-peptides and peptidomimetics (amide bond isosteres, non-natural amino acids, etc.)
- Non-commercial building blocks available
- Labeling (non-radioactive isotopes, chromophores, etc.)
- Site-directed conjugations with KLH, BSA, ovalbumin or other carriers
- Cyclic peptides (disulfide bridges, lactams, thioether-bridges, etc.)
- Long peptides (> 70 amino acids)
- Scales ranging from 1 mg to several grams

Need other modifications or specifications?
We will give our best to make it happen!
Contact us at peptide@jpt.com!

Benefits of JPT´s Custom Peptides

- Proprietary synthesis technologies warrant fastest turnaround and most competitive pricing
- Reliable and stringent QC/QA
- ISO 9001:2015 and GCLP compliance
- Rapid order processing
- Large variety of chemistry protocols
- Fully automated pooling, aliquoting and vialing
- Solubility, stability and sterility testing optional
- Personal consultation with experienced scientists
- Highest purities available (> 95 %, > 97 %)
- Full range of analyses including LC-MS (trap and/or quad), MALDI-MS, HPLC, AAA, NMR, CE, UPLC, HR-MS, as well as peptide content determination to confirm the identity and demonstrate the high quality of our peptides
- Substantial, long-standing expertise in providing custom peptides
- Highly skilled and committed scientific staff

Freeze dried peptides are delivered with full analytical coverage.

Quality Assurance

- JPT´s entire peptide production, purification and analysis procedures are backed by a stringent DIN ISO 9001:2015 certified Quality Management System
- All quality relevant processes are well documented and regulated according to a comprehensive SOP system
- All peptide production is performed at JPT´s headquarters in Berlin, Germany under continuous quality measures
- All peptides assembled from components that are of non-animal origin

Selected References

- *"Effect of HIV-1 Envelope Cytoplasmic Tail on Adenovirus Primed Virus Encoded Virus-Like Particle Immunizations"*
  Andersson et al., Vaccine (2016)

- *"Identification of Peptide Mimics of a Glycan Epitope on the Surface of Parasitic Nematode Larvae"*
  Umair et al., PloS One (2016)

- *"Safety, Immune and Clinical Responses in Metastatic Melanoma Patients Vaccinated With a Long Peptide Derived From Indoleamine 2,3-Dioxygenase in Combination With Ipilimumab"*
  Bjoern et al., Cytotherapy (2016)

"Our research relies heavily on developing robust high-throughput screens with fluorescent peptides. We have found that JPT's are the best on the market because the signal-to-noise ratio is very high, providing the sensitivity we need for the screens. Their peptides always perform well. In addition, the knowledge, wonderful customer support, and fast turnaround time provided by JPT have been invaluable in helping us develop the best peptides for our assays."

Carla Koehler, Professor, UCLA, Chemistry & Biochemistry, Los Angeles, CA

Automated synthesis allows a large variety of scales and chemistries.

MHC Multimers & Antigen Peptides

Fluorescent-labeled MHC multimers are used to detect, quantify and isolate antigen-specific T-cells by flow cytometry, and for in situ detection by immunohistochemistry (IHC). The corresponding antigen peptides are available for T-cell stimulation.

MHC Multimers

Dextramers combine a dextran polymer backbone with a high number of MHC and fluorochrome molecules. Therefore, they show a stronger staining intensity than other multimers with minimal background staining.

Applications

- Detection, enumeration and isolation of antigen-specific T-cells by flow cytometry
- In vitro staining of tissue sections

Benefits

- More sensitive than conventional MHC multimers
- Applicable for low-affinity interactions (e.g. in cancer and autoimmune disease)

Selected References

- *"Comparison of Peptide-major Histocompability Complex Tetramers and Dextramers for the Identification of Antigen-specific T Cells"*
  Dolton et al., Clin Exp Immunol. (2014)
- *"Combination Immunotherapy after ASCT for Multiple Myeloma Using MAGE-A3/Poly-ICLC Immunizations Followed by Adoptive Transfer of Vaccine-Primed and Costimulated Autologous T Cells"*
  Rapoport et al., Clin Cancer Res (2014)

Antigen Peptides

For each MHC Multimer we offer the corresponding antigen peptide to stimulate antigen-specific T-cells in functional T-cell assays such as ELISPOT.

Applications

- Stimulation of antigen-specific $CD8^+$ T-cells
- Immune monitoring of cellular immune responses
- Validation of multimer assay results

Benefits

- Conveniently order the corresponding peptide for every multimer
- Freeze-dried for long shelf-stability
- Off-the-shelf for quick delivery

Selected References

- *"Identification of Theileria lestoquardi Antigens Recognized by $CD8^+$ T Cells"*
  Goh et al., Plos One (2016)
- *"Identification of a A naturally Processed HLA-A*02:01-Restricted CTL Epitope from the Human Tumor-Associated Antigen Nectin-4"*
  Lopez et al., Cancer immunology, immunotherapy (2016)

MHC multimers for efficient detection of antigen-specific T-cells by flow cytometry.

Humoral Immunity

Our proprietary tools and services to study humoral immunity range from high content PepStar™ Peptide Microarrays, PepSpot™ Arrays and RepliTope™ Multiwell Microarrays to Peptide ELISA and peptides conjugated to carriers and adjuvants. The reliability of these papers allows not only the differential analysis of biological samples for immune profiling and epitope identification but also antibody generation and mimotope optimization at high efficiency.

Let's talk about peptide arrays

Peptide or Protein Arrays

Epitope discovery and analysis of epitope spreading are only possible on peptide level. Additonally, short peptide binders enable development of robust diagnostic tests.

Batch-to-Batch Consistency

A single synthesis batch yields in hundreds of identical microarrays. All peptides have the same flexible orientation due to a directed immobilization to the slide surface.

Peptide Purity

Our proprietary PepStar™ technology includes a purification step for each peptide. We warrant that all peptides are free of deletion sequences that are a source for false positive results.

Sample Consumption

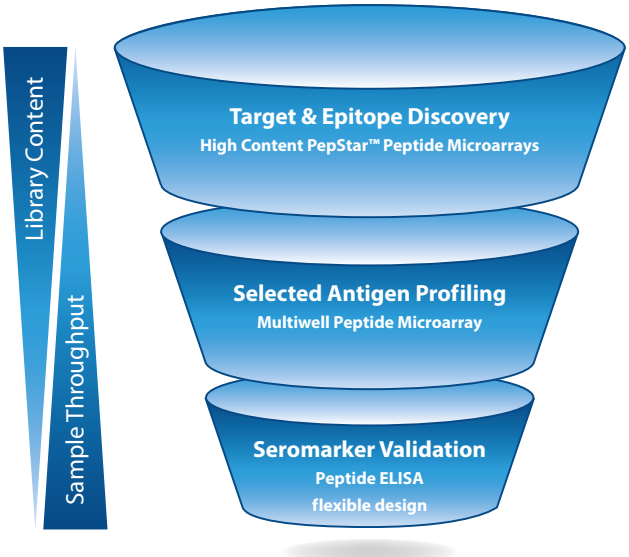
Only tiny amounts of your precious samples are needed for incubation. Our microarrays are applicable to serum, blood or cell lysate as well as purified antibodies or proteins.

Validation of Identified Seromarkers

Use our Peptide ELISA platform as robust tool to confirm and validate protein-protein interactions such as antibody-epitope binding.

Sequence Diversity and PTMs

We address sequence diversity as found in cancers and viruses by combining our bioinformatic ULTRA approach with advanced chemistry protocols to assemble peptide libraries and arrays.



Benefit: Fast emergency response to zoonotic infections, differential analysis of similar pathogens (i.e Flaviviruses)

Benefit: High sample throughput, low cost per sample, low sample consumption

Benefit: Robust, reproducible and quantitative confirmation of discovery results

PepStar™ Tailored Peptide Microarrays

Our unique PepStar™ Peptide Microarrays are used for target discovery, immune monitoring, antibody epitope mapping, multiplexed epitope mapping or for detection and validation of protein-protein interactions. They can display up to 21 000 peptides from antigens or whole proteomes from pathogens, tumor associated antigens, or designed peptides.

What are PepStar™ Peptide Microarrays?

Large numbers (up to 21 000) of peptides are N-terminally attached to glass slides by directed and chemoselective immobilization. Patented high-throughput synthesis of peptides results in high-content peptide arrays. Yield of synthesis is sufficient to generate hundreds of identical slides. Incubation can be performed with proteins and patient samples. Read-out is achieved by fluorescence using validated protocols and commercial equipment.

Applications

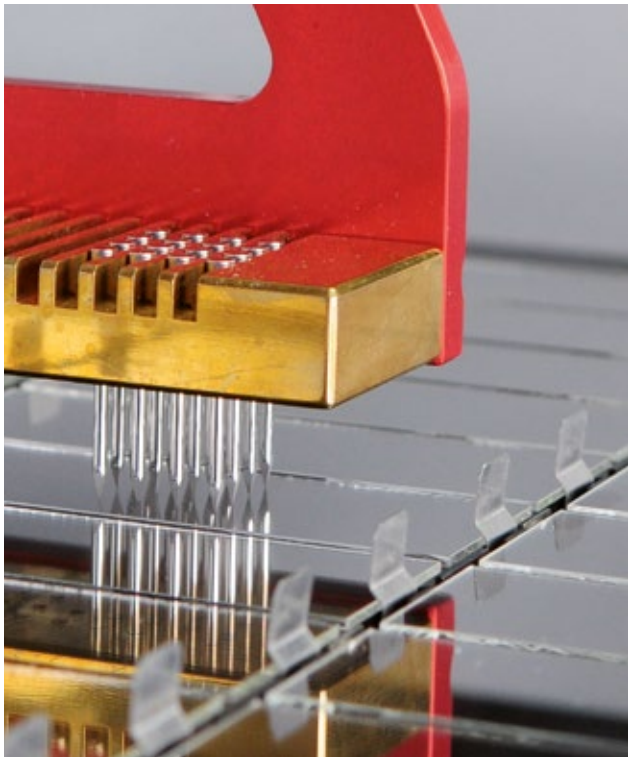
- Target discovery
- Seromarker identification and validation
- Mutiplexed immune monitoring in clinical trials
- Elucidation of antigen and epitope spreading during disease progression and therapeutic intervention
- Mapping of immunodominant regions in antigens
- QC/QA of therapeutic biologics
- Vaccine target identification
- Identification and optimization of enzyme substrates

Benefits

- Cost effective provision of hundreds of identical microarrays from a single synthesis batch
- Directed immobilization of purified peptides
- Flexible co-immobilization of controls
- Chemical synthesis and analysis warrant batch- to-batch reproducibility
- High shelf stability
- High assay sensitivity
- Defined posttranslational modifications are possible
- Commercial incubation and read-out equipment can be applied
- Low consumption of patient materials and proteins
- Incubation and read-out protocols available

We will be happy to discuss the design of your peptide microarray. Contact our support team at peptide@jpt.com!

Above:
Your PepStar™ microarrays are delivered with detailed QC/QA documentation and application protocol.



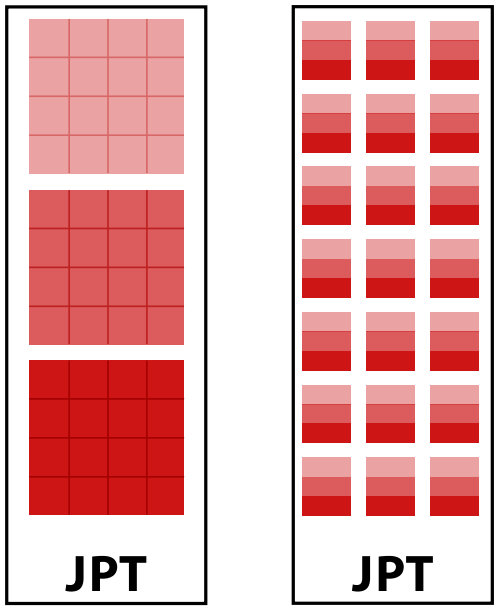
Right:
State-of-the-art printing devices support high accuracy and batch-to-batch reproducibility.

"One focus of our group is to decipher the nature of immune responses by identification of biomarkers and indicators of immune protection. With the support of JPT's high content peptide microarray platform, we created a peptide chip which contains 22 000 individual peptides. This enabled the visualization of the B-cell „signature" in individuals with TB-infection vs. non-infected individuals. In our hands, JPT's peptide microarrays turned out to be very robust tools to identify novel peptide based biomarkers in the context of novel diagnostics and vaccine target identification."

Prof. Markus Maeurer, Karolinska Institute, Solna, Sweden

Selected References

- *"Protective Efficacy of Multiple Vaccine Platforms Against Zika Virus Challenge in Rhesus Monkeys"* Abbink et al., Science (2016)
- *"Increased IgG Antibody Responses to Neoepitope and Native Peptides Containing High Affinity Domains for MHCI Following Combination Cancer Immunotherapy"* Hulett et al., Cancer Research (2016)
- *"Anti-Hemagglutinin Antibody Derived Lead Peptides for Inhibitors of Influenza Virus Binding"* Memczak et al., PLoS One (2016)
- *"Combined HIV-1 Envelope Systemic and Mucosal Immunization of Lactating Rhesus Monkeys Induces Robust IgA-Isotype B Cell Response in Breast Milk"* Nelson et al., Journal of Virology (2016)
- *"Development of a Genus-Specific Antigen Capture ELISA for Orthopoxviruses–Target Selection and Optimized Screening"* Stern et al., PloS one (2016)



The PepStar™ Microarray layout depends on the number of peptides and can be adjusted to your needs.

Left: High density microarray with 3 subarrays.
Right: Multiwell microarray with 21 subarrays (3 copies each) that can be incubated separately with different samples using a multiwell array chamber.

RepliTope™ Catalog Peptide Microarrays

RepliTopes™ combine all the advantages of PepStar™ Microarrays with the availability of a catalog product. We selected many common antigens from infectious pathogens and cancer types. The RepliTope™ Antigen Collections are high density peptide microarrays displaying large collections of antigens from, or even the whole proteome of a particular virus or bacterium.

Applications

- Antibody epitope mapping and optimization
- Antibody signature profiling
- Seromarker discovery
- Immune monitoring
- Protein-protein interactions

Benefits

- Premade microarrays available within days
- RepliTopes™ display peptide scans through antigens or whole proteomes
- Each peptide is presented 2-4 times on each microarray to ensure reproducibility of results
- Economical access to many identical peptide microarrays

Selected References

"Superior Efficacy of an HIV Vaccine Combined with ARV Prevention in SHIV Challenged Non-human Primates"
Le Grand et al., Journal of Virology (2016)

"Protective Efficacy of Adenovirus-protein Vaccines Against SIV Challenges in Rhesus Monkeys"
Barouch et al., Science (2015)

"Structure of GPN-loop GTPase Npa3 and Implications for RNA Polymerase II Assembly"
Niesser t al., Mol Cell Biol. (2015)

Selection of available RepliTopes™

Tumor Associated Antigens	Infectious Diseases	Antigen Collections
Breast/Prostate • Mammaglobin A • NY-ESO-1 • PSA ...	Adenovirus • Hexon and penton proteins	Pan-Flavivirus Ultra (Zika) • 6253 peptides from antigenic proteins of Flaviviruses (ZIKA virus, Dengue virus, West Nile virus and more)
Epithelia • CEA • Claudin-6 ...	BKV • Capsid proteins (VP1, VP2, VP3) • Large and small T antigens	TAA • 1882 overlapping peptides from selected tumor associated antigens (TAA)
Melanoma • MAGEA1, A3 and A4 • Melan-A/MART-1 • Prame/OIP4 ...	EBV • EBNA (1, 2, 3a, 3b, 3c, LP) • LMP1 and LMP2 ...	HIV ULTRA • Coverage for ENV 57%, GAG 72%, NEF 62% and TAT 46% for frequent clades (A,B,C,D,G, CRF1,CRF2).
Vaccinia virus • MVA018L (Host range p. 2) • MVA093L (p53) ...	HCMVA • IE-1, IE-2, pp65, • UL28, UL32, UL40 ...	HBV ULTRA • 255 proteins of 53 annotated proteomes of HBV. Non-redundant sequences from genes P, S, X, C for 14 genotypes.
Wilms tumor1 • WT33	Influenza A • HA, MP1 and NC from different strains	M. tuberculosis ULTRA • 40 antigens of MTB reference, 17 different MTB strains are represented by 6388 peptides.
Miscellaneous • Cyclin B1 • Histone H1.2 and H4 • P53_human ...	RSV • Protein F, NC protein N	
	Miscellaneous • HBV (Large envelope protein) • HHV6 (U54) • Yellow fever (NS24B) ...	

A full up-to-date list can be found on: www.shop.jpt.com

Peptide ELISA

Enzyme-linked immunosorbent assay (ELISA) is a common analytical and highly sensitive immunological assay classically performed with proteins. Peptide ELISA is of additional value, because it enables analysis at the amino acid sequence level, e.g. mapping of epitopes or delineation of protein interaction sites.

What is Peptide ELISA?

Peptide ELISA is an economic and tailored ELISA platform. Peptides are synthesized according to your specifications and coated onto ELISA plates. It is a very flexible assay as you can chose the peptide sequences, number and purity of the peptides and plate format.

Applications

- Antibody epitope mapping
- Immune profiling
- Determination of antibody titers
- Analysis of protein-protein interactions
- Validation of microarray results

Benefits

- High batch-to-batch reproducibility
- Economic production of tailored ELISA plates
- Easy-to-use and compatible with standard ELISA protocols and equipment
- Generation of quantitative results
- High sensitivity
- Directed immobilization of purified peptides for reproducible results

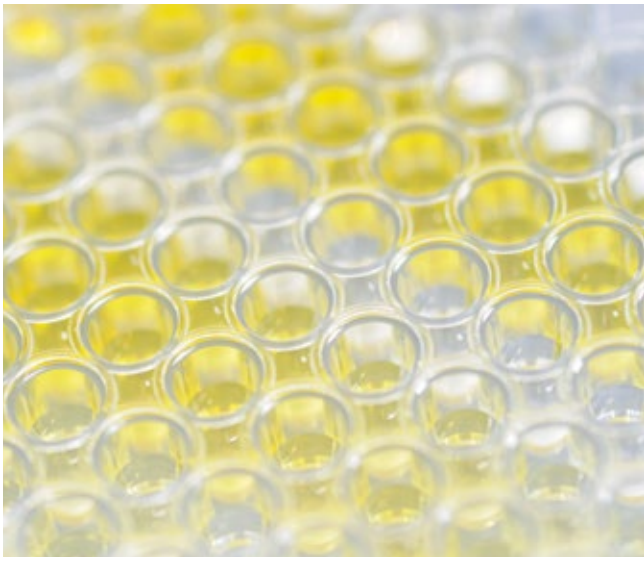
Selected References

"Identification of Novel Antiacetylated Vimentin Antibodies in Patients with Early Inflammatory Arthritis"
Juarez et al., Ann Rheum Dis (2016)

"Evaluating the Efficacy of Aluminium Phosphate Formulated L2 Based HPV Vaccine"
Lakshmikanth et al., Asian Journal of Pharmaceutical and Clinical Research (2015)

"Development of β-Lactoglobulin-Specific Chimeric Human IgEκ Monoclonal Antibodies for In Vitro Safety Assessment of Whey Hydrolysates"
Knipping et al., PloS One (2014)

Have a look in our webshop for off-the-shelf Peptide ELISA plates such as our Histone Code Peptide ELISA!
shop.jpt.com



JPT offers reliable and sensitve Peptide ELISA plates tailored to your needs or as pre-made catalog product.

Microarray & ELISA Assay Services

We provide a comprehensive and modular seromarker and antibody profiling workflow ranging from high resolution epitope discovery and verification of identified epitopes by large sample cohorts to the validation of results using robust and well established assay systems. These three assay modules can be combined or utilized individually.

Workflow & Applications

- **Module I – Discovery:** High resolution epitope discovery (selection of relevant peptides from thousands of candidate peptides)
- **Module II – Verification:** selective antigen profiling (verification of candidate peptides for a significant number of samples)
- **Module III – Validation:** Marker validation (validation of peptides in secondary assay)

Book modules individually or combine them as needed.

Benefits

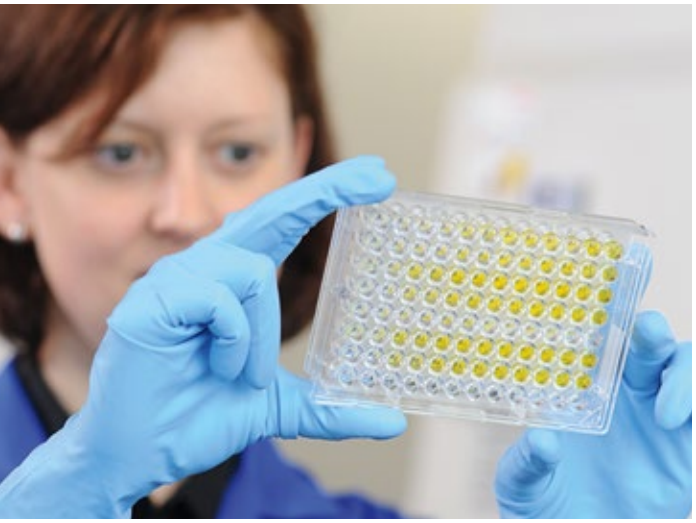
- Modular workflow allows efficient and tailored planning of projects
- All processes controled, validated and ISO 9001:2015 regulated for highest quality
- Each module optimized for specific purpose
- Experienced and dedicated team of scientists
- Assays compatible with antibodies, sera, whole blood and other fluids that contain antibodies

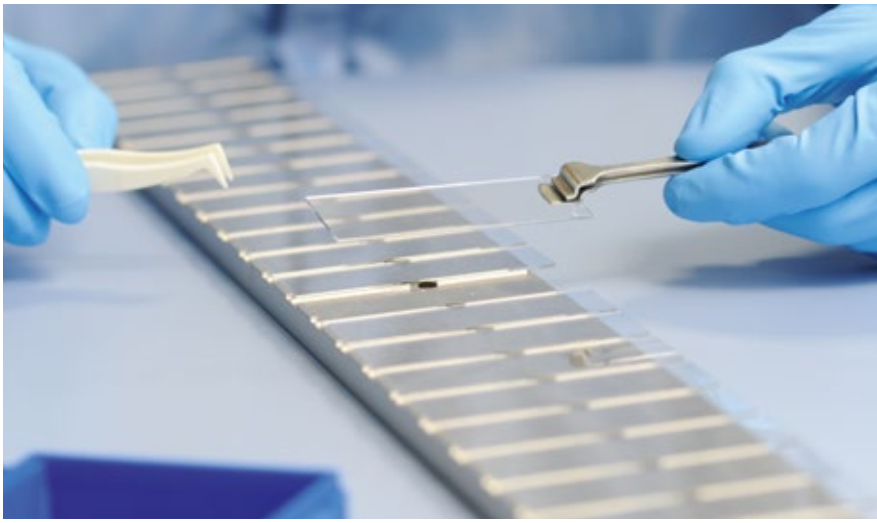
Our Service Includes

- Finding the optimal strategy for your project
- Help to design peptide sequences
- Production of PepStar™ high content peptide microarrays, PepStar™ multiwell peptide microarrays and/or peptide ELISA plates
- Screening and control experiments using your samples
- JPT's biologists and computer scientists will perform data evaluation and analysis

Our Reporting Includes

- Experiment descripton
- Data evaluation and analysis
- Data visualisation
- Description of results
- Data file with raw-data used
- Reporting format can be adjusted to your needs



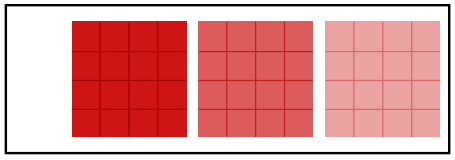


Save time and money by making use of our dedicated and experienced staff and state of the art equipment.

	Multiplexed Epitope Discovery	Selective Antigen Profiling	Marker Validation
Assay Format	High content peptide microarray	Multiwell peptide microarray	Peptide ELISA
No. of Peptides	Up to 6912 peptides in triplicates per sample	Up to 192 peptides in triplicates per sample	Up to 96 peptides per plate
No. of Samples	1 sample per slide	21 samples per slide	Up to 96 samples per plate
Principle	Large number of peptides tested against a limited number of samples	Selected peptides tested against a large number of samples	Flexible for low numbers of peptides & samples
Advantages	Low cost per peptide, high peptide throughput	Low cost per sample, high sample throughput	Economic & robust assay
Applications	Identification of relevant epitopes from thousands of candidate peptides	Verification of candidate peptides using a larger number of samples	Validation of epitopes in secondary assay
Sample consumption	200µl / microarray (1µg / ml antibody or serum 1:200)	100µl / microarray (1µg / ml antibody or serum 1:200)	100µl / vial (1µg / ml antibody or serum 1:200)
Batch Size	1000 identical microarrays from 1 synthesis batch	45 identical microarrays from 1 synthesis batch	200 ELISA vials coated from 1 synthesis batch

Peptide Microarray

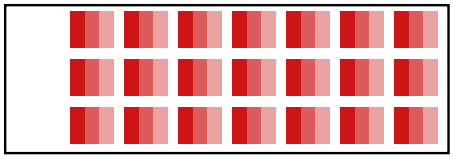
High Content:
6912 peptides in 3 copies/sample



Multiplexed Epitope Discovery

Peptide Microarray

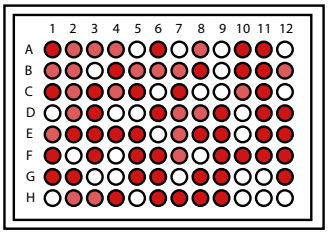
Multiwell:
192 peptides in 3 copies/21 samples



Selective Antigen Profiling

Peptide ELISA

1-96 peptides/samples



Marker Validation

The three modules of our service vary in complexity and can be used individually or combined according to your project plans.

PepSpots™ Peptide Arrays

Your customized membrane based peptide array could display peptide scans through antigens, random peptides, positional, alanine or D-amino acid scans or truncation libraries.

What are PepSpots™?

Peptides are synthesized on a cellulose membrane, c-terminally attached via a flexible linker. The membrane can be used directly for incubation with antibodies or other proteins and read-out via chemiluminescence. Membranes are delivered with a detailed application protocol.

Applications

- Antibody epitope mapping and characterization
- Characterization of protein-protein interactions
- Systematic optimization of peptide lead structures

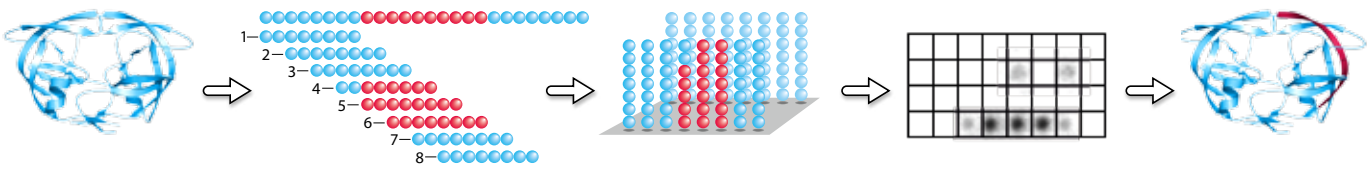
Benefits

- Standard equipment and protocols are applicable
- Rapid, economical, and flexible synthesis of any set of peptides
- Hydrophilic cellulose membranes minimize unspecific interactions

Selected References

- *"Optimization of the All-D Peptide D3 for Aβ Oligomer Elimination"*
  Klein et al., PLoS One (2016)
- *"Differential Basal-to-apical Accessibility of Lamin A/C Epitopes in the Nuclear Lamina Regulated by Changes in Cytoskeletal Tension"*
  Ihalainen et al., Nature (2016)
- *"Structural and Functional Analysis of a Novel Interaction Motif within UFM1-Activating Enzyme 5 (UBA5) Required for Binding to Ubiquitin-like Proteins and Ufmylation"*
  Habisov et al., Journal of Biological Chemistry (2016)
- *"A Novel Sequence in AP180 and CALM Promotes Efficient Clathrin Binding and Assembly"*
  Moshkanbaryans et al., PloS One (2016)
- *"TX1111: A Peptide Homologue of Topoisomerase-1 Sensitizes Pancreatic Cancer Cells to Gemcitabine"*
  Gnanamony et al., Cancer Research (2016)

For a typical order we synthesize overlapping peptides of your protein of interest on cellulose membranes. Resulting PepSpots™ membranes can be incubated with your sample and binding region detected by chemiluminescence read-out.



Antigen of interest | *Overlapping peptides* | *PepSpots™ membrane* | *Result of incubation* | *Binding region*

BioTides™ Biotinylated Peptides

Biotinylated peptides for your biomedical assays using streptavidin coated beads, membranes, glass slides or microtiter plates.

What are BioTides™?

BioTides™ are custom synthesized inexpensive sets of small scale biotinylated peptides. Thousands of BioTides™ are available within days.

- Amounts of 50 – 250 nmol per peptide
- Peptide length up to 20 aa
- Ready-to-use soluble peptides in 96- or 384-well plates delivered freeze dried

Selected References

- *"Epitope Mapping via Selection of Anti-FVIII Antibody-Specific Phage-Presented Peptide Ligands That Mimic the Antibody Binding Sites"* Kahle et al., Thromb Haemost (2015)
- *"Evaluation of Viral Peptide Targeting to Porcine Sialoadhesin Using a Porcine Reproductive and Respiratory Syndrome Virus Vaccination-Challenge Model"* Ooms et al., Virus Research (2013)
- *"Human IgE Against the Major Allergen Bet v 1 – Defining an Epitope with Limited Cross-Reactivity Between Different PR-10 Family Protein"* Levin et al., Clinical & Experimental Allergy (2013)

Applications

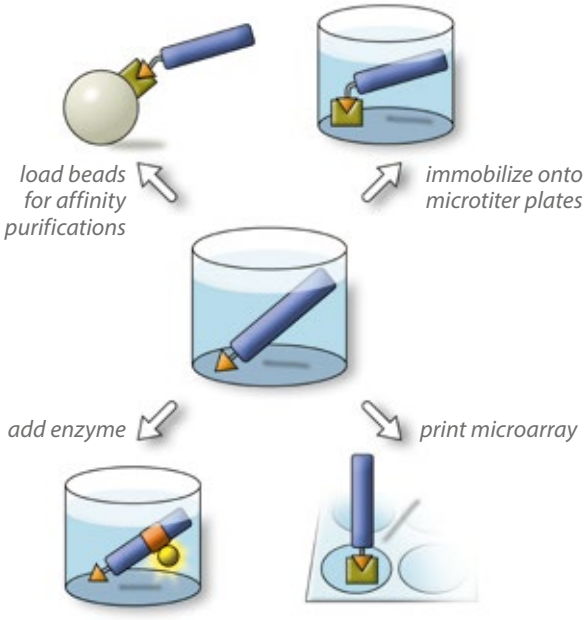
- Identification and optimization of kinase-, phosphatase-, acetyltransferase- and histone deacetylase-substrates via standard screening systems (AlphaScreen, FlashPlates, SPA-Beads, Luminex and many more)
- Mapping of protein/protein interaction sites
- Peptide ELISA assays
- Production of peptide microarrays
- Loading of columns for affinity chromatography

Benefits

- Thousands of unpurified biotinylated peptides for screening and peptide array production
- Unmatched turnaround times (10 000 peptides per week!)
- Delivery in ready-to-use microtiter plates
- Lowest price in the industry due to patented technology
- Complete QC (LC-MS, MALDI etc.) and aliquotation service available

Your BioTides™ will be delivered in 96-well plates with detailed documentation and QC/QA report on a CD-ROM.

Use of BioTides™ for binding and enzymatic assays.



Bioinformatics & Cheminformatics

**With our long term experience in Bioinformatics, Computational Chemistry and Modeling we are able to support your research projects at all stages.
We offer this unique know-how and expertise as part of our high content peptide microarray and library services or in R&D collaborations focusing on peptide hit discovery and optimization.**

Capabilities

- Library design based on all available and relevant data sources (sequence, structure, function, homology, literature, ligands, databases)
- Evaluation of experimental data (medium and high-throughput assays)
- Management of complex data sets
- Presentation of complex data sets
- Conversion of structure, sequence and other data to different formats
- Support for compound logistics
- Supply of compound data in any format (sequence or structure)
- Generation of homology models for peptide selection
- Prediction and modelling of data
- Scaffold design for native-like presentation of peptides
- Management and integration of data from different sources
- Customized data presentation

Benefits

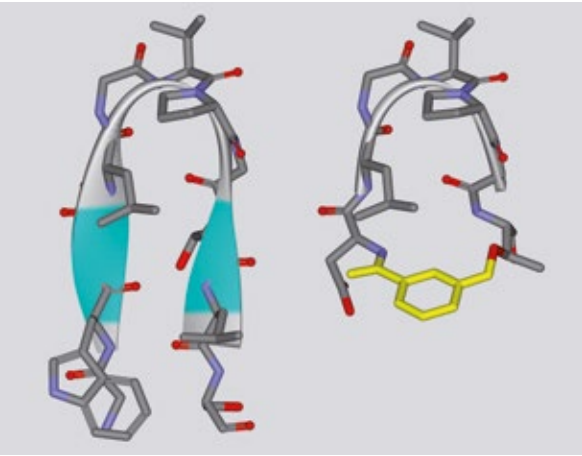
- Long-term track record on the discovery and development of peptides in immunotherapy, drug discovery and diagnostic development
- State of the art prediction, data interpretation and data mining algorithms and software paired with chemical and biological know how
- Expertise available as a fee-for-service or in collaborative partnerships

Service Specifications

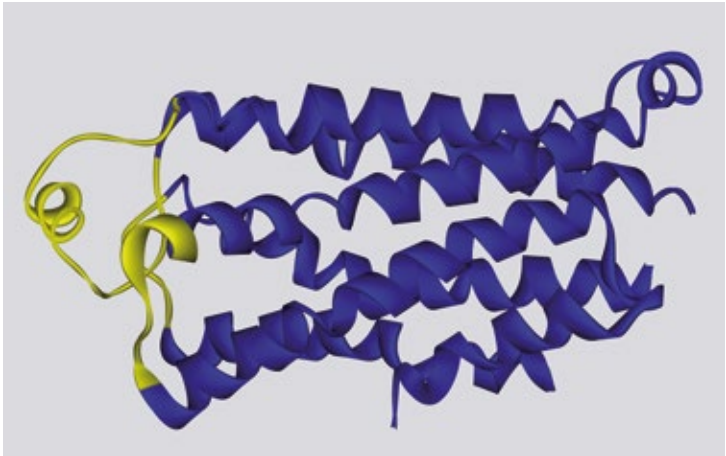
- Detailed discussion of your project and definition of a suitable strategy based on scientific feasibility and experience
- Receive project proposal on how our bio- and cheminformatic expertise can support your project
- Obtain detailed and comprehensive service reports

Discuss your project directly with our computer scientists. Contact us at peptide@jpt.com!

X-ray loop structure (left) and model (right) stabilized by scaffold.



Use of homology model for the selection of cytosolic loop peptides for a GPCR (MSH).



Meeting Sequence Diversity

Sequence diversity on DNA and protein level is abundant in organisms, often connected to disease. Pathogens exhibit tremendous sequence diversity to bypass the mechanisms of immune defense, individuals differ from each other by germline mutations and somatic mutations can cause diseases like cancer. More complexity is added by post-translational modifications which further alter proteins and give rise to potential neo-epitopes. Therefore, sequence diversity has to be taken into account when designing peptide libraries for development of immune monitoring and immunotherapy approaches. Our ULTRA-library concept covers sequence diversity in peptide libraries of optimal size.

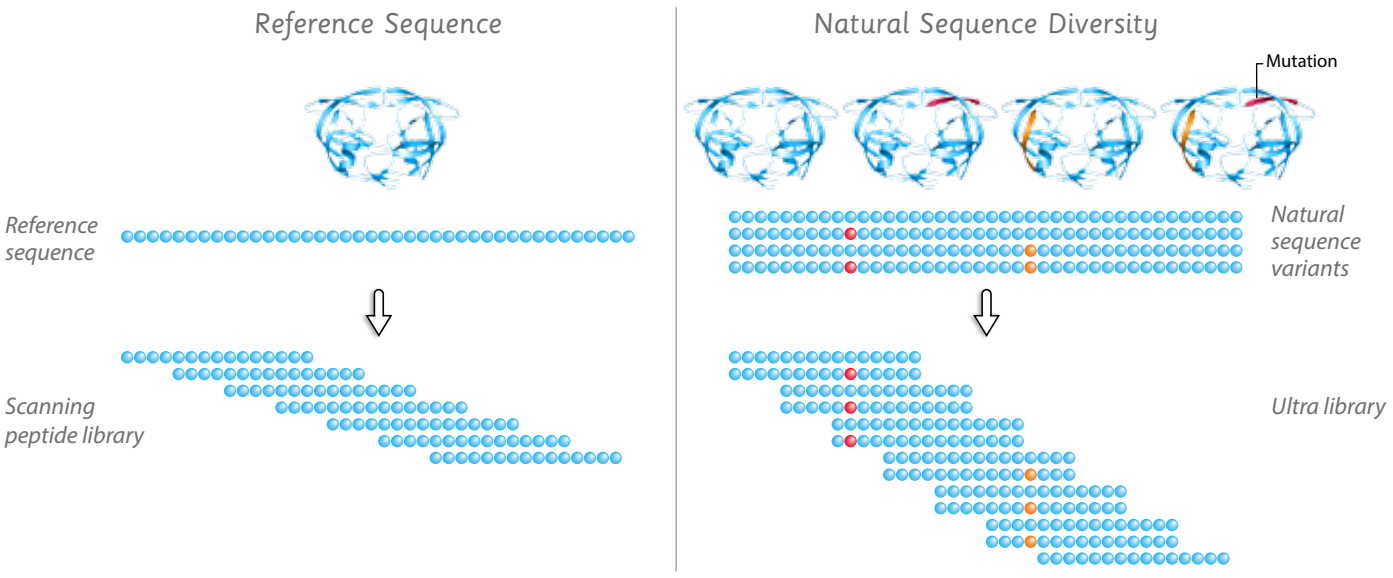
Peptide Prioritization

Chemical peptide accessibility, stability and solubility vary largely based on their specific amino acid sequence, physicochemical properties and secondary structure propensities and need to be considered for selecting appropriate candidates for immunotherapy and vaccination. Backed by our experience in synthesizing hundreds of thousands of peptides and deducted prediction algorithms we provide assistance to select peptides with favorable properties regarding synthetic access, solubility and shelf life.

Selected References

- *"Antibody Responses after Analytic Treatment Interruption in Human Immunodeficiency Virus-1-Infected Individuals on Early Initiated Antiretroviral Therapy"*
  Stephenson et al., Open Forum Infect Dis. (2016)
- *"Fine Specificity of the Antibody Response to Epstein-Barr Nuclear Antigen-2 and other Epstein-Barr Virus Proteins in Patients with Clinically Isolated Syndrome: A Peptide Microarray-Based Case-Control Study"*
  Schlemm et al., J Neuroimmunol. (2016)
- *"Protective Efficacy of Adenovirus/Protein Vaccines against SIV Challenges in Rhesus Monkeys"*
  Barouch et al., Science (2015)
- *"Quantification of the Epitope Diversity of HIV-1-Specific Binding Antibodies by Peptide Microarrays for Global HIV-1 Vaccine Development"*
  Stephenson et al., J Immunol Methods (2015)
- *"Mass-Spectrometry-Based Draft of the Human Proteome"*
  Wilhelm et al., Nature (2014)
- *"Multiple Sclerosis: the Elevated Antibody Response to Epstein-Barr Virus Primarily Targets, but is not Confined to the Glycine-Alanine Repeat of Epstein-Barr Nuclear Antigen-1"*
  Ruprecht et al., J Neuroimmunol (2014)

The design of ULTRA peptide libraries ensures optimal coverage of sequence diversity by using the minimal number of peptides.



We take pride in our competent service and swift response.
Please do not hesitate to contact us for further information.
We also very much welcome your feedback and comments.

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