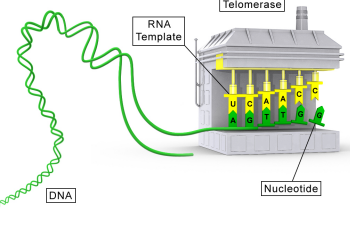


# Telomerase

Telomerase	
	
Bezeichner	
Externe IDs	CAS-Nummer: 9068-38-6
Enzymklassifikation	
EC, Kategorie	2.7.7.49 <sup>[1]</sup> Nukleotidyltransferase
Substrat	DNA
Produkte	Telomere der DNA

Die **Telomerase** ist ein Enzym des Zellkerns, welches aus einem Protein- (TERT) und einem langen RNA-Anteil (TR) besteht. Dieses Enzym stellt die Endstücke der Chromosomen, die so genannten Telomere, wieder her. Die Enzymaktivität der Telomerase lässt sich durch die TRAP-Methode feststellen.

## Entdeckung

Die Telomerase wurde 1985 von den beiden Forscherinnen Elizabeth Blackburn und Carol Greider in dem Wimpertierchen *Tetrahymena* entdeckt.<sup>[2]</sup> Sie wurden dafür 2009 mit dem Paul-Ehrlich-Preis und, zusammen mit Jack W. Szostak, mit dem Nobelpreis für Physiologie oder Medizin ausgezeichnet.

## Merkmale

Das Enzym ist eine reverse Transkriptase, welche den RNA-Anteil als Matrize verwendet. Reverse Transkriptasen dürften noch aus der alten RNA-Welt stammen und sind die einzige Konstante in allen Retroelementen. Es wird heute angenommen, dass sie retroviralen Ursprungs sind.<sup>[3]</sup>

## Funktion

Die Länge der Telomere ist vom Organismus abhängig. Bei Menschen beträgt die Länge etwa 10 kb (Kilobasen), nach mehreren Zellteilungen (etwa 50–100) kann eine Länge von ca. 4–6 kb erreicht werden. Danach geht die Zelle in die Ruhephase über und teilt sich nicht mehr. Bei jeder Zellteilung geht ein Stück (ca. 100 Nucleotide) der Telomere verloren. Die Telomerase verhindert in bestimmten Zellen durch die Wiederherstellung der Telomere, dass die Chromosomen mit jeder Zellteilung kürzer werden und umgeht so das End-Replikationsproblem.

Dieses Problem entsteht, da die DNA-Polymerase  $\delta$  am diskontinuierlichen DNA-Strang ebenfalls von 5' nach 3' repliziert. Am diskontinuierlichen Strang synthetisiert die DNA-Polymerase  $\delta$  ausgehend vom RNA-Primer die Okazaki-Fragmente, bis sie auf einen bestehenden RNA-Primer stößt. Durch Exonukleaseaktivität wird die erste RNA-Base am 5'-Ende des Primers entfernt. Die vollständige Entfernung des RNA-Primers übernehmen sogenannte Flap Endonukleasen. Die Lücken des diskontinuierlichen DNA-Strangs werden ebenfalls mit Hilfe der Polymerase  $\delta$  geschlossen und mit Desoxynucleotiden gefüllt. Eine Ligase verknüpft die noch bestehenden Strangbrüche. Da am

diskontinuierlichen Strang DNA nur so lange repliziert werden kann, solange die Bindung eines RNA-Primers möglich ist, bleibt minimal ein Stück der Länge des RNA-Primers übrig. Abhängig von der Bindung des letzten RNA-Primers kann dieses Stück deutlich länger sein (bis zu 100 Nukleotide). Somit gehen Sequenzinformationen an den DNA-Enden verloren und die Chromosomenlänge nimmt mit jeder Zellteilung und der damit verbundenen DNA-Replikation ab (siehe Alterung).

In den meisten normalen Zellen ist die Aktivität der Telomerase nicht nachweisbar. Aktiv ist die Telomerase nur bei einzelligen Organismen sowie in Zellen der Keimbahn (siehe auch Keimzelle), Embryonalzellen (= embryonale Stammzellen), Stammzellen sowie bei bestimmten Arten von Immunzellen bei mehrzelligen Organismen.

Die Telomerase ist außerdem aktiv in Krebszellen und verhilft ihnen dadurch dazu, sich unendlich oft zu teilen und im Körper zu wuchern. Nicht entartete Zellen können sich nur einer bestimmten Anzahl von Zellteilungen unterziehen (sogenannte Hayflick-Grenze).

## **Einzelnachweise**

[1] [http://www.brenda-enzymes.org/php/result\\_flat.php4?ecno=2.7.7.49](http://www.brenda-enzymes.org/php/result_flat.php4?ecno=2.7.7.49)

## **Weblinks**

- Umfangreiche Telomerase-Datenbank (<http://telomerase.asu.edu/>) (englisch)

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