Docket #: S24-141

Therapeutic and Immunogenic Protein Production Using Mammalian IRES-like Sequences for Enhanced Circular RNA translation

New Paper! The inventors have just published "A versatile toolbox for determining IRES activity in cells and embryonic tissues" in The EMBO Journal as of March 13, 2025.

Stanford University and University Hospital Bonn scientists have discovered that mammalian IRES-like sequences can overcome the efficiency limitations of eukaryotic translation initiation in circular RNA therapeutics. This breakthrough technology could transform RNA-based therapeutics by allowing sustained protein expression from stable circular RNA, with applications ranging from cancer treatment to enzyme replacement therapy and RNA-based vaccines.

IRES (Internal Ribosome Entry Site) sequences are crucial for initiating protein translation in circular RNA, but current solutions rely heavily on viral sequences which pose significant limitations for therapeutic applications. While eukaryotic IRES-like sequences offer a safer alternative, their efficiency has traditionally been much lower than their viral counterparts. Particularly interesting are the IRES-like sequences found in Hox genes, which play critical roles in tissue development through their precise spatiotemporal expression patterns. The development of effective non-viral IRES sequences for circular RNA could provide a new path forward for long-term protein delivery in diseases requiring sustained therapeutic protein expression.

IRES-like sequences from mouse Hox genes enabled highly efficient cap-independent translation in circular RNA constructs. These sequences demonstrated superior translation efficiency compared to other eukaryotic IRES sequences, while

maintaining the safety advantages of non-viral elements. Importantly, the system allows for fine-tuned protein expression through targeted 2-4 nucleotide mutations in the IRES-like sequences, enabling precise control over therapeutic protein levels. This technology has broad potential applications, from producing tumor-suppressing proteins for cancer treatment to generating therapeutic enzymes, and could significantly advance the field of RNA therapeutics by enabling sustained protein expression with lower dosing requirements.

Stage of Development:
Proof of concept

Applications

- Production of therapeutic proteins for sustained expression
- Development of RNA-based vaccines with enhanced stability
- Generation of enzymes for metabolic disorders
- Expression of tumor-suppressing proteins for cancer treatment

Advantages

- Higher translation efficiency than traditional eukaryotic IRES sequences
- Avoids safety concerns associated with viral IRES elements
- Enables lower dosing due to circular RNA stability
- Tunable protein expression through targeted mutations

Publications

- Philipp Koch, Zijian Zhang, Naomi R Genuth, Teodorus Theo Susanto, Martin Haimann, Alena Khmelinskaia, Gun Woo Byeon, Saurabh Dey, Maria Barna, and Kathrin Leppek (2025). A versatile toolbox for determining IRES activity in cells and embryonic tissues. EMBO J (13 March 2025).

Patents

- Published Application: WO2026064145

Innovators

- Maria Barna
- Kathrin Leppek
- Philipp Koch

Licensing Contact

Sam Rubin

Licensing Associate, Life Science

Email