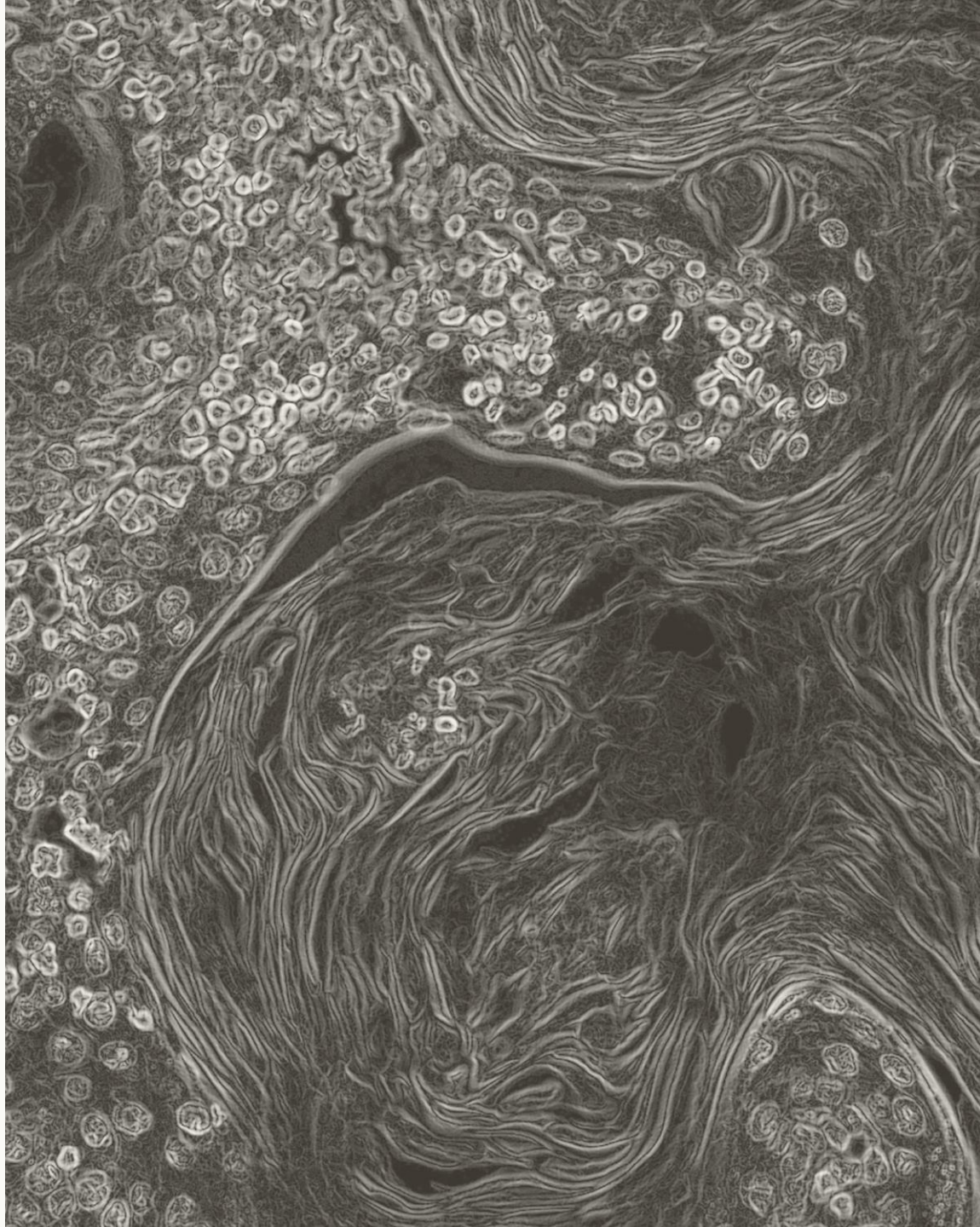
CELL ORIGINS

Your Partner in Phage Display

BOUTIQUE PEPTIDE DISCOVERY

cellorigins.com

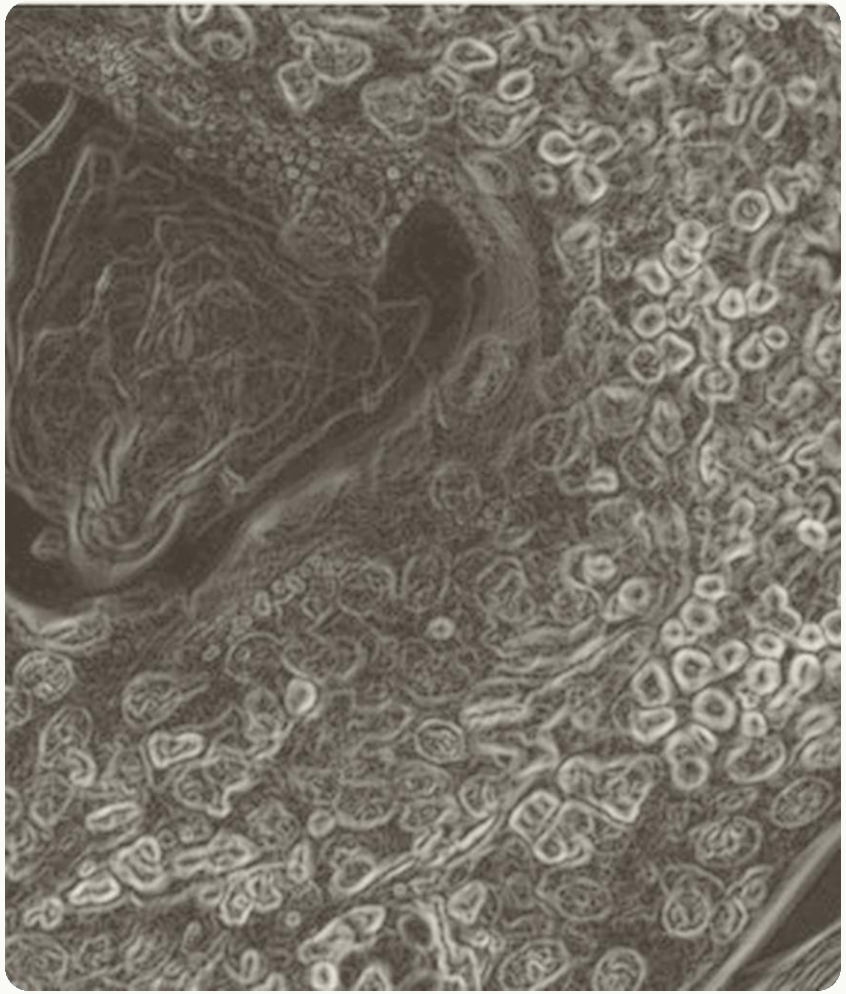


THE CELL ORIGINS DIFFERENCE

DISCOVERY IS PERSONAL

Cell Origins is a *boutique* CRO built around a single specialty: peptide discovery by phage display. We are small on purpose. You work directly with the founders, and with the scientists who run your selections at the bench.

There is no account manager between you and the work. Every strategy is written for your target, every result is discussed with you in person, and every project is treated as if it was our own.



OUR ORIGINS

WE ARE PASSIONATE ABOUT PHAGE DISPLAY

Cell Origins was founded by scientists with deep roots in phage display. Our founders trained at the University of Missouri, where Dr. George P. Smith invented the technology, work recognized with the 2018 Nobel Prize in Chemistry.

We run our selections using the vectors Dr. Smith developed, obtained from his laboratory. Members of our team have published alongside him. With that legacy we are not simply continuing a tradition, we are evolving it.

2019
FOUNDED

30+
PEER-REVIEWED PUBLICATIONS

>25
YEARS AT THE BENCH

MEET OUR TEAM

You collaborate directly with the people who shaped the field.

LeAnn Qi, MBA

Founder & CEO · Strategic scientific ventures

Brings deep expertise in guiding the business side of early-stage biotech ventures, with a track record spanning grant strategy, financial innovation, and product positioning. At Cell Origins, she shapes the company's strategic direction and oversees business operations with a focus on precision and impact.

Mette Soendergaard, PhD

Founder & CSO · Innovator in phage display design

Brings leadership in phage display innovation, with a distinct focus on strategic selection design and precision targeting of cancer biomarkers. A recognized expert in the field, she drives the evolution of phage display platforms, refining innovative peptide discovery and designing novel libraries.

Jessica Newton-Northup, MS

Founder & COO · Expert in translational peptide discovery

Brings 25 years of hands-on expertise in phage display, with a focus on identifying cancer-targeting peptides. Her work has contributed to over 30 peer-reviewed publications and numerous successful grants. At Cell Origins, she applies her experience to perfect phage display in the laboratory.

HOW WE WORK WITH YOU

You work with the founders, not an account manager.

01 Direct access

Your point of contact is a named scientific lead. The people who design your selection are the people who run it at the bench and the people who interpret the data.

02 Built for your target

Nothing is run off a template. Your discovery strategy is written from the literature, for your target and your intended application, before any bench work begins.

03 You see everything

Written progress updates through the project, a review meeting at every milestone, and raw as well as processed data in your hands, not only conclusions.

04 Small on purpose

We take on a limited number of projects, so each one gets full attention. We pay attention to your project as if it were our own, because this is the science we care about most.

THE PROCESS

An integrated discovery workflow, designed around your target and intended application.

01 **Discovery strategy**

Target and literature review, followed by a written selection strategy developed with your team

02 **Feasibility & optimization**

Target format, assay conditions and chemistry established before biopanning begins

03 **Library**

Premade or custom libraries across linear and cyclic formats

04 **Biopanning**

Multi-tier selections designed around the biological context and intended use of the peptide

05 **Phage display-focused NGS**

Controlled amplification, library preparation and deep Illumina sequencing

06 **Bioinformatics & prioritization**

Enrichment analysis, sequence-family clustering and candidate prioritization

07 **Screening & validation**

Experimental confirmation, lead refinement and validation in relevant biological models

OUR RECORD

Every discovery campaign we have conducted has produced specific binders

Across our founders' careers, every phage display discovery campaign has yielded specific binding candidates.

FROM STRATEGY TO SELECTION

The quality of a discovery campaign is shaped by how the selection is designed and executed.

01 Discovery strategy

Selection design begins with the intended application.

- A literature-driven assessment of the target informs a written strategy developed with your team before experimental work begins
- Delivery peptides, tumor-targeting ligands and radionuclide carriers require different selection pressures and biological models

02 Feasibility & optimization

Critical experimental parameters are established before biopanning.

- Confirm target expression, immobilization and presentation, including cell-surface and nanodisc formats
- Establish selection chemistry, cyclization conditions and appropriate binding assays as needed

03 Libraries

Flexible library formats matched to the discovery objective.

- Premade and custom linear or cyclic peptide libraries using display vectors developed in the Dr. George P. Smith's laboratory
- Library and vector customization, including biotinylation, soluble ligand expression and affinity-capture strategies

04 Biopanning

Selection is performed in the most relevant biological context

- Negative selection and preclearing can be combined with recombinant targets, cells, tissues and *in vivo* models
- Each selection tier is designed to enrich candidates with the characteristics required for downstream performance

FROM SEQUENCE TO VALIDATED LEAD

NGS, bioinformatics and experimental validation turn enriched sequences into prioritized candidates.

05 Phage display-focused NGS

Amplification bias can significantly distort phage display sequencing data.

- Controlled PCR conditions minimize amplification bias and help preserve representation of sequence diversity, with unique molecular identifiers available when appropriate
- Library preparation and Illumina sequencing performed in house, with quality-control metrics generated for every sample pool

06 Prioritization

Enrichment is only one component of candidate prioritization.

- Sequence-family analysis identifies related enriched motifs and provides additional support beyond individual sequence abundance
- Net charge, hydrophobicity and other physicochemical or developability characteristics are evaluated alongside enrichment

07 Screening & validation

Prioritized sequences are experimentally confirmed before lead advancement.

- Clone confirmation and phage-based binding assays are followed by peptide synthesis panels selected to represent sequence and motif diversity
- Lead refinement, affinity maturation and validation are performed in biologically relevant models, including in vivo models where appropriate

WHAT YOU RECEIVE

Everything below is yours at the end of a campaign, in a form your own team can use.

Discovery strategy

Written, target-specific selection strategy agreed before experimental work begins

Selection records

Conditions and stringency parameters documented across each selection round

NGS datasets

Quality-controlled raw and processed sequencing data for each library and selection round

Bioinformatic analysis

Sequence abundance and enrichment, sequence-family clustering, cluster-level enrichment

Ranked candidate list

Prioritized candidates annotated with enrichment, clustering, and developability risk

Binding data

Results for sequence-confirmed clones against target and relevant controls

Final report

Methods, selection conditions, results, interpretation and conclusions

Organized data package

Structured datasets, source data and figures ready for internal review and downstream use

Written progress updates throughout the campaign, with a review meeting at every milestone.
A named scientific lead is your point of contact from strategy through final reporting.

SELECTED WORK

CASE STUDIES

Four programs. Four phage display strategies, each built for its target.

01 Ovarian tumor targeting *in vivo*

02 Cell-based screening

03 Reduced kidney retention

04 Affinity maturation

1 CASE STUDY

Multi-tier approach delivers a peptide optimized for ovarian tumor targeting and *in vivo* performance.

SCIENTIFIC OBJECTIVE

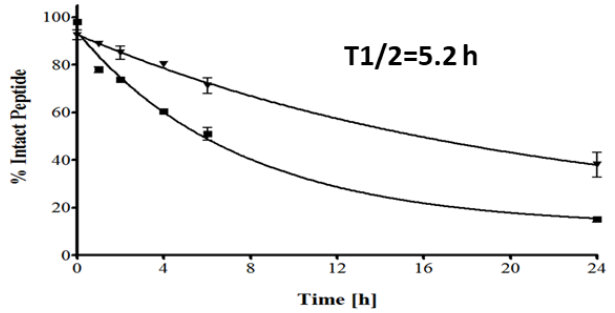
To identify a peptide that selectively targets human ovarian tumors with favorable *in vivo* stability and pharmacokinetics to overcome the limitations of recombinant protein models.

OUR TAILORED STRATEGY

We developed a refined, multi-tier phage display workflow to address the limitations of recombinant selections. The strategy included preclearing in healthy mice, *in vivo* selection against xenografted tumors, and direct selection using freshly isolated tumor cells to preserve native antigen context across all tiers.

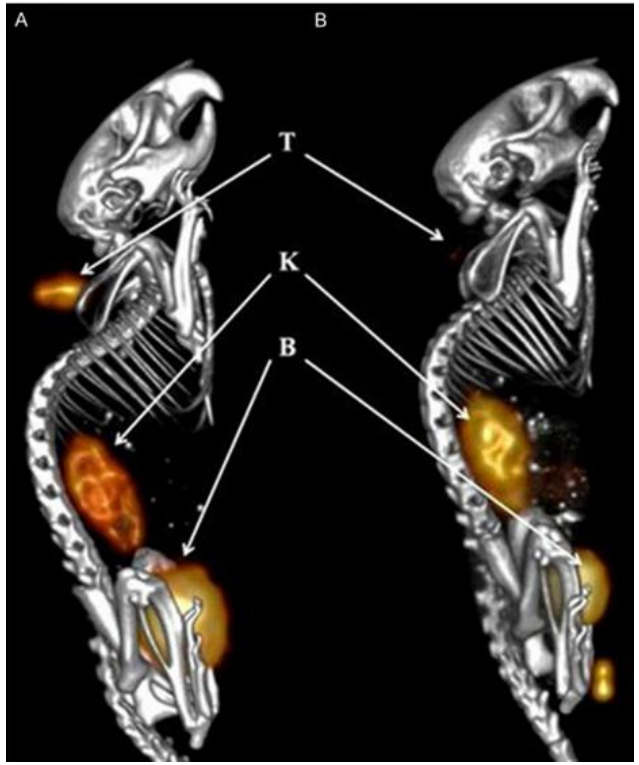
OUTCOME

This approach yielded J18, an ovarian cancer-targeting peptide with favorable stability, pharmacokinetics and SPECT/CT imaging properties.



Mouse serum (■) and HEPES buffer (▼) at 37°C.

Time	Tumor/muscle	Tumor/blood
0.5 h	5.10	0.69
1 h	9.40	1.61
2 h	18.56	8.67
4 h	7.45	0.54



^{111}In-DOTA-GSG-J18 and (B) In-DOTA-GSG-J18 followed by ^{111}In-DOTA-GSG-J18 were injected into xenografted mice. Images were acquired 1 h post-injection. T=tumor, K=kidneys and B=bladder.

Soendergaard M, *et al*. In vivo phage display selection of an ovarian cancer targeting peptide for SPECT/CT imaging. Am J Nucl Med Mol Imaging. 2014 Sep 6;4(6):561-70. **Cited in George P. Smith's 2018 Nobel Lecture.**

2 CASE STUDY

Cell-based selection identifies tumor-targeting sequences that retain activity in a native cell-surface context.

SCIENTIFIC OBJECTIVE

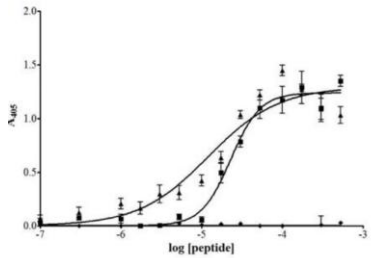
To accelerate the discovery of tumor-targeting peptides by integrating cell-based selections to ensure that identified candidates retain functionality in physiologically relevant contexts.

OUR TAILORED STRATEGY

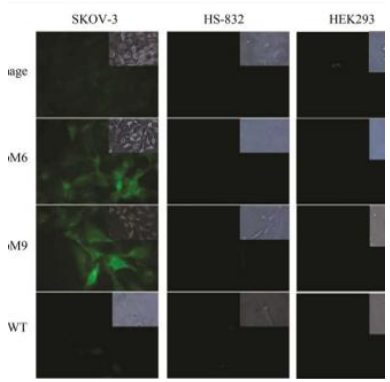
We applied a cell-based phage display approach using a human ovarian cancer cell line as the selection target. By incorporating live-cell binding steps, we enriched for peptides capable of recognizing native cell surface structures. Selected clones were evaluated via imaging in a mouse xenograft model.

OUTCOME

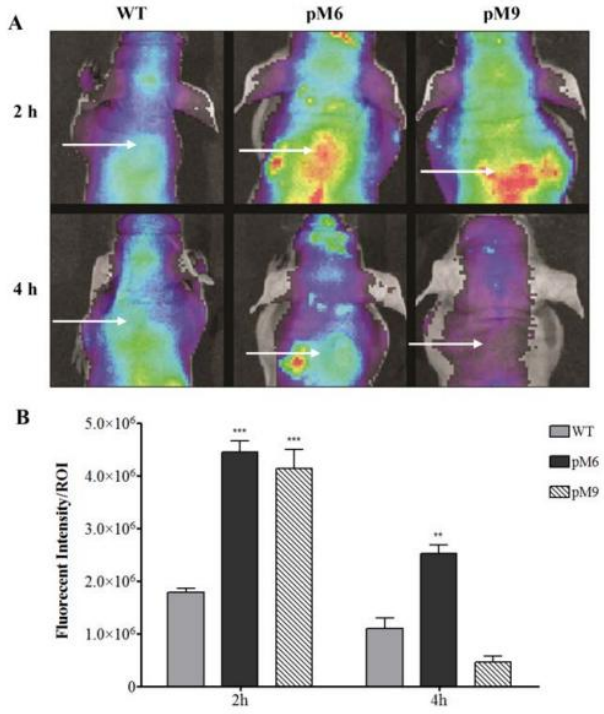
Phage-displayed peptides demonstrated selective accumulation in xenografted tumors, validating their ability to home to cancer cells *in vivo*. This approach supports faster identification of translationally viable targeting ligands.



M6 and M9 showed dose-dependent binding to SKOV-3 cells, with EC_{50} values of 22.9 ± 2.0 µM and 12.2 ± 2.1 µM, respectively.



Selected phage clones pM6 and pM9 show specific binding to SKOV-3 cells.



In vivo imaging of NIR-labeled phage clones was used to evaluate the tumor-targeting and pharmacokinetic properties of selected candidates.

Soendergaard M, Newton-Northup JR, Deutscher SL. In vitro high throughput phage display selection of ovarian cancer avid phage clones for near-infrared optical imaging. Comb Chem High Throughput Screen. 2014;17(10):859-67
Cited in George P. Smith's 2018 Nobel Lecture.

3 CASE STUDY

In vivo phage display enables selection of peptides with reduced kidney retention and improved clearance.

SCIENTIFIC OBJECTIVE

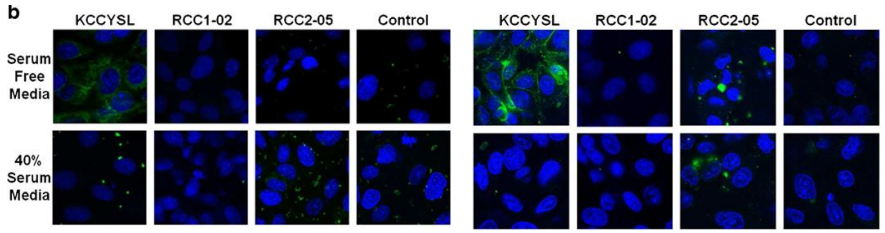
To overcome a key barrier in peptide drug development: off-target retention in the kidneys and liver. The goal was to discover peptides with favorable pharmacokinetics and rapid systemic clearance.

OUR TAILORED STRATEGY

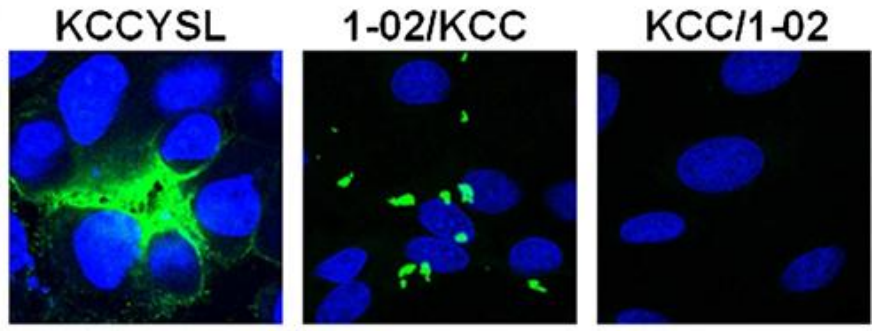
We used *in vivo* phage display to identify sequences that promote rapid renal clearance while minimizing kidney retention. To support translation, we developed a custom *in vitro* assay predictive of renal retention and conducted full pharmacokinetic profiling of selected clones.

OUTCOME

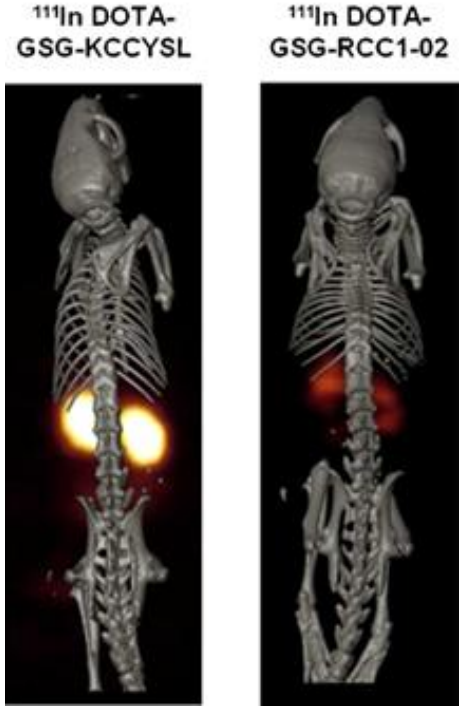
Peptide RCC1-02 demonstrated significantly reduced kidney retention compared to control peptides in mouse models, validating its potential for use in therapeutic designs requiring rapid clearance and low off-target exposure.



Binding of phage and peptides to kidney cells with or without BSA competition. BSA reduced binding of known megalin/cubilin ligand KCCYSL, but not RCC1-02 or RCC2-05. (Left) Phage binding; (Right) Biotinylated peptide binding.



Cell binding analysis of KCCYSL and RCC1-02 fusion peptides shows that the selected sequences reduce kidney binding of KCCYSL.



Pharmacokinetic and SPECT/CT studies of ^{111}In-labeled peptides show rapid renal clearance and reduced kidney retention of RCC1-02 compared with the control peptide.

Newton-Northup JR, Dickerson MT, Kumar SR, Smith GP, Quinn TP, Deutscher SL. In vivo bacteriophage peptide display to tailor pharmacokinetics of biological nanoparticles. Mol Imaging Biol. 2014 Dec;16(6):854-64. doi: 10.1007/s11307-014-0762-z. PMID: 25001195.

4 CASE STUDY

Alanine scanning–guided peptide engineering yields a ~100-fold improvement in binding

SCIENTIFIC OBJECTIVE

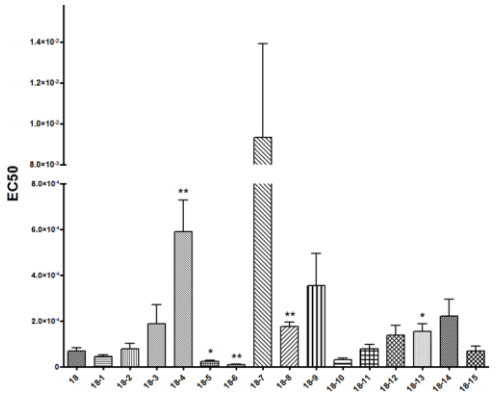
To enhance the binding of a cancer-targeting peptide through alanine scanning-guided optimization to transform a promising lead into a high-performance candidate.

OUR TAILORED STRATEGY

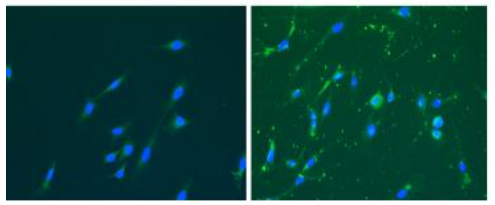
We employed alanine scanning to identify key residues contributing to target engagement. Substitution of serine-5 (S5) and aspartic acid-6 (D6) revealed a dramatic impact on binding. Based on these insights, we designed a dual-substitution variant, J18-S5A-D6A, to test for synergistic affinity gains.

OUTCOME

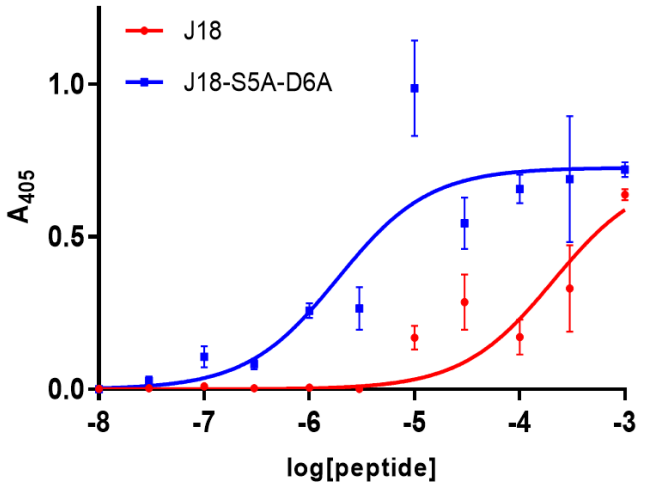
The engineered J18-S5A-D6A variant exhibited an EC_{50} value approximately 100-fold lower than the parent peptide, validating the power of minimal, rational substitutions for precision tuning of peptide performance.



Sequential alanine scanning of a cancer-targeting peptide. EC_{50} values were determined using a *cell-based* dose-response assay.



Fluorescent microscopy of the original peptide (left) and the optimized variant (right) showing improved binding to the target cell line.



A double-alanine substitution of the peptide J18-S5A-D6A was evaluated and compared to the original peptide J18 using a cell-based ELISA. The EC_{50} value of the maturated peptide was decreased by approximately 100-fold.

Soendergaard M., *et al.* Unpublished data.

WHY CELL ORIGINS?

Phage display expertise, applied to the biology that matters.

Designed for the target

Every campaign is built around the target, biological context and intended application. Library format, depletion strategy, selection model and stringency are chosen deliberately, not taken from a standard workflow.

Discovery in relevant biology

We move beyond recombinant targets when the biology requires it, using cell-based, *ex vivo*, and *in vivo* selection strategies to preserve native target presentation and select for the properties that matter downstream.

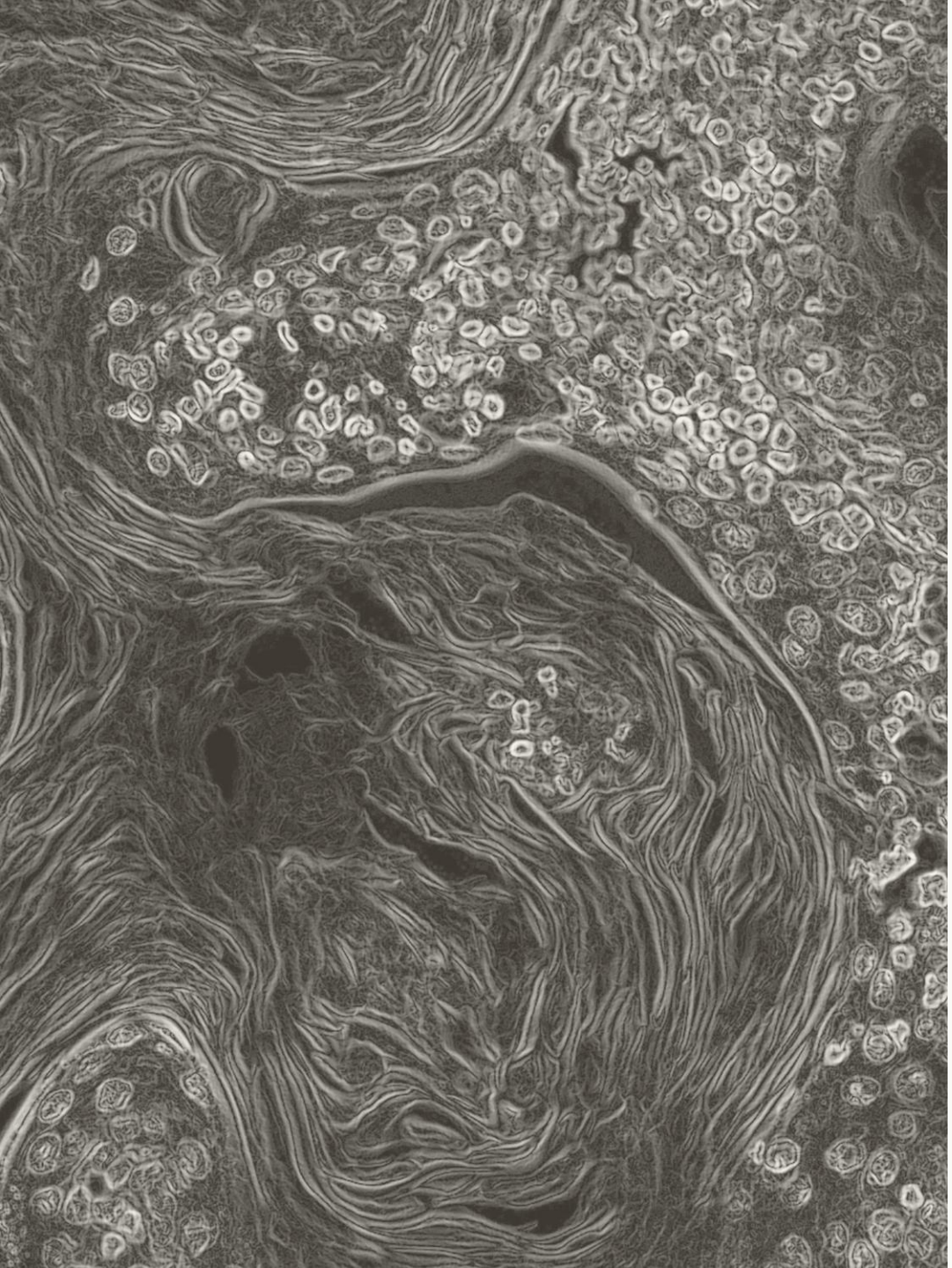
Expertise across the workflow

From library design and biopanning through phage-focused NGS, bioinformatics, candidate prioritization and validation, the work stays with scientists who understand the entire discovery process.

BUILD AROUND THE TARGET

Let the biology define the discovery strategy.

CELL ORIGINS · YOUR PARTNER IN PHAGE DISPLAY



Let’s explore how we can support your next discovery

CONNECT WITH OUR TEAM

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