



Your Transglutaminase Handbook!

- Transglutaminases
- Microbial Transglutaminase
- Protein Labeling
- Assays & Substrates
- Inhibitors
- Antibodies & Microarrays
- Proteases
- Cereal Proteins
- Blood Coagulation
- Celiac Disease Products



2022

The Decade of Transglutaminase Ahead!

In mid-2020 the findings of the Phase 2a proof-of-concept study of Celiac Disease with our tissue transglutaminase inhibitor ZED1227 were unblinded, revealing striking results:

For the first time, a transglutaminase was clinically validated as a druggable target.

Celiac Disease, a gluten-triggered autoimmune disorder, affecting up to 2% of western populations, is still associated with a high medical need. Despite adhering to a gluten-free diet – the only way to live with the disorder – many patients still suffer from symptoms and pain. The fear of gluten contaminations in their diet characterizes a patient's daily life. Tissue transglutaminase (TG2) in the small intestinal mucosa plays a key role in the pathogenesis: deamidation of glutamine residues in gliadin peptides and cross linking of TG2 to these gliadin peptides results in breaking self-tolerance, production of (auto)antibodies, and inflammation.

The proof-of-concept study enrolled more than 160 patients in 7 European countries. The ZED1227 compound proved to be safe and well tolerated. Further, in all three dosage groups over the course of the 6 weeks gluten challenge study the intestinal

mucosal morphology was significantly better compared to that of the placebo group, and patients in the drug cohorts felt better. The details of the study design and outcome were recently published in the New England Journal of Medicine (Schuppan, Mäki et al., 2021).

The study not only gives hope for a better quality of life to celiac patients, but its impact also extends far beyond celiac disease. The therapeutic approach of transglutaminase inhibition might translate to other indications, especially to fibrotic disorders, for which there is still a strong medical need for additional treatment options.

Moreover, it is anticipated that future research in academia and industry will focus intensively on the role of transglutaminases in physiology and pathophysiology.

A new era of transglutaminase research has just begun!

Sincerely yours, Ralf Pasternack and Martin Hils

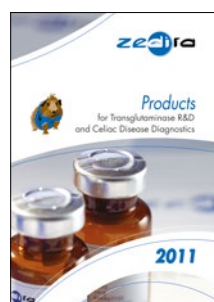
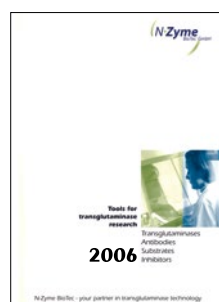
20 Years Transglutaminase Specialty Reagents Catalogue – the Final Print Edition

This 2022 edition of the Transglutaminase Specialty Reagents catalogue is a double jubilee edition. For 20 years we have provided tools to the global community for R+D on and with transglutaminases. Moreover, the current catalogue is the 10th edition. The covers shown below nicely depict the evolution of the catalogue and the specialty reagents produced by Zedira: from 17 products in 2002 to about 300 products today.

Zedira is located in Darmstadt, Germany. Since the 2012 edition we have depicted prominent buildings in Darmstadt to you on the cover, starting with the Art Nouveau Wedding Tower at Artists' Colony on Mathildenhöhe. What a nice coincidence, that just in July 2021 the Mathildenhöhe became a UNESCO World Heritage Site!

While being a jubilee edition, the 2022 catalogue will be the last printed catalogue. This reflects the changing user behaviour: most of our customers reported preferring the homepage. At the same time, we received your feedback, that you appreciated the additional information on transglutaminases provided by the catalogue. We are going to continue providing this information, by transforming the product catalogue to a "Handbook on Transglutaminases" - which will still be available as a print version.

Dear valued customers, please be assured, we won't stop providing you with excellent and unique products to support your essential work.





Zedira is now certified according to
DIN EN ISO 9001:2015

Zedi - Zedira's transglutaminase mascot



In honor of Heinrich Waelsch, Nirmal Sarkar and Donald Clarke who discovered transglutaminase in extracts from guinea pig liver in 1957, we chose the guinea pig as mascot. Zedi's mission is to inform you of novel products and activities in the transglutaminase research field.

In the catalogue Zedi highlights the most important products we recommend to scientists working with transglutaminases.

Stay informed on Zedira's new products as well as general activities like conferences in the fields of transglutaminase, celiac disease and thrombosis and haemostasis:

- Visit our homepage www.zedira.com
- Register for the Transglutaminase Newsletter
(send an e-mail to contact@zedira.com)

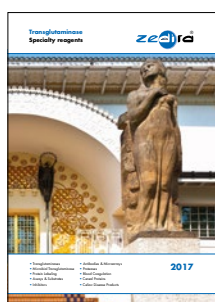
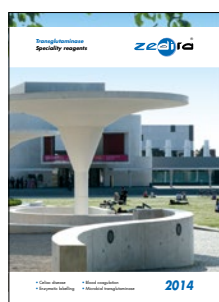
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Note / Contact

The content of this catalogue is subject to change without notice. Prices apply according to our website. To view latest product developments, prices and availability please visit our homepage: www.zedira.com.

For any question please contact us via e-mail:
contact@zedira.com.



Transglutaminases

Background information

The history of the enzyme class of transglutaminases started more than 60 years ago, when the term transglutaminase (TG) was introduced in scientific literature by Heinrich Waelsch and co-workers.

Today, we know that we are talking about a family of nine different isoenzymes in the human body. Although transglutaminases have

one basic common feature – the formation of high molecular weight aggregates by covalent protein cross-linking – they fulfill a multitude of other catalytic and physiological functions.

The sketch below gives you a rough overview about the members and their implications in physiology, diseases and diagnostics - as it is known today.

Deficiencies

TG1: lammellar ichthyosis
 TG3: uncombable hair syndrome
 TG5: acral peeling skin syndrome
 FXIII: bleeding, impaired wound healing, abortions

Diagnostic markers

TG2-autoantibodies
 TG3-autoantibodies
 TG6-autoantibodies
 Factor XIII-activity

Functions

cross-linking
 protein modification
 signaling (G-protein)
 structural protein

Autoimmune diseases

celiac disease
 dermatitis herpetiformis
 gluten ataxia

Neurodegeneration

Alzheimer's disease
 Chorea huntington
 Parkinson's disease

Eyes

cataract formation

Skin diseases

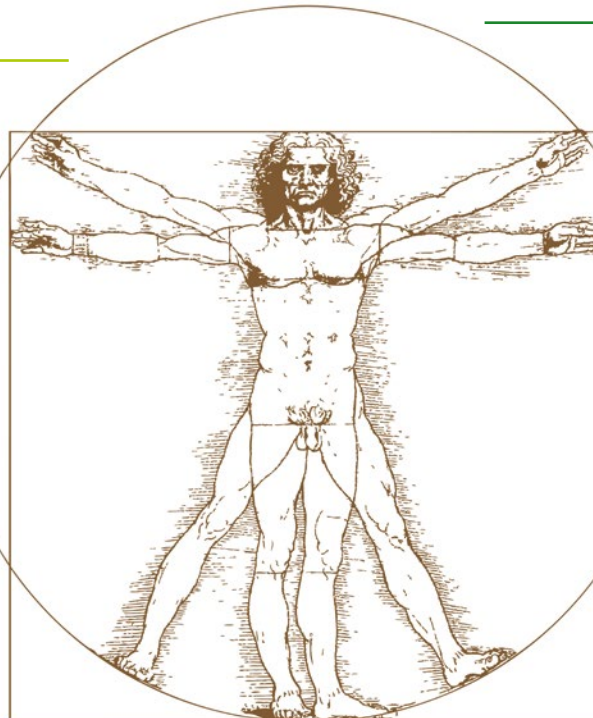
acne, psoriasis

Fibrosis

scarring
 scleroderma
 lung fibrosis
 liver fibrosis and cirrhosis
 diabetic nephropathy

Cancer

drug resistance
 carcinogenesis
 vascularisation



Location

intracellular, extracellular
 intranuclear
 plasma

Cell biology

differentiation
 cell adhesion
 apoptosis
 cell-cell interaction
 cell-matrix interaction
 phagocytosis
 vascularisation
 wound healing
 inflammation
 receptor mediated endocytosis

Skin

cornified envelope formation
 trans-epidermal water loss
 barrier function

The transglutaminase family

TG1: keratinocyte transglutaminase
 TG2: tissue transglutaminase
 TG3: epidermal transglutaminase
 TG4: prostate transglutaminase
 TG5: transglutaminase 5
 TG6: neuronal transglutaminase
 TG7: transglutaminase 7
 FXIII: blood coagulation factor XIII
 B4.2: inactive structural protein

Coagulation

fibrin cross-linking
 decoration with antifibrinolytics
 clot stability
 half-life and composition

ECM

stabilisation
 attachment and spreading of cells
 profibrotic factor

Products

Transglutaminase 1

Synonyms: Keratinocyte transglutaminase, TG1, TGase 1, TG_k

Art. No.	Name	Unit	Price
T009	Human keratinocyte transglutaminase (TG1, recombinantly produced in E. coli)	150 µg	400 €
Reference:	Chrobok et al., PLoS One. 2018, 13:e0196433; Plank et al., J Invest Dermatol. 2018, pii: S0022-202X(18)32817-3; Fischer et al., J. Invest. Dermatol. 2013, 133:1170-7; Fukui et al., FEBS J. 2013, 280:1420-9; Schaertl et al., J. Biomol. Screen. 2010, 15:478-87; Yamane et al., FEBS J. 2010, 277:3564-74		
T035	Human keratinocyte transglutaminase (TG1, recombinantly produced in insect cells)	150 µg	400 €

Transglutaminase 2

Synonym: Tissue Transglutaminase, TG2, TGase 2, TG_c, tissue type protein-glutamine-γ-glutamyltransferase

In the table below you find an overview of human TG2 variants available. Please have a look on the following pages for more detailed product descriptions.

Do you need any other TG2 variants?




Just contact us for customized production: contact@zedira.com

Human TG2 variants available										
Source	Wild type			Mutants						Open tTG™
	T002	T106		T018	T117	T167	T168	T169	T173	
E. coli										
Insect cells	T022		T067							T051 T148
HEK cells	T034	T123								T134
Description	wild type (WT)	biotinylated WT	endotoxin free WT	Cys277Ser mutant	biotinylated Cys277Ser mutant	Beta-barrel 1 + 2 domain deletion-mutant	Cys230Ala mutant	Arg580Ala mutant	Arg116Cys mutant	Open tTG™ biotinylated Open tTG™

Need individual domains of human TG2? Please contact us!

Transglutaminases

Human Transglutaminase 2

Art. No.	Name	Unit	Price
	T002 Human tissue transglutaminase	250 µg	400 €
	(hTG2, recombinantly produced in E. coli)	1 mg	1200 €
Reference:	Chrobok et al., PLoS One. 2018, 13:e0196433; Hietikko et al., Acta Derm Venereol. 2018, 98:366-72; Sánchez-Lara et al., Vet Pathol. 2015, 52:513-23; de Jager et al., J. Neurochem. 2015, 34:1116-28; Fukui et al., FEBS J. 2013, 280:1420-9; Van den Akker et al., PLoS ONE 2011, 6:e23067; Schaertl et al., J. Biomol. Screen. 2010, 15:478-87; Byrne et al., Clin. Immunol. 2010, 136:426-31; Yamane et al., FEBS J. 2010, 277:3564-74; Perez Alea et al., Anal. Biochem. 2009, 389:150-6		
	T018 Inactive human tissue transglutaminase	250 µg	400 €
	(hTG2, Cys277Ser-mutant , recombinantly produced in E. coli)	1 mg	1200 €
Reference:	Shinde et al., J. Mol. Cell Cardiol. 2018, 117:36-48; Van den Akker et al., PLoS ONE 2011, 6:e23067		
	T022 Human tissue transglutaminase	250 µg	400 €
	(hTG2, recombinantly produced in insect cells)	1 mg	1200 €
Reference:	Lexhaller et al., Nutrients. 2019, 11:2263; Engstrom et al., Sci. Rep. 2017, 7:77; Hardes et al., Anal. Biochem. 2012, 428:73-80;		
T034	Human tissue transglutaminase	100 µg	400 €
	(hTG2, recombinantly produced in human embryonic kidney cells)		
	T051 Open tTG™	250 µg	550 €
	(inhibited human tissue transglutaminase, stabilized in its open conformation , recombinantly produced in insect cells)	1 mg	1650 €
Reference:	Lortat-Jacob et al., J. Biol. Chem. 2012, 25:18005-17; Lindfors et al., J. Clin. Immunol. 2011, 31:436-42; Pallav et al., Dig. Liver Dis. 2012, 44:375-8		
T067	Human tissue transglutaminase, endotoxin free	250 µg	450 €
	(hTG2, recombinantly produced in insect cells)	1 mg	1350 €
T106	Biotinylated human tissue transglutaminase	100 µg	400 €
	(biotinylated hTG2, recombinantly produced in E. coli)	250 µg	800 €
T117	Biotinylated inactive hTG2 (Cys277Ser)	100 µg	400 €
	(biotinylated hTG2 (Cys277Ser), recombinantly produced in E. coli)	250 µg	800 €
T123	Biotinylated human tissue transglutaminase	50 µg	400 €
	(biotinylated hTG2, recombinantly produced in human embryonic kidney cells)		

Art. No.	Name	Unit	Price
T134	Open tTG™ (inhibited human tissue transglutaminase, stabilized in its open conformation , recombinantly produced in human embryonic kidney cells)	100 µg	550 €
T148	Biotinylated human Open tTG™ (biotinylated inhibited human tissue transglutaminase (T051), stabilized in its open conformation , recombinantly produced in insect cells)	50 µg 250 µg	400 € 1600 €
T167	Short human tissue transglutaminase, aa 1-475 (hTG2, Barrel 1 and 2 deletion-mutant , recombinantly produced in E. coli) Reference: Stamnaes et al., PLOS ONE 2015, 10:e0134922	250 µg	400 €
T168	Human tissue transglutaminase, C230A mutant (hTG2, Cys230Ala-mutant , recombinantly produced in E. coli) Reference: Stamnaes et al., JBC 2010, 285:25402-9	250 µg 1 mg	400 € 1200 €
T169	Human tissue transglutaminase, R580A mutant (hTG2, Arg580Ala-mutant , recombinantly produced in E. coli) Reference: Liu et al., PNAS 2002, 99:2743-7	250 µg 1 mg	400 € 1200 €
T173	Human tissue transglutaminase, R116C mutant (hTG2, Arg116Cys-mutant , recombinantly produced in E. coli)	1 mg	1200 €

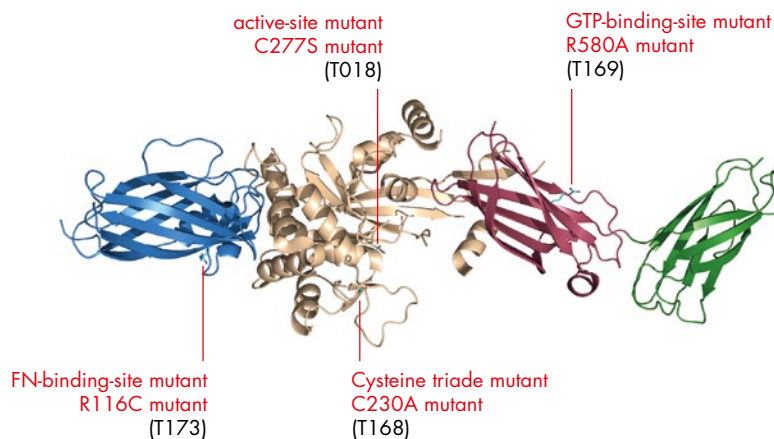


Figure: „Open“ conformation structure of TG2. Available mutants are indicated.

Need individual domains of human TG2? Please contact us!

Transglutaminases



Animal Transglutaminase 2

Art. No.	Name	Unit	Price
T039	Guinea pig liver transglutaminase (gpTG2, recombinantly produced in E. coli)	10 U	410 €
Reference:	Hauser et al., Amino Acids. 2017, 49:567-83; Wodtke et al., Chembiochem. 2016, 17:1263-81		
T038	Rat tissue transglutaminase (rTG2, recombinantly produced in E. coli)	250 µg 1 mg	400 € 1200 €
Reference:	Sánchez-Lara et al., Vet Pathol. 2015, 52:513-23		
T040	Mouse tissue transglutaminase (mTG2, recombinantly produced in E. coli)	250 µg 1 mg	400 € 1200 €
Reference:	Chrobok et al., PLoS One. 2018, 13:e0196433; Shinde et al., J. Mol. Cell Cardiol. 2018, 117:36-48; Schaertl et al., J. Biomol. Screen. 2010, 15:478-87; Schulze-Krebs et al., Brain Res. 2016, 1631:22-33		
T156	Biotinylated mouse tissue transglutaminase (Biotin-mouse TG2, recombinant in E. coli)	250 µg 1 mg	550 € 1650 €
T102	Mouse open TG2 (Inhibited mouse tissue transglutaminase, recombinantly produced in E. coli)	250 µg 1 mg	550 € 1650 €
T150	Biotinylated mouse open TG2 (Product derived from T102)	50 µg 250 µg	400 € 1600 €
T072	Dog tissue transglutaminase (clTG2, recombinantly produced in insect cells)	250 µg 1 mg	400 € 1200 €
T139	Rabbit tissue transglutaminase (oTG2, recombinantly produced in E. coli)	250 µg 1 mg	400 € 1200 €
T108	Cynomolgus tissue transglutaminase (mfTG2, recombinantly produced in human embryonic kidney cells)	250 µg	550 €
T109	Cynomolgus open TG2 (inhibited cynomolgus tissue transglutaminase, stabilized in its open conformation, recombinantly produced in human embryonic kidney cells)	100 µg	550 €
T160	Biotinylated cynomolgus tissue transglutaminase (Biotinylated mfTG2, recombinantly produced in human embryonic kidney-cells)	50 µg	400 €
Art. No.	Name	Unit	Price
T159	Pig tissue transglutaminase (sTG2, recombinantly produced in E. coli)	250 µg 1 mg	400 € 1200 €
T184	Cat tissue transglutaminase (fcTG2, recombinantly produced in E. coli)	200 µg	400 €

Transglutaminase 3

Synonym: Epidermal transglutaminase, TG3, TGase 3, epidermal protein-glutamine- γ -glutamyltransferase, TG_E



Art. No.	Name	Unit	Price
T013	Human epidermal transglutaminase, Dispase activated (TG3a, recombinantly produced in insect cells)	200 µg	550 €
Reference:	Akbar et al., J. Med. Chem. 2017, 60:7910-27		
T024	Human epidermal transglutaminase (TG3, recombinantly produced in insect cells)	200 µg	400 €
Reference:	Hietikko et al., Acta. Derm. Venereol. 2018, 98:366-72; Yamane et al., FEBS J. 2010, 277:3564-74		
T057	Inhibited human epidermal transglutaminase (inhibited TG3, recombinantly produced in insect cells)	250 µg	550 €
T140	Biotinylated human epidermal transglutaminase (TG3, recombinantly produced in E. coli , followed by biotinylation)	100 µg	400 €

Transglutaminase 4

Synonym: Prostate Transglutaminase, TG4, TGase 4

Art. No.	Name	Unit	Price
T042	Human prostate transglutaminase (TG4, recombinantly produced in E. coli)	100 µg	400 €
Reference:	Csobán-Szabó et al., bioRxiv 2021, DOI 10.1101/2021.09.01.458359		

Transglutaminase 5

Synonym: TG5, TGase 5, TG_x

Art. No.	Name	Unit	Price
T086	Human transglutaminase 5 (inactive TG5 inclusion body preparation, recombinantly produced in E. coli)	100 µg	400 €

Transglutaminases

Transglutaminase 6

Synonym: Neuronal Transglutaminase, TG_v, TG6, TGase 6



Art. No.	Name	Unit	Price
T021	Human neuronal transglutaminase (TG6, recombinantly produced in insect cells)	250 µg 1 mg	500 € 1500 €
Reference:	Fukui et al., FEBS J. 2013, 280:1420-9; Schaertl et al., J. Biomol. Screen. 2010, 15:478-87		
T064	Inhibited human neuronal transglutaminase (inhibited TG6, recombinantly produced in insect cells)	250 µg	685 €
T141	Biotinylated human neuronal transglutaminase (TG6, recombinantly produced in insect cells , followed by biotinylation)	100 µg	500 €

Need individual domains of human TG6? Please contact us!

Transglutaminase 7



Synonym: TG7, TGase 7

Art. No.	Name	Unit	Price
T011	Human transglutaminase 7 (TG7, recombinantly produced in E. coli)	250 µg	400 €
Reference:	Kuramoto et al., Arch: Biochem Biophys. 2013, 537:138-43; Fukui et al., FEBS J. 2013, 280:1420-9		

Factor XIII

Synonym: Coagulation factor XIII, FXIII, F13, Fibrin stabilizing factor, FSF, Laki-Lorand factor

Human Factor XIII-A₂

Art. No.	Name	Unit	Price
 T027	Human blood coagulation Factor XIII-A₂ (hFXIII, A subunit, recombinantly produced in insect cells)	200 µg	400 €
Reference:	Böhm et al., J. Med. Chem. 2014, 57:10355-65; Nikolajsen et al., J. Biol. Chem. 2014, 289:6526-34; Heil et al., Thromb. Res. 2013, 131:e214–e22; Schaerli et al., J. Biomol. Screen. 2010, 15:478-87		
T063	Human blood coagulation Factor XIII-A ₂ , Val34Leu-mutant (hFXIIIVal34Leu, A subunit, recombinantly produced in insect cells)	200 µg	400 €
Reference:	Heil et al., Thromb. Res. 2013, 131:e214–e22		
 T070	Human Factor XIIIa, Thrombin activated (hFXIIIa, recombinantly produced in insect cells)	200 µg	550 €
Reference:	Chrobok et al., PLoS One. 2018, 13:e0196433; Akbar et al., J. Med. Chem. 2017, 60:7910-27; de Jager et al., Neuropathol. Appl. Neurobiol. 2016, 42:255-72; Hamedani et al., Chem. Commun. 2015, 51:1135-39; Böhm et al., J. Med. Chem. 2014, 57:10355-65		
T092	Human blood coagulation Factor XIII-A₂ (hFXIII, A subunit, recombinantly produced in human embryonic kidney cells)	100 µg	450 €
T127	Biotinylated human blood coagulation Factor XIII (product derived from T027)	50 µg	400 €
T197	Coagulation factor XIII, recombinant human Factor XIII-A₂ (Recombinant fibrin stabilizing factor, HSA formulation)	100 E 250 E	725 € 1450 €
Note:	This product replaces T007		

Need individual domains of human Factor XIII? Please contact us!

Human Factor XIII-B

Art. No.	Name	Unit	Price
T050	Human blood coagulation Factor XIII B subunit (hFXIII-B, F13B, recombinantly produced in insect cells)	200 µg	400 €
Reference:	Böhm et al., J. Med. Chem. 2014, 57:10355-65; Heil et al., Thromb. Res. 2013, 131:e214–e22; Katona et al., Blood. 2014, 123:1757-63		

Transglutaminases

Human Factor XIII activation peptide (AP-FXIII)

Art. No.	Name	Unit	Price
A125	Human Factor XIII activation peptide (Ac-SETSRATFGGRRVPPNNSNAAEDDLPTVELQGVVPR-OH, AP-FXIII)	10 mg	475 €
Reference:	Dodt et al., Br. J. Haematol. 2015, 172:452-60		
T187	Factor XIII activation peptide, recombinant (recombinantly produced in <i>E. coli</i> , fused to carrier protein)	500 µg	400 €

Animal Factor XIII-A₂

Reference: Heil et al., Thromb. Res. 2013, 131:e214–e22

Art. No.	Name	Unit	Price
T061	Mouse blood coagulation Factor XIII-A ₂ (mFXIII, A subunit, recombinantly produced in insect cells)	200 µg	400 €
T062	Dog blood coagulation Factor XIII-A ₂ (clFXIII, A subunit, recombinantly produced in insect cells)	200 µg	400 €
T065	Rat blood coagulation Factor XIII-A ₂ (rFXIII, A subunit, recombinantly produced in insect cells)	200 µg	400 €
T066	Pig blood coagulation Factor XIII-A ₂ (sFXIII, A subunit, recombinantly produced in insect cells)	200 µg	400 €
T142	Biotinylated mouse blood coagulation Factor XIII-A ₂ (product derived from T061, recombinantly produced in insect cells)	50 µg	400 €
T152	Rabbit blood coagulation Factor XIII-A ₂ (oFXIII, A subunit, recombinantly produced in insect cells)	200 µg	400 €
T161	Cynomolgus blood coagulation Factor XIII-A ₂ (Macaca fascicularis FXIIIa, mfFXIIIa, recombinantly produced in insect cells)	200 µg	400 €

Spotlight - First structure of Factor XIII in active conformation

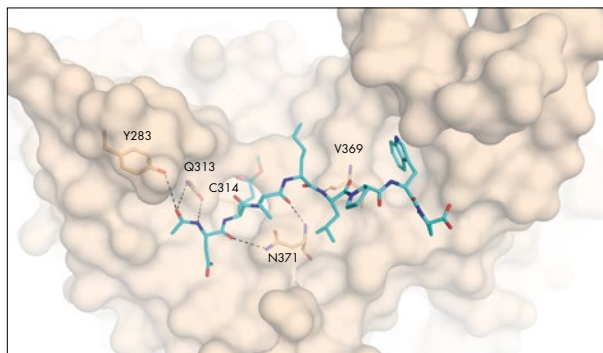
Thrombotic events are a major cause of morbidity and mortality, particularly in industrialized countries. Accordingly, remarkable effort has been undertaken to develop drugs targeting coagulation factors or platelet activation to prevent thromboembolic events. However, current anticoagulants are associated with adverse bleeding events.

Since decades factor XIIIa has been considered a suitable target for anticoagulation treatment in risk patients due to its unique mode-of-action. Direct acting FXIIIa blockers would not impair thrombin level or platelet activity, however, the lack of structural information about FXIIIa's active conformation as well as about the architecture of the active site prevented any rational design of selective inhibitors until now.

In cooperation with the group of Prof. Gerhard Klebe in Marburg, Zedira scientists reported the first crystal structure of FXIIIa° in complex with an irreversible peptidic inhibitor. This novel structure exposes the active site along with concomitant rearrangements and deciphers the mechanism of plasma transglutaminase. But probably most important, the structure solved at 1.98 Å provides the blueprint for rational drug design.

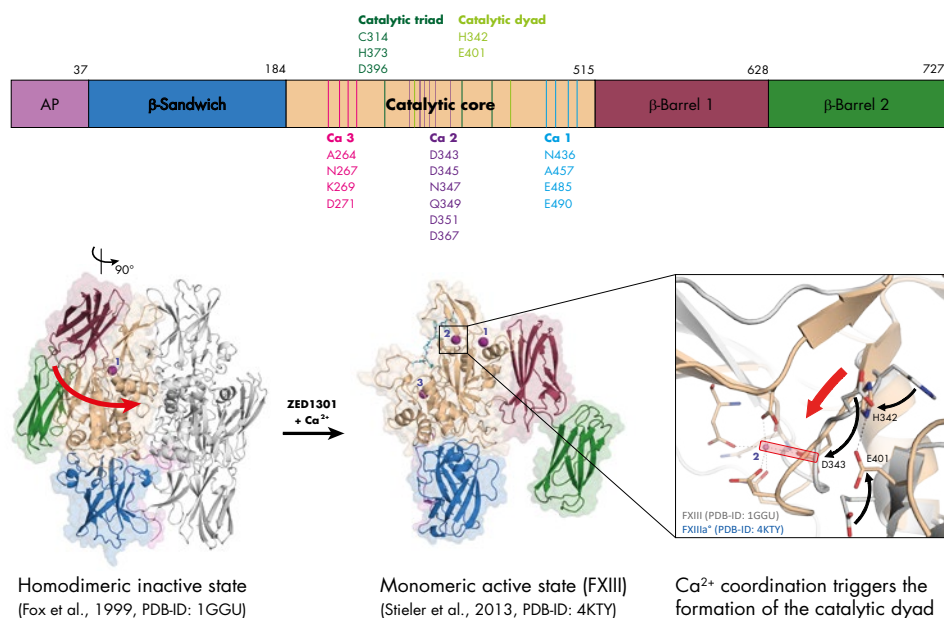
Reference:

Structure of Active Coagulation Factor XIII Triggered by Calcium Binding:
Basis for the Design of Next-Generation Anticoagulants
Martin Stieler, Johannes Weber, Martin Hils, Peter Kolb, Andreas Heine,
Christian Büchold, Ralf Pasternack, Gerhard Klebe
Angewandte Chemie Intl. Ed. 2013, 52:11930.



Binding Mode of ZED1301 in the Active Site of FXIIIa°.

The inhibitor ZED1301 (purple) binds covalently to Cys314 of the catalytic center. The crystal structure reveals that the peptidic lead compound interacts via several H-bonds with FXIII.



Structure of Active Coagulation Factor XIII

In the inactive state, recombinant FXIII exists as a dimer. Upon binding of the irreversible acting blocker ZED1301 (A108) and three calcium ions per subunit, FXIII dissociates and the β-barrel 1 and β-barrel 2 domains undergo a remarkable shift exposing the active site (upper left). The crystal structure of FXIII in its active conformation provides detailed information on an atomic level regarding the role of calcium in the activation process. Calcium coordination affects the shape of the active site of FXIII and triggers the formation of the catalytic dyad (H342, E401).

Microbial Transglutaminase

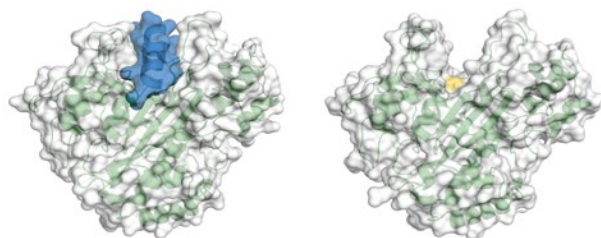
A unique tool for site specific antibody conjugation – and more

Microbial transglutaminase (MTG or synonymous BTG for bacterial transglutaminase) is a Ca^{2+} -independent transglutaminase originally isolated from *Streptomyces mobaraensis* [1]. Today MTG is available as high quality recombinant enzyme produced in *E. coli* (T001).

In *S. mobaraensis* as well as recombinantly in *E. coli* MTG is produced as an inactive proenzyme (zymogen) [2]. Subsequently, proteolytic cleavage of the 45 amino acid propeptide with proteases TAMP and TAP yields active MTG with the N-terminal Sequence DSDDR... in *S. mobaraensis* [3, 4].

For activation of recombinant Pro-MTG the neutral protease Dispase® is used, resulting in the 4 amino acids longer N-terminus FRAPDSDDR... .

MTG is a cross-linking enzyme which – as all transglutaminases – catalyzes the formation of covalent bonds between glutamine and lysine side chains of proteins. The active site cysteine of MTG nucleophilically attacks the γ -carbon in glutamine forming an acyl-enzyme complex. This reactive complex is resolved by reaction with the ϵ -amine group of protein bound lysine, resulting in covalently cross-linked protein. However, simple primary amines are also accepted as co-substrate.



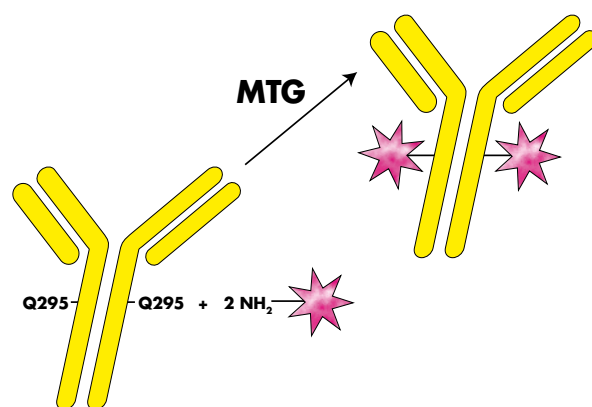
Microbial Transglutaminase crystal structures.

Left: Pro-Transglutaminase (PDB-ID: 3IU0) [5]. The propeptide is shown in blue. Right: active Transglutaminase (PDB-ID: 1IU4) [6]. Active site cysteine is marked in yellow.

In contrast to eukaryotic transglutaminases MTG is Ca^{2+} -independent. It is active over a broad pH range from pH 4 to pH 9 and stable up to 50°C. While being selective for the glutamine substrate sequence/structural environment, MTG accepts a broad range of primary amines.

Based on its stability and Ca^{2+} -independence in the past decades MTG got broadly used in food-industry for improvement of food products like pasta, bread, sausage and yoghurt.

A current trend in oncology and even beyond is the development of antibody drug conjugates (ADCs). Such innovative biomolecules enable the targeted delivery of cytotoxic payloads to cancer cells. Enzymatic conjugation by microbial transglutaminase (MTG) is a state of the art method for the production of site specifically conjugated and homogenous ADCs with a defined drug-to-antibody ratio (DAR) [7, 8]. For details please see section “protein labeling” on page 18.



Antibodies can be conjugated homogeneously and site specifically with payloads at Q295 using MTG.

Alternatively MTG-substrate sequence tags introduced by genetic modification into the antibodies can be used for conjugation.

Our highly purified MTG is the product of choice for this purpose and we are going to meet the increasing requirements of our customers, both in quantity and regulatory aspects. For early development MTG #T001 is suitable. MTG #T153 is characterized for its impurity thresholds host cell protein (HCP) and host cell DNA content, endotoxin content, and microbial burden and therefore recommended for the production of preclinical and clinical ADCs. MTG #T178 contains a C-terminal His₆-Tag enabling easy removal of MTG from a reaction mixture.

Zedira offers the whole toolbox for working with MTG: Assays, ELISAs, antibodies, inhibitors and substrates. Please have a look at the following pages and explore our broad MTG portfolio.

References:

- [1] Ando et al., Agric. Biol. Chem. 1989, 53:2613-17
- [2] Pasternack et al., Eur. J. Biochem. 1998, 257:570-6
- [3] Zotzel et al., Eur. J. Biochem. 2003, 270:4149-55
- [4] Zotzel et al., Eur. J. Biochem. 2003, 270:3214-22
- [5] Yang et al., J Biol Chem. 2011, 286:7301-7
- [6] Kashiwagi et al. J Biol Chem. 2002, 277:44252-60
- [7] Jeger et al., Angew. Chem. Int. Ed. Engl. 2010, 49:9995-7
- [8] Dennler et al., Bioconjugate Chem. 2014, 25, 569-78

Products

Microbial (Pro)Transglutaminase

Synonym: Bacterial transglutaminase, MTG, BTG



Art. No.	Name	Unit	Price
T001	Recombinant microbial (bacterial) transglutaminase (MTG, recombinantly produced in E. coli , gene derived from <i>Streptomyces mobaraensis</i>)	25 U	270 €
		250 U	2140 €
		10 x 25 U	2140 €
		500 U	3750 €
		20 x 25 U	3750 €



Reference: Kaempffe et al., J. Pharm. Sci. 2021, S0022-3549(21)00400-7; Früh et al., ACS Nano 2021, 15, 12161–70; Stricker et al., J. Pediatr. Gastroenterol. Nutr. 2019, 68:e43-e50; Spycher et al., ChemBioChem 2017, 18:1923-7; Steffen et al., J. Biol. Chem. 2017, 292:15622-35; Dennler et al., Chembiochem. 2015, 16:861-7; Dennler et al., Bioconjugate Chem. 2014, 25, 569-78; Kaufmann et al., Food Addit. Contam. Part. A 2012, 29:1364-73; Jeger et al., Angew. Chem. Int. Ed. Engl. 2010, 49:9995-7; Gianfrani et al., Gastroenterology 2007, 133:780-9; Pfeleiderer et al., Microbiol. Res. 2005, 160:265-71; Ando et al., Agric. Biol. Chem. 1989, 53:2613-17; Pasternack et al., Eur. J. Biochem. 1998, 257:570-6



T153	Andracon™ – recombinant microbial transglutaminase, (Production grade)	25 U 10 x 25 U 20 x 25 U	370 € 2950 € 5150 €
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Special features of Andracon™

- Recombinantly produced in *E. coli*
- Ultra-pure and highly active
- Batch to batch consistent quality
- Scientific and technical support
- Available from 25 U vials up to bulk amounts
- License free
- Produced according to an SOP in an ISO9001:2015 certified environment
- Characterized for host cell protein, host cell DNA, and endotoxin-levels
- Customer audits for qualification according to guideline ICH Q7 possible

T016	Microbial (bacterial) Pro -transglutaminase (Pro-MTG, recombinantly produced in E. coli , gene derived from <i>Streptomyces mobaraensis</i>)	250 µg	300 €
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Reference: Pasternack et al., Eur. J. Biochem. 1998, 257:570-6

T178	Microbial transglutaminase with C-terminal His₆-Tag (MTG-His ₆ , recombinantly produced in E. coli , gene derived from <i>Streptomyces mobaraensis</i>)	25 U 10 x 25 U 20 x 25 U	400 € 3150 € 5550 €
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Inhibitor

Art. No.	Name	Unit	Price
C102	MTG-Blocker	10 mg 25 mg	250 € 425 €
Application:	Inhibition of microbial transglutaminase, IC ₅₀ ~ 125 µM		
Reference:	Spycher et al., ChemBioChem 2017, 18:1923-7; Rickert et al., Protein Sci. 2016, 25:442-5		

Microbial Transglutaminase

Antibodies to Microbial Transglutaminase

Art. No.	Name	Unit	Price
A020	Polyclonal antibody to microbial pro transglutaminase (pro-MTG)	500 µg	400 €
Immunogen:	Bacterial protransglutaminase (T016), raised in rabbit		
Format:	Purified IgG		
A051	Biotinylated polyclonal antibody to microbial transglutaminase (MTG)	50 µg	400 €
Format:	Purified via affinity chromatography on protein A, followed by biotin-labeling		
A143	Monoclonal antibody to microbial transglutaminase (clone XM67, IgG1)	200 µg	400 €
Immunogen:	Microbial protransglutaminase (T016), raised in mouse		
Format:	Purified IgG, recommended as capture antibody		
A144	Monoclonal antibody to microbial transglutaminase (clone XM68, IgG2a)	200 µg	400 €
Immunogen:	Microbial protransglutaminase (T016), raised in mouse		
Format:	Purified IgG, recommended as detection antibody		
A145	Polyclonal antibody to microbial transglutaminase	200 µg	400 €
Immunogen:	Microbial protransglutaminase (T016), raised in rabbit		
Format:	Purified IgG		
Note:	A145 replaces polyclonal antibody A019		

Activity Assay Kits for Microbial Transglutaminase

Art. No.	Name	Unit	Price
M001	MTG-ANiTA-KIT (Ammonium-NicotinamidADPH-GLDH-Transglutaminase Assay)	1 Kit	610 €
T036	Transglutaminase Assay Kit, fluorescent , Casein, Dansylcadaverine	1 Kit	300 €
Application:	Fluorescent measurement of transglutaminase activity		
Reference:	Lorand et al., Anal. Biochem. 1971, 44:221-31		
Z018	Z-Glutamyl-Hydroxamate-Glycine This product replaces Art. No. G048	100 mg	150 €
Application:	Reference substance to determine the concentration of product formed by microbial transglutaminase (MTG).		
Z009	ZediXclusive Microbial Transglutaminase Assay Kit	1 Kit	390 €
Application:	Determination of microbial transglutaminase activity		
Reference:	Grossowicz et al., J. Biol. Chem. 1950, 187:111-25 See Spotlight next page!		

**ELISA for Microbial Transglutaminase**

Art. No.	Name	Unit	Price
E021	ZediXclusive Microbial Transglutaminase (MTG) ELISA	1 Kit	425 €
Application:	ELISA for the detection of Microbial Transglutaminase (MTG) in food samples. See Spotlight below!		

Spotlight - Detection of MTG protein and activity in food and processing aids

Microbial transglutaminase is used as processing aid in food industry in order to improve the quality, e.g. of sausage, pasta, bread and yoghurt.

Zedira provides the tools to determine MTG activity (Z009) and MTG protein (E021) in MTG raw materials, formulations and food samples in easy to use kit formats.

In addition, the analysis of raw materials, formulations and food samples for MTG activity and protein is also available on a fee for service base. Please contact us for a quotation.

**Raw
Material****Formulation****Processed
Food****Z009****Microbial Transglutaminase Assay Kit**

Activity determination of high activity MTG-samples
(raw material and formulations)

Lower Limit of Detection: 0.3 U/mL
15 µg/mL
15 ppm

3 x 11 cuvette assays, chromogenic (525 nm)

E021**Microbial Transglutaminase ELISA**

Immuno-detection of MTG (native and denatured) in
food samples

Lower Limit of Detection:
Native: 3 ng/L
3 ppb
Denatured: 60 ng/mL
60 ppb

96-well microtiter assays, chromogenic (450 nm)

Spotlight - Microbial Transglutaminase Labeling

Chemical modification of proteins is widely used. However, there are several drawbacks and limitations like heterogeneous products and batch-to-batch variations. Transglutaminase and especially calcium independent, highly purified microbial (bacterial) transglutaminase are smart tools for "site-specific target labeling", yielding homogenous products.

A protocol has recently been published by the group of Prof. Roger Schibli in Zürich: Enzymatic antibody modification by bacterial transglutaminase; Dennler P, Schibli R, Fischer E, Meth. in Mol. Bio. 1045, 205 (2013).

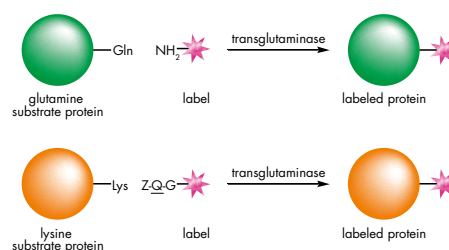
In conclusion, enzymatic labeling using transglutaminase is characterized by:

- Homogeneity
- Defined degree of labeling
- Defined label position(s)
- Minimized amounts of unlabeled protein
- Bioactivity equal to the unlabeled protein
- High solubility in water

Requirements of the target Protein

- Accessible lysine residues
or
- Accessible glutamine residues
otherwise
- Transglutaminase substrate sequence tags can be introduced recombinantly, if no lysine or glutamine residues are accessible

Principle of TGase-catalyzed protein labeling



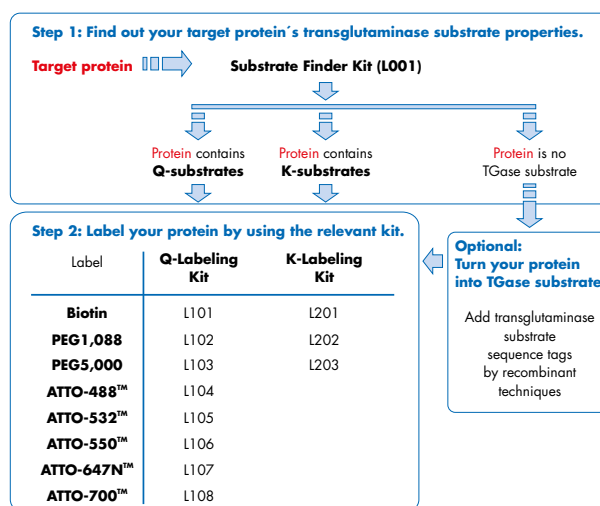
TGase Protein Labeling Kits

Our labeling kits exploit Microbial Transglutaminase catalytic activity for labeling of proteins. Transglutaminase also accepts short glutamine-containing peptides and – as already mentioned – primary amines as substrates. In consequence, protein-bound glutamines can be labeled using primary amines, and protein-bound lysines can be labeled with short glutamine-containing peptides.

Primary amines as well as glutamine-containing peptides may carry a broad variety of labels like biotin, PEG, fluorescent dyes etc.

Transglutaminase labeling requires substrate sequences on the target protein surface, which are generally not abundant on proteins. Therefore, in a first step the target protein has to be analyzed for its transglutaminase substrate properties, which is performed using the Substrate Finder Kit.

The target protein is accessible to transglutaminase labeling, if it contains either glutamine-substrate sequence(s) or lysine substrate sequence(s) or both. If the target protein contains neither glutamine- nor lysine-substrate sequences, transglutaminase-substrate tags may be introduced by recombinant techniques.



Currently, kits for Glutamine (Q)- or Lysine (K)-labeling with the following labels are available: Biotin, PEG1,088, PEG5,000, ATTO-488™, ATTO-532™, ATTO-550™, ATTO-647N™ and ATTO-700™.

Please contact us if further labels are required.

Products

TGase Protein Labeling Kits

Art. No.	Name	Unit	Price
L001	Substrate Finder Kit	1 Kit	390 €
Application:	Dertermination of protein's MTG substrate properties		

TGase Q-Labeling Kits

Art. No.	Name	Unit	Price
L101	Biotin TGase Protein Q -Labeling Kit, sufficient for 5x 1 mg labeling reactions	1 Kit	550 €
L102	PEG1,088 TGase Protein Q -Labeling Kit, sufficient for 5x 1 mg labeling reactions	1 Kit	550 €
L103	PEG5,000 TGase Protein Q -Labeling Kit, sufficient for 5x 1 mg labeling reactions	1 Kit	550 €
L104	ATTO-488™ TGase Protein Q -Labeling Kit, sufficient for 1 mg labeling reaction	1 Kit	610 €
L105	ATTO-532™ TGase Protein Q -Labeling Kit, sufficient for 1 mg labeling reaction	1 Kit	610 €
L106	ATTO-550™ TGase Protein Q -Labeling Kit, sufficient for 1 mg labeling reaction	1 Kit	610 €
L107	ATTO-647N™ TGase Protein Q -Labeling Kit, sufficient for 1 mg labeling reaction	1 Kit	610 €
L108	ATTO-700™ TGase Protein Q -Labeling Kit, sufficient for 1 mg labeling reaction	1 Kit	610 €

TGase K-Labeling Kits

Art. No.	Name	Unit	Price
L201	Biotin TGase Protein K -Labeling Kit, sufficient for 5x 1 mg labeling reactions	1 Kit	550 €
L202	PEG1,088 TGase Protein K -Labeling Kit, sufficient for 5x 1 mg labeling reactions	1 Kit	550 €
L203	PEG5,000 TGase Protein K -Labeling Kit, sufficient for 5x 1 mg labeling reactions	1 Kit	550 €

Protein Labeling

Amine-donors (Q-Labeling)

Suitable substrates for labeling of your target molecule with accessible glutamine residues (Q-Labeling).

For more details see Section: Assays & Substrates

Biotin Labels

Art. No.	Name	Unit	Price
B002	N-(Biotinyl)cadaverine	25 mg	175 €
		100 mg	475 €

Click-Chemistry Labels

Art. No.	Name	Unit	Price
A152	3-Azidopropan-1-amine	100 mg	175 €
Application:	Amine donor substrate for transglutaminase, suitable for click chemistry		

A153	4-Azidobutan-1-amine	100 mg	175 €
Application:	Amine donor substrate for transglutaminase, suitable for click chemistry		

PEG Labels

Art. No.	Name	Unit	Price
P010	(PEG1,088)amine , monodisperse	10 mg	200 €
Application:	Polyethylene glycol amine substrate of transglutaminase		

P011	(PEG5,000)amine , polydisperse	10 mg	200 €
Application:	Polyethylene glycol amine substrate of transglutaminase		

Fluorescent Labels

Art. No.	Name	Unit	Price
A106	(ATTO-488™)cadaverine	1 mg	275 €
A112	(ATTO-532™)cadaverine	1 mg	275 €
A113	(ATTO-550™)cadaverine	1 mg	275 €
A114	(ATTO-647N™)cadaverine	1 mg	325 €
A115	(ATTO-700™)cadaverine	1 mg	325 €
D006	N-(Dansyl)cadaverine	100 mg	175 €
K004	"KxD", Boc-Lys-en-DNS	10 mg	275 €
R001	N-(Tetramethylrhodaminyl)cadaverine , N-(TAMRA)cadaverine	10 mg	200 €
Reference:	Dennler et al., Chembiochem. 2015, 16:861-7; Lee et. al., J. Biotechnol. 2013, 168:324-30; Kasprzak et al., Biochemistry 1988, 27:4512-22		

Glutamine-donor peptides (K-Labeling)

Suitable substrates for labeling of your target molecule with accessible lysine residues (K-Labeling).

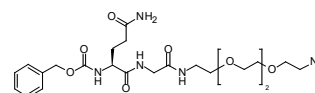
For more details see Section: Assays & Substrates

Biotin Labels

Art. No.	Name	Unit	Price
C091	Z-Gln-Gly-CAD-Biotin	25 mg	350 €
Reference:	Spidel et al., Bioconjugate Chem. 2017, 28:2471-84; Zindel et al., PLoS One 2016, 11:e0149145; Pasternack et al., Anal. Biochem. 1997, 249:54-60		

Click-Chemistry Labels

Art. No.	Name	Unit	Price
C079	Z-Gln-Gly-PEG(3)-N₃	25 mg	500 €
Application:	Glutamine donor substrate for transglutaminase, suitable for click chemistry		

**PEG Labels**

Art. No.	Name	Unit	Price
C092	Z-Gln-Gly-(PEG1,088) , monodisperse	25 mg	500 €
Application:	Polyethylene glycol glutamine substrate of transglutaminase		
C093	Z-Gln-Gly-(PEG5,000) , polydisperse	25 mg	500 €
Application:	Polyethylene glycol glutamine substrate of transglutaminase		

Fluorescent Labels

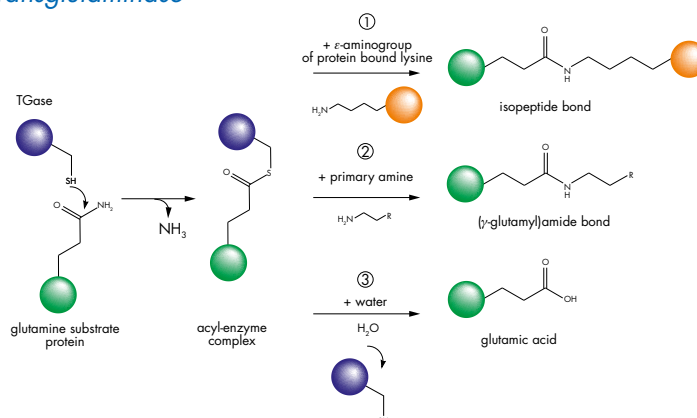
Art. No.	Name	Unit	Price
C002	Z-Gln-Gly-CAD-DNS	25 mg	175 €
		100 mg	400 €
C090	Z-Gln-Gly-CAD-TAMRA	25 mg	500 €
Reference:	Spycher et al., ChemBioChem 2017, 18:1923-7		

Background information

Transglutaminases are defined as R-glutaminyl-peptide: amine γ -glutamyl-transferase (EC 2.3.2.13). They use a modified double-displacement mechanism to carry out an acyl transfer reaction between the γ -carboxamide group of a peptide-bound glutamine residue and the ϵ -amino group of a peptide-bound lysine. The active site consists of a catalytic triad (Cys, His and Asp). The active site cysteine reacts with the γ -carboxamide of the glutamine,

forming a γ -glutamyl thioester resulting in the release of ammonia. This activated species subsequently reacts with nucleophilic primary amines, yielding either an isopeptide bond (pathway 1) or a (γ -glutamyl)amine bond (pathway 2). When an amine is not available, the acyl-enzyme intermediate reacts with water to yield glutamic acid (pathway 3).

Reaction pathways of transglutaminase



The incorporation of dansylcadaverine into casein (compare to pathway 2) leads to an increase in fluorescence intensity. The principle is used in kit **T036**.

During the transpeptidation reaction ammonia (NH_3) is released. The amount of ammonia can be monitored using glutamate dehydrogenase and NADPH as co-factor. Dependent on the transglutaminase either casein or synthetic peptides serve as acyl donor substrates. The reaction can be monitored online using a UV photometer at 340 nm. An activity assay using this principle is available for MTG (**MTG-ANITA-KIT M001**).

The kit **M003** is most sensitive allowing detection of TG2 in the **picogram** range using the incorporation of biotinylated peptides to microtiter plates displaying primary amines on the surface. After enzymatic incorporation of the biotinylated peptide, biotin is subsequently detected using streptavidin / peroxidase conjugates.

The reverse reaction of TGs is measured in the isopeptidase assays **F001**, **F014** and **F015**, see Spotlight on the next page.

The chromogenic assay kit **Z009** uses Z-Gln-Gly as the amine acceptor substrate and hydroxylamine as amine donor. In the presence of transglutaminase, hydroxylamine is incorporated forming glutamyl-hydroxamate which develops a colored complex with iron (III) detectable at **525 nm (red)**.

A similar principle is used for the tissue transglutaminase assay kit **Z010**, see Spotlight on page 25.

TG2 - Enzyme Immuno Assay (EIA):

The kit **E018** is dedicated to determine the overall quantity of TG2. The principle behind is a sandwich EIA based on two monoclonal antibodies against tissue transglutaminase (TG2). The kit provides coated plates and all reagents necessary, including a tissue transglutaminase calibrator.



Spotlight - ZediXcite: NEW Fluorogenic Isopeptidase Assay Kits

Transglutaminases are best known for their crosslinking activity but also can cleave isopeptide bonds. This feature is used to provide easy to handle, robust and precise fluorogenic assays to measure transglutaminase isoenzymes. The assays are suitable for drug discovery programs and quality assurance.

Transglutaminases cleave the carboxamide bond and thereby release the dark quencher (2,4-dinitrophenyl, DNP) linked to a cadaverine spacer. The increase in fluorescence results from the unquenched N-terminally attached fluorophore 2-amino benzoic acid (2-Abz).

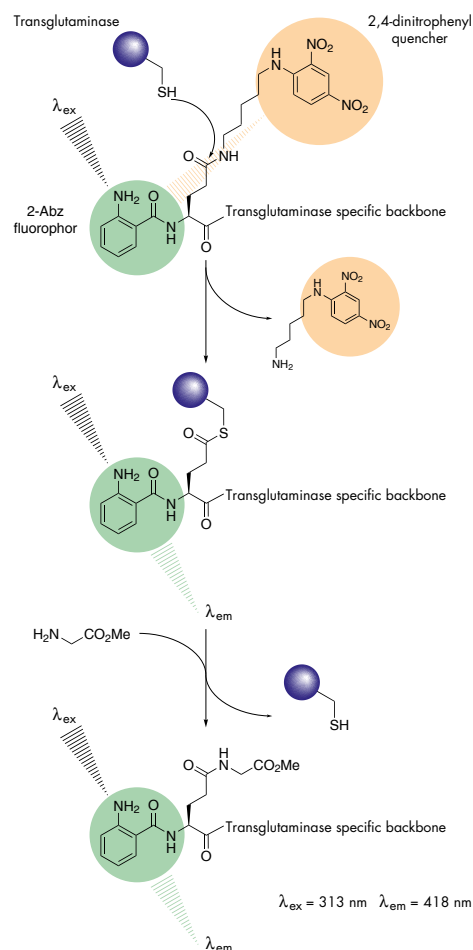
Recently, Zedira developed two novel modified peptides being the mainstay in our ZediXcite fluorogenic isopeptidase assay kits **F014 (TG2)**, **F015 (MTG, microbial transglutaminase)** in addition to our well established **FXIII-Assay Kit F001**.

Ready to use assay kits **F001**, **F014**, and **F015** are characterized by their performance and sensitivity. Kinetic data of the optimized substrate peptides is reported in the following table.

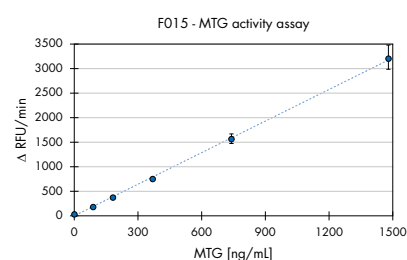
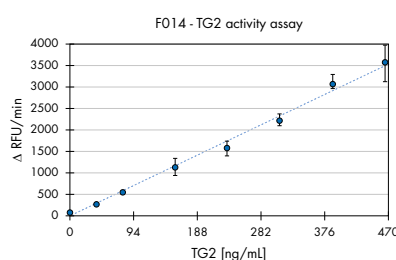
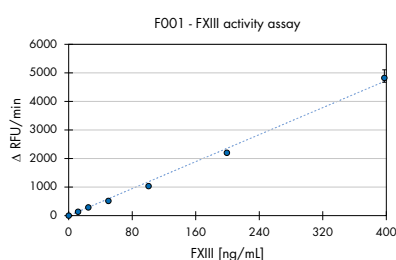
	FXIIIa	hTG2	MTG
Assay	F001	F014	F015
K_m [μ M]	6.3	4.5	46.3
v_{max} [nM/min]	3.4	1.5	0.6

Further, the well-known fluorogenic substrate **A101** is not only suitable for FXIII measurement but also for the determination of TG1, TG2, TG3, and TG6. Kinetic data for these transglutaminase isoenzymes is displayed in the following table.

A101	hTG1	hTG2	hTG3	hTG6
K_m [μ M]	77	8.3	13.4	35.1
v_{max} [nM/min]	0.2	0.3	2.3	0.3



Assay principle: Cleavage of a carboxamide bond is catalyzed by transglutaminase. The release of the dark quencher is followed by incorporation of glycine methylester. After the dark quencher is released, the fluorescence of the dequenched 2-Abz-dye increases – “the assay directly monitors transglutaminase activity”. The specific backbone provides selectivity and affinity to the assay peptides for the respective TG isoenzyme.



Performance of ZediXcite activity assay kits F001 (also contains thrombin), F014, and F015: Plots of the increase in fluorescence emission dependent on the respective transglutaminase concentration as measured in triplicate on a microplate reader.

Assays & Substrates

Assays

Isopeptidase-Fluorogenic Assays

Art. No.	Name	Unit	Price
A101	FXIII-Assay Substance , Abz-NE(CAD-DNP)EQVSPITLLK-OH	10 mg	575 €
Application:	Fluorescent measurement of transglutaminase activity, also suitable for TG1, TG2, TG3 and TG6		
Reference:	Singh et al., Int. J. Mol. Sci. 2019, 20:2682; Durda et al., Transfus Apher Sci. 2018, 57:700-4; Chrobok et al., PLoS One. 2018, 13:e0196433; Akbar et al., J. Med. Chem. 2017, 60:7910-27; de Jager et al., Neuropathol. Appl. Neurobiol. 2016, 42:255-72; Dodt et al., Br. J. Haematol. 2016, 172, 452-60; Királyet al., Amino Acids 2016, 48, 31-40; van der Wildtet al., Nucl. Med. Biol. 2016, 43, 232-42; Schroeder et al., Br. J. Haematol. 2015, 168:757-9; Berny-Lang et al., J. Am. Heart Assoc. 2013, 2, e000026; Dodt et al., Anal. Biochem. 2013, 439: 145-5; 1 Sossdorf et al., Crit. Care. 2009, 13:R208; Oertel et al., Anal. Biochem. 2007, 367:152-8		
F001	ZediXcite Fluorogenic FXIII-Assay Kit	1 Kit	600 €
	Isopeptidase-activity based FXIII assay (313/418 nm)		
	Ready to use, contains FXIII-Assay Substance (A101) and thrombin		
Application:	Fluorescent measurement of transglutaminase activity, optimized for FXIII		
Reference:	Durda et al., Transfus Apher Sci. 2018, 57:700-4; Sossdorf et al., Crit. Care. 2009, 13:R208; Oertel et al., Anal. Biochem. 2007, 367:152-8		
F014	ZediXcite Fluorogenic TG2-Assay Kit	1 Kit	600 €
	Isopeptidase-activity based TG2 assay (313/418 nm)		
Application:	Fluorescent measurement of transglutaminase activity, optimized for TG2		
F015	ZediXcite Fluorogenic MTG-Assay Kit	1 Kit	600 €
	Isopeptidase-activity based MTG assay (313/418 nm)		
Application:	Fluorescent measurement of transglutaminase activity, optimized for MTG		


Transglutaminase Fluorogenic Activity Assay

Art. No.	Name	Unit	Price
T036	Transglutaminase Assay Kit, fluorescent , Casein, Dansylcadaverine	1 Kit	300 €
Reference:	Lorand et al., Anal. Biochem. 1971, 44:221-31		

Enzyme Immuno Assay (EIA)

Art. No.	Name	Unit	Price
E018	ZediXclusive Tissue Transglutaminase EIA	1 Kit	550 €
Application:	Determination of TG2 protein quantity in biological fluids		
E021	ZediXclusive Microbial Transglutaminase (MTG) ELISA	1 Kit	425 €
Application:	ELISA for the detection of Microbial Transglutaminase (MTG) in food samples.		

Photometric Activity Assays

Art. No.	Name	Unit	Price
M001	MTG-ANiTA-KIT (Ammonium-NicotinamidADPH-GLDH-Transglutaminase-Assay)	1 Kit	610 €
Reference:	Steffen et al., J. Biol. Chem. 2017, 292:15622-35		
	M003	Tissue Transglutaminase Pico-Assay Kit	1 Kit 425 €
Application:	Determination of tissue transglutaminase activity		
Reference:	Furini et al., J. Am. Soc. Nephrol. 2018, 29:880-905		
T114	Blood Coagulation Factor XIII-Microassay Kit, colorimetric	1 Kit	425 €
Application:	Colorimetric measurement of transglutaminase activity, optimized for blood coagulation factor XIII (FXIII)		
	Z009	ZediXclusive Microbial Transglutaminase Assay Kit	1 Kit 390 €
Reference:	Grossowicz et al., J. Biol. Chem. 1950, 187:111-25		
Z010	ZediXclusive Tissue Transglutaminase Assay Kit (Chromogenic activity assay optimized for tissue transglutaminase, also suitable for epidermal transglutaminase)	1 Kit	450 €
Reference:	Lexhaller et al., Nutrients. 2019, 11:2263		

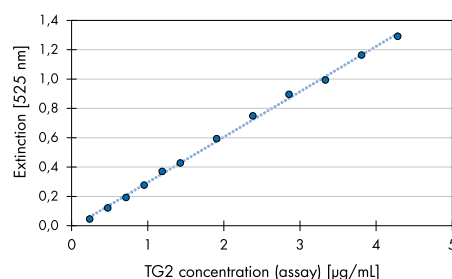
Spotlight - Tissue Transglutaminase Assay Kit Z010 (chromogenic)

TG2 is present in various tissues and involved in a multitude of physiological as well as pathological processes. The enzyme catalyses the acyl transfer reaction between the γ -carboxamide group of peptidebound glutamine residues and a variety of primary amines, particularly the ε -amino group of lysine (Lorand L. et al., 1962). The assay **Z010** enables the measurement of TG2 activity according to the chromogenic hydroxamate detection principle (Grossowicz, N. et al., 1950).

The ZediXclusive Tissue Transglutaminase Assay Kit **Z010** uses Z-QQPF as the amine acceptor substrate and hydroxylamine as amine donor. In the presence of tTG hydroxylamine is incorporated into Z-QQPF to form Z-glutamylhydroxamate-QPF which develops a colored complex with iron (III) detectable at 525 nm.

Assay characteristics:

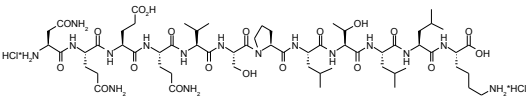
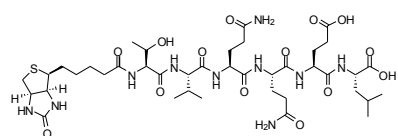
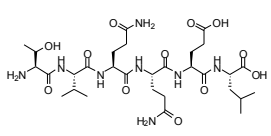
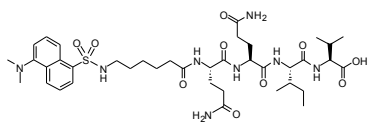
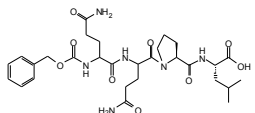
- Easy to use chromogenic endpoint assay
- Optimized for tissue transglutaminase (TG2)
- Results within 30 min

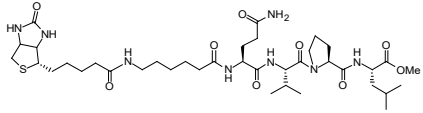
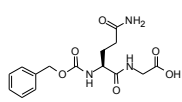
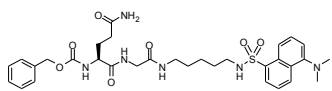


Assays & Substrates

Substrates

Glutamine-donor peptides

Art. No.	Name	Unit	Price
A105	NQEQVSPLTLK , α_2 -Antiplasmin peptide (1-12)	25 mg	500 €
Synonym:	Asn-Gln-Glu-Gln-Val-Ser-Pro-Leu-Thr-Leu-Leu-Lys-OH dihydrochloride		
Application:	Factor XIII glutamine donor substrate		
References:	Kárpáti et al., Clin. Chem. 2000, 46:1946-55; Pénzes et al., J. Thromb. Haemost. 2009, 7:627-33; Reed et al., Circulation 1999, 99:299-304		
			
B001	Biotinyl-Thr-Val-Gln-Gln-Glu-Leu-OH	5 mg	175 €
Synonym:	Biotinyl-L-Threoninyl-L-Valinyl-L-Glutaminyl-L-Glutaminyl-L-Glutamyl-L-Leucin; A25-peptide	25 mg	525 €
Application:	Biotinylated glutamine donor substrate for tissue transglutaminase		
Reference:	Zindel et al., PLoS One 2016, 11, e0149145; Recktenwald et al., J. Biol. Chem. 2016, 291:13580-90; Chou et al., J. Biol. Chem. 2011, 286:27825-35; Tseng et al. J., Cell. Biochem. 2009, 107:899-907; Trigwell et al., Anal.Biochem. 2004, 330:164-6; Esposito et al., Protein Sci. 2003, 12:1290-7; Esposito et al., Am. J. Gastroenterol. 2003, 98:1813-20; Ruoppolo et al., Prot. Sci. 2003, 12:1290-7; Orrù et al., J. Biol. Chem. 2003, 278:31766-73; Groenen et al., J. Biol. Chem. 1994, 269:831-3;		
Related products:	B006		
B006	Thr-Val-Gln-Gln-Glu-Leu-OH	25 mg	400 €
Synonym:	L-Threoninyl-L-Valinyl-L-Glutaminyl-L-Glutaminyl-L-Glutamyl-L-Leucin		
Application:	Substrate for tissue transglutaminase		
Reference:	Trigwell et al., Anal. Biochem. 2004, 330:164-6; Ruoppolo et al., Prot. Sci. 2003, 12:1290-7; Esposito et al., Am. J. Gastroenterol. 2003, 98:1813-20; Groenen et al., J. Biol. Chem. 1994, 269:831-3		
Related products:	B001		
D001	Dansyl-ϵ-aminohexanoyl-Gln-Gln-Ile-Val-OH	25 mg	200 €
Synonym:	5-N,N-dimethylamino-1-naphtalenesulfonyl- ϵ -aminohexanoyl-Gln-Gln-Ile-Val-OH	100 mg	500 €
Application:	Fluorescent glutamine donor substrate for tissue transglutaminase , used as co-substrate of transglutaminase activity assay together with N-(2,4-Dinitrophenyl)cadaverine (D002)		
Reference:	Messersmith et al., J. Am. Chem. Soc. 2003, 125:14298; Lorand et al., Exp. Eye. Res. 1998, 66:531-6; Parameswaran et al., J. Biol. Chem. 1997, 272:10311-7; Lorand et al., PNAS USA 1992, 89:11161-3		
Z004	Z-Gln-Gln-Pro-Leu-OH	25 mg	325 €
Synonym:	Z-QQPL-OH		
Application:	Glutamine donor substrate for tissue transglutaminase		

Art. No.	Name	Unit	Price
B019	Biotin-Ahx-QVPL-OMe	10 mg	400 €
Application:	Glutamine donor substrate for transglutaminase B019 is a suitable for TG1 , TG2 , TG3 , TG6 and MTG . B019 is a weak glutamine donor substrate for FXIII.		
C001	Z-Gln-Gly-OH	1 g	100 €
Synonym:	Z-Glutaminylglycin; Benzyloxycarbonyl-L-Glutaminyl-Glycin		
Application:	Glutamine donor substrate for microbial transglutaminase and gpTG2		
Reference:	Pasternack et al., Eur. J. Biochem. 1998, 257:570-6; Grossowicz et al., J. Biol. Chem. 1950, 187:111-25		
C002	Z-Gln-Gly-CAD-DNS	25 mg	175 €
Synonym:	1-N-(Benzyloxycarbonyl-L-Glutaminyl-Glycyl)-5-N-(5'-N',N'-dimethylamino-1'-naphthalenesulfonyl)-diaminopentane	100 mg	400 €
Application:	Fluorescent glutamine donor substrate for microbial transglutaminase		
Reference:	Jeitner et al., Anal. Biochem. 2001, 292:198-206; Pasternack et al., Anal. Biochem. 1997, 249:54-60		
A109	β-Amyloid peptide 1-42 (A β 1-42) (H-DAEFRHDSGYEVHH QK LVFFAEDVGSN K GAIIGLMVGGVVIA-OH)	1 mg	275 €
References:	Hartley et al., J. Biol. Chem. 2008, 283:16790-800; Zhang et al., Life Sci. 1997, 60:2323-32; Jarrett et al., Biochemistry 1993, 32:4693-7		



Assays & Substrates

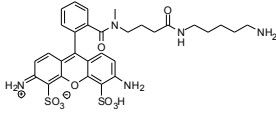
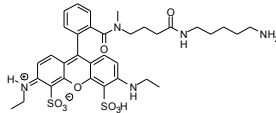
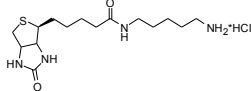
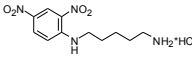
„Hitomi“-peptides

Transglutaminase-isoenzyme specific glutamine donor substrates identified by Kiyotaka Hitomi et al. at Nagoya University, Japan.

Art. No.	Name	Unit	Price
B007	Keratinocyte transglutaminase (TG1)-substrate-peptide K5	10 mg	350 €
Sequence:	Biotinyl-YEQHKLPSSWPF		
Reference:	Schulze-Krebs et al., Brain Res. 2016, 1631:22-33; Itoh et al., J. Histochem. Cytochem. 2013, 61:793-801; Sugimura et al., J. Biol. Chem. 2006, 281:17699-706; Sugimura et al., FEBS J. 2008, 275:5667-77; Yamane et al., FEBS J. 2010, 277:3564-74		
B008	Tissue transglutaminase (TG2)-substrate-peptide T26	10 mg	350 €
Sequence:	Biotinyl-HQSYVDPWMLDH		
Reference:	Schulze-Krebs et al., Brain Res. 2016, 1631:22-33; van der Wildt et al., Nucl. Med. Biol. 2016, 43, 232-242; de Jager et al., J. Neurochem. 2015, 134:1116-28; Itoh et al., J. Histochem. Cytochem. 2013, 61:793-801; Sugimura et al., J. Biol. Chem. 2006, 281:17699-706; Sugimura et al., FEBS J. 2008, 275:5667-77; Yamane et al., FEBS J. 2010, 277:3564-74		
B009	Epidermal transglutaminase (TG3)-substrate-peptide E51	10 mg	350 €
Sequence:	Biotinyl-PPYSFYQSRWV		
Reference:	Schulze-Krebs et al., Brain Res. 2016, 1631:22-33; Sugimura et al., J. Biol. Chem. 2006, 281:17699-706; Sugimura et al., FEBS J. 2008, 275:5667-77; Yamane et al., FEBS J. 2010, 277:3564-74		
B010	Blood coagulation FXIII-substrate-peptide F11KA	10 mg	350 €
Sequence:	Biotinyl-DQMMLPWPAVAL		
Reference:	Sugimura et al., J. Biol. Chem. 2006, 281:17699-706; Sugimura et al., FEBS J. 2008, 275:5667-77; Yamane et al., FEBS J. 2010, 277:3564-74		
B013	Neuronal transglutaminase (TG6)-substrate peptide Y25	10 mg	350 €
Sequence:	Biotinyl-DDWDAMDEQIWF		
Reference:	Fukui et al., FEBS J. 2013, 280:1420-9		
B014	Transglutaminase 7 (TG7)-substrate peptide Z3S	10 mg	350 €
Sequence:	Biotinyl-YSLQLPVWNDWA		
Reference:	Kuramoto et al., Arch: Biochem Biophys. 2013, 537:138-43		
B017	Microbial Transglutaminase (MTG)-substrate peptide M48	10 mg	350 €
Sequence:	Biotinyl-WALQRPHYSYPD		
Reference:	Sugimura et al., FEBS J. 2008, 275:5667-77		
A132	Microbial Transglutaminase (MTG)-substrate peptide Ac-M48	10 mg	350 €
Sequence:	Ac-WALQRPHYSYPD		
Reference:	Spycher et al., ChemBioChem 2017, 18:1923-7; Sugimura et al., FEBS J. 2008, 275:5667-77		

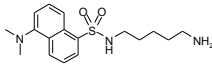
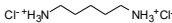
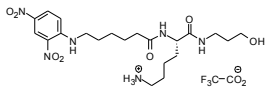
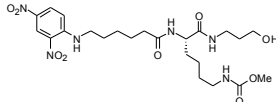
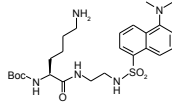
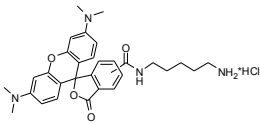


Amine-donors

Art. No.	Name	Unit	Price
A106	(ATTO-488™)cadaverine	1 mg	275 €
Application:	Fluorescent amine donor substrate for transglutaminases		
Reference:	Dennler et al., Chembiochem. 2015, 16:861-7		
A109	β-Amyloid peptide 1-42 (Aβ 1-42) (H-DAEFRHDSGYEVHH Q KLIVFFAEDVGSN K GAIIGLMVGGVIA-OH)	1 mg	275 €
Reference:	Hartley et al., J. Biol. Chem. 2008, 283:16790-800; Zhang et al., Life Sci. 1997, 60:2323-32; Jarrett et al., Biochemistry 1993, 32:4693-7		
A112	(ATTO-532™)cadaverine	1 mg	275 €
Application:	Fluorescent amine donor substrate for transglutaminases		
A113	(ATTO-550™)cadaverine	1 mg	275 €
Application:	Fluorescent amine donor substrate for transglutaminases		
A114	(ATTO-647N™)cadaverine	1 mg	325 €
Application:	Fluorescent amine donor substrate for transglutaminases		
A115	(ATTO-700™)cadaverine	1 mg	325 €
Application:	Fluorescent amine donor substrate for transglutaminases		
B002	N-(Biotinyl)cadaverine	25 mg	175 €
Synonym:	N-(Biotinamido)-1,5-diaminopentane hydrochloride	100 mg	475 €
Application:	Biotinylated amine donor substrate for transglutaminases		
Reference:	Spycher et al., ChemBioChem 2017, 18:1923-7; Steffen et al., J. Biol. Chem. 2017, 292:15622-35; Király et al., Amino Acids 2016, 48:31-40; Recktenwald et al., J. Biol. Chem. 2016, 291:13580-90; Dennler et al., Chembio-chem. 2015, 16:861-7; Wang et al., Cell Death & Dis. 2013, 4:e808; Wang et al., PLoS Pathog. 2010, 6:e1000763; Ruoppolo et al., Prot. Sci. 2003, 12:1290-7; Lee et al., Clin. Chem. 1988, 34:906-10		
D002	N-(2,4-Dinitrophenyl)cadaverine	100 mg	175 €
Synonym:	N-(2,4-Dinitrophenyl)-1,5-diaminopentane hydrochloride		
Application:	Fluorescence quenching amine donor substrate for transglutaminases, used as co-substrate of transglutaminase activity assay together with Dansyl-ε-Aminohexanoyl-Gln-Gln-Ile-Val-OH (D001)		
Reference:	Murthy et al., Exp. Eye Res. 1998, 67:273-81; Parameswaran et al., J. Biol. Chem. 1997, 272:10311-17; Lorand et al., Proc. Natl. Acad. Sci. USA 1992, 89:11161-63		

Assays & Substrates

Amine-donors continued

Art. No.	Name	Unit	Price
D006	N-(Dansyl)cadaverine , DNS-CAD	100 mg	175 €
Application:	Fluorescent amine donor substrate for transglutaminases		
Reference:	Spycher et al., ChemBioChem 2017, 18:1923-7; Murthy et al., J. Biol. Chem. 1994, 269, 22907-11		
D007	Cadaverine	100 mg	75 €
Synonym:	1,5-Diaminopentane; 1,5-Pentanediamine		
Application:	Amine donor substrate for transglutaminases		
Reference:	Schmidt et al., FEBS Lett. 2008, 582:3132-8		
D008	"DALP", DNP-aminohexanoic acid-Lys-aminopropanol	5 mg	350 €
Application:	Non-membrane permeable amine donor substrate for transglutaminases		
Reference:	Nemes et al., J Biol Chem. 1997, 272:20577-83; Király et al., FEBS J. 2011, 278:4717-39 (Review)		
D009	"DALP-methyl carbamate"	5 mg	450 €
Synonym:	(S)-Methyl 5-[6-(2,4-dinitrophenylamino)hexanamido]-6-(3-hydroxypropylamino)-6-oxohexylcarbamate; methoxycarbonyl-DALP		
Application:	Membrane permeable amine donor substrate for transglutaminases		
Reference:	Nemes et al., J Biol Chem. 1997, 272:20577-83; Király et al., FEBS J. 2011, 278:4717-39 (Review)		
K004	"KxD", Boc-Lys-en-DNS	10 mg	275 €
Application:	Fluorescent amine donor substrate for transglutaminases		
Reference:	Schaertl et al., J. Biomol. Screen. 2010, 15:478-87; Case et al., Biochemistry 2007, 46:1106-15		
R001	N-(Tetramethylrhodaminy)cadaverine	10 mg	200 €
Synonym:	5-(and 6)-((N-(5-aminopentyl)amine)carbonyl)tetramethylrhodamine hydrochloride		
Application:	Fluorescent amine donor substrate for transglutaminases		
Reference:	Dennler et al., Chembiochem. 2015, 16:861-7; Lee et. al., J. Biotechnol. 2013, 168:324-30; Kasprzak et al., Biochemistry 1988, 27:4512-22		

Protein Substrates

Art. No.	Name	Unit	Price
F004	Fibrinogen , purified from human plasma	50 mg	125 €
Synonym:	Factor I		
F006	FITC-labeled Fibrinogen (product derived from F004)	5 mg	225 €
Reference:	Mutch et al., J. Thromb. Haemost. 2010, 8:2017-24		
I001	Involucrine, human , recombinantly produced in <i>E. coli</i>	500 µg	400 €
Synonym:	hIVL		
Application:	Recombinant human involucrin may be used as transglutaminase substrate.		
P004	PT-Gluten	1 mg	250 €
Definition:	PT-Gluten is based on a wheat gluten preparation which has been proteolyzed by pepsin (porcine) and trypsin (porcine).	10 mg	1200 €
Application:	PT-Gluten may be used in biochemical approaches, e.g. as substrate for transglutaminases or as antigen for gliadin antibodies.		
Reference:	Elli et al., Hum. Immunol. 2012, 73:992-7		

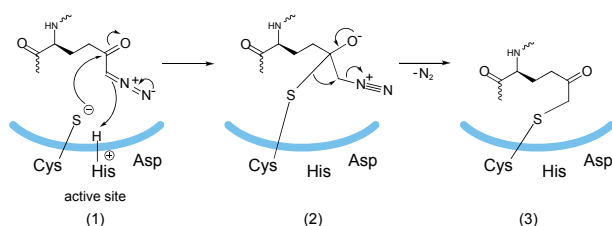
Background information

Transglutaminases are involved in a multitude of physiological processes. One way to explore these processes is to use specific inhibitors. Rationally designed synthetic, small molecule inhibitors such as **Z006** ("Z-DON"; Z-DON-Val-Pro-Leu-OMe) will be of immeasurable help to scientists wishing to decipher the enigmatic roles of individual transglutaminases.

In the following section, Zedira's range of transglutaminase inhibitors is introduced with a special focus on their respective mechanism of action.

"DON" compounds (6-diazo-5-oxo-L-norleucine containing peptides)

These potent molecules are side chain-modified peptides. The electrophilic "DON" group replaces the substrate glutamine. The active site cysteinyl residue attacks the carbonyl group (1). The subsequent reaction leads to the release of nitrogen (2) and the concomitant irreversible alkylation at the active site of the transglutaminases (3).



Zedira developed molecules frequently cited in scientific literature.

- **"Z-DON"** (Z006; Z-DON-Val-Pro-Leu-OMe) is a very potent and specific blocker of tissue transglutaminase (IC_{50} about 0.02 μ M, Z011 as control available) and is **membrane permeable** (see table page 34).
- **"Boc-DON"** (B003; Boc-DON-Gln-Ile-Val-OMe) is a potent and specific blocker of tissue transglutaminase (IC_{50} about 0.3 μ M) and is **not membrane permeable** (see table on page 34).

2-[[2-oxopropyl]thio]imidazolium derivatives

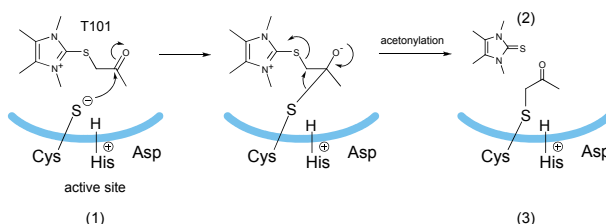
This class of non-peptidyl, active site directed molecules was developed by Merck Sharp & Dohme in the 1990s. The active site cysteinyl residue attacks the carbonyl group (1) similar to the glutamine residue. However, the subsequent reaction leads to the release of the complementary thione (2) and to the acetylation of the cysteine (3) (Freund et al., Biochemistry 1994, 33:10109-19).

Even if the molecules were developed to block coagulation factor XIIIa, the compounds inhibit tissue transglutaminase as well (Barsigan et al., J. Biol. Chem. 1991, Vol 22501-9).

One candidate out of the series has been evaluated in animal models (e.g. Shebuski et al., Blood 1990, 75:1455-9). Please notice that the authors reported a plasma half life of 5 to 10 minutes only.

Zedira offers three derivatives of the thioimidazolium scaffold.

- **T101** (L-682.777) is a good blocker of tissue transglutaminase and coagulation factor XIIIa. Both enzymes are inhibited with an IC_{50} of about 0.25 μ M.
- **D004** (L-683.685) is a good cell permeable blocker of tissue transglutaminase and coagulation factor XIIIa. Both enzymes are blocked with an IC_{50} of about 0.35 μ M.
- **D003** is a weak blocker of tissue transglutaminase with an IC_{50} of about 1.0 μ M.



Naturally occurring inhibitors

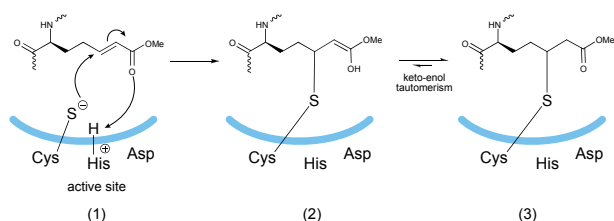
FXIIIa-blocker **Tridegin** (T087) is a 66 amino acid polypeptide present in the saliva of the giant Amazon leech *Haementeria ghilianii*. Recent data revealed that the glutamine residue at position 52 of tridegin seems to react / bind to the active site of factor XIIIa (Böhm et al., ChemMedChem 2012, 7:326-333). Finney et al. (Biochem. J. 1997, 324:797-805) reported an IC_{50} of about 10 nM for factor XIIIa, whereas Sicker (PhD thesis, 2008) measured an IC_{50} of 2.5 μ M for the recombinant protein.

Using recombinant Tridegin (T087), we determined IC_{50} -values against FXIIIa of 0.4 μ M (T036) and 1.8 μ M (F001) depending on the assay used (Product No. indicated in brackets). Human TG2 isn't inhibited by recombinant Tridegin at concentrations up to 10 μ M.

Further, some microorganism derived unspecific "factor XIII-blockers" with IC_{50} -values in the micromolar range have been described, e.g. the antifungal antibiotic Cerulenin (Tymiak et al., J. Antibiot. 1993, 46:204-6).

Michael acceptor (MA) inhibitors

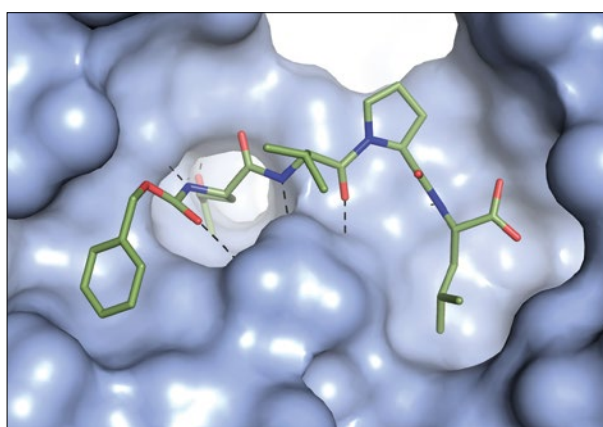
Zedira designed blockers bearing a Michael acceptor warhead. The electrophilic α,β -unsaturated carbonyl compounds are attacked by the active site cysteine residue (1) to form an irreversible complex (2,3).



The peptidic lead compound **ZED754** (Z013) was used to co-crystallize with tissue transglutaminase (PDB ID: 3S3P). The scaffold was subsequently optimized using medicinal chemistry.

Our clinical candidate ZED1227 is the first TG inhibitor in clinical trials (see Section: Services and Partnering for more information).

Compound **ZED1301** (A108) is a potent, selective FXIII inhibitor.

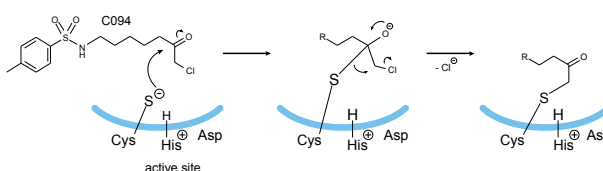


Crystal structure of inhibited tissue transglutaminase.

The inhibitor Z006 (shown in light green) is covalently bound to the active site Cys277 (blue surface), which is located at the bottom of the catalytic tunnel. It mimics the peptide substrates. The main part of the inhibitor fits onto the protein surface, forming several hydrogen bonds and stabilizing the open conformation (PDB ID: 3S3J).

Lysine analogues - chloromethyl ketones

Already in 1981, a medicinal chemist at Bayer in Wuppertal, Germany [Gerd Reinhardt, Ann. N.Y. Acad. Sci. 1981, 370, 836.] designed a series of direct acting Factor XIIIa blockers. According to the author, the molecule combines the substrate amine architecture (lysine co-substrate) with the chemical reactivity of the sulfhydryl reagent (active site cysteine attacking the chloromethyl ketone). The compound inhibits at least tissue transglutaminase as well.



Which transglutaminase inhibitor should I use in my experiments?

Although this is a commonly asked question, the answer is not always straight forward. Of course, inhibitor choice strongly depends on the respective experimental set-up and upon the target. Just follow the guidelines below for finding the most suitable blocker for your task.

Please notice that all following inhibitors should be considered being "tool compounds" but not "drugs".

Your target is tissue transglutaminase (tTG, TG2)?

We offer two potent inhibitors showing selectivity against other members of the transglutaminase family. Actually, the molecules Z-DON-Val-Pro-Leu-OMe (Z006; "Z-DON") and Boc-DON-Gln-Ile-Val-OMe (B003; "Boc-DON") represent probably the most frequently cited inhibitors in the scientific literature.

Independent studies published by Schaertl et al. summarize the features of both compounds. They are very complementary to each other, since one is cell-permeable (Z006; "Z-DON") while the other (B003; "Boc-DON") is not.

Characterization of irreversible peptidic inhibitors "Z-DON" and "Boc-DON" in transamidation assays.

Inhibitor	IC ₅₀ in μ M						*Cytotox	
	hTG2	hTG1	hTG3	hTG6	FXIIIa	mTG2	cellular TG2	(μ M)
Z006; "Z-DON"	0.02	7.3	0.2	0.15	67	0.07	40	146
B003; "Boc-DON"	0.3	1.1	20	0.98	24	0.6	—	—

Data taken from Schaertl et al., J. Biomol. Screen. 2010, 15:478-87. *Determined by "ATPlite" method with HEK cells.

Pan-transglutaminase blockers – forget about cyst(e)amine!

In case you would like to block at least "every" transglutaminase in your sample, we recommend using the well known "Merck Sharp & Dohme" (MSD)-compounds.

Again, we offer a pair of complement compounds, T101 and cell permeable D004. They are blocking any transglutaminase at concentrations between 1 - 10 μ M. However, it is not clear whether other proteins/enzymes (so called "off-targets") are also influenced.

One point has to be emphasized: the MSD compounds are clearly better than cyst(e)amine, putrescine or iodoacetamide!

Some papers describe the usage of cyst(e)amine, putrescine or even iodoacetamide as "transglutaminase-inhibitors". From the perspective of a medicinal chemist these "pseudo-substrate inhibitors" or "harsh chemicals" are not preferred since they are generally nonspecific (Schaertl et al., J Biomol Screen. 2010, 15:478-87). The topic of cystamine / cysteamine with respect to *in vivo* studies is discussed by Jeitner et al. [Bioscience Reports (2018) 38 BSR20180691].

Your target is Factor XIII?

ZED1301 (product number A108) is a potent molecule with unique properties. This peptidic blocker was used to solve the first crystal structure of FXIIIa in the active conformation. The IC₅₀-value is about 100 nM and the molecule shows selectivity (25-fold) over TG2.

Need a blocker for MTG?

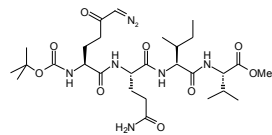
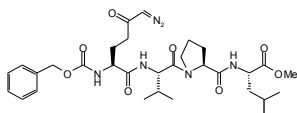
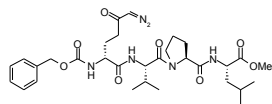
Simply use C102 – our MTG-inhibitor having an IC₅₀-value of 125 μ M!

As you may have learned from the previous pages, Zedira has a broad portfolio of inhibitors to address even the most sophisticated tasks. Please do not hesitate contacting us for technical and scientific support.


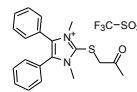
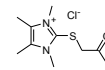
Products

„DON“ compounds



Art. No.	Name	Unit	Price
B003	Boc-DON-Gln-Ile-Val-OMe, „Boc-DON“	10 mg	400 €
Product Name:	tert-Butyloxycarbonyl-(6-Diazo-5-oxonorleucyl)-L-Glutaminyl-L-Isoleucyl-L-Valinmethylester		
Synonym:	Boc-DON		
Application:	Irreversible inhibitor of tissue transglutaminase; $IC_{50} \sim 0.3 \mu M$		
Reference:	Shinde et al., J. Mol. Cell Cardiol. 2018, 117:36-48; Basso et al., J. Neurosci. 2012, 9:6561-9 Verhaar et al., Neurochem. Int. 2011, 58:785-93; Schaertl et al., J. Biomol. Screen. 2010, 15:478-87; McConoughey et al., EMBO Mol. Med. 2010, 2:1-22; Zeugolis et al., J. Biomed. Mater. Res. A. 2010, 15:1310-20; Kristen et al., Circ. Res. 2008, 102:529-37; Mádi et al., Anal. Biochem. 2005, 343:256-62		
Z006	Z-DON-Val-Pro-Leu-OMe, „Z-DON“	10 mg	425 €
Product Name:	Benzyloxycarbonyl-(6-Diazo-5-oxonorleucyl)-L-Valinyl-L-Prolinyl-L-Leucinmethylester		
Synonym:	Z-DON		
Application:	Irreversible inhibitor of TG2 and TG6 TG2: $IC_{50} \sim 0.02 \mu M$; Cell permeable at $40 \mu M$ TG6: $IC_{50} \sim 0.15 \mu M$ As biochemical control see Z011 below!		
Reference:	Chrobok et al., PLoS One. 2018, 13:e0196433; Katt et al., Oncotarget. 2018, 9:34379-97; Algarni et al., Biochem. Pharmacol. 2017, 128:55-73; de Jager et al., Neuropathol. Appl. Neurobiol. 2016, 42:255-72; Wilhelmus et al., Sci. Rep. 2016, 6:20569; van der Wildt et al., Nucl. Med. Biol. 2016, 43:232-42; Recktenwald et al., J. Biol. Chem. 2016, 291:13580-90; de Jager et al., J. Neurochem. 2015, 134:1116-28; Fischer et al., J. Invest. Dermatol. 2013, 133:1170-7; Hsieh et. al., PLoS One. 2013, 8:e81516; Wang et al., Cell Death & Dis. 2013, 4:e808; Johnson et. al., Am. J. Physiol. Heart Circ. Physiol. 2012, 302:H1355-66; Lauzier et al., Arthritis Res. Ther. 2012, 14:R159; Verhaar et al., Neurochem. Int. 2011, 58:785-93; Schaertl et al., J. Biomol. Screen. 2010, 15:478-87; McConoughey et al., EMBO Mol. Med. 2010, 2:1-22; Kazemi-Esfarjani and La Spada, EMBO Mol. Med. 2010, 2:335-7		
Z011	Z-(D)-DON-Val-Pro-Leu-OMe	10 mg	450 €
Application:	Non-inhibiting control to Z-DON-VPL-OMe (Z006) $IC_{50} \sim 20.000 \text{ nM}$ (compared to 20 nM for Z-DON-VPL-OMe) This compound is 1,000 fold less potent than the parent molecule Z-DON-VPL-OMe (Z006)		

2-[(2-oxopropyl)thio]imidazolium derivatives

Art. No.	Name	Unit	Price
D003	1,3-Dimethyl-2-[(2-oxopropyl)thio]imidazolium chloride	100 mg	500 €
Synonym:	1,3-Dimethyl-2-[2-oxo-propyl]thio]imidazol chloride, NTU283		
Application:	Inhibition of transglutaminases		
Reference:	Katt et al., Oncotarget. 2018, 9:34379-97; Algarni et al., Biochem. Pharmacol. 2017, 128:55-73; Sánchez-Lara et al., Vet Pathol. 2015, 52:513-23; Hugues et al., J. Biol. Chem. 2012, 287:18005-17; Harrison et al., Br. J. Dermatol. 2007, 156:247-57; Skill et al., J. Biol. Chem. 2004, 279:47754-62; Freund et al., Biochemistry 1994, 33:10109-19		
			
D004	1,3-Dimethyl-4,5-diphenyl-2-[(2-oxopropyl)thio]imidazolium trifluorosulfonic acid salt	10 mg	550 €
Synonym:	L-683.685; 1,3-Dimethyl-2-(2-oxopropylthio)-4,5-diphenyl-1H-imidazol-3-ium trifluoromethanesulfonate		
Application:	Inhibition of transglutaminases; cell permeable*		
Reference:	*Basso et al., J. Neurosci. 2012, 9:6561-9; Lorand et al., Exp. Eye Res. 1998, 66:531-6; Barsigian et al., J. Biol. Chem. 1991, 266:22501-9		
			
T101	1,3,4,5-Tetramethyl-2-[(2-oxopropyl)thio]imidazolium chloride	10 mg	500 €
Synonym:	L-682.777 1,3,4,5-Tetramethyl-2-(2-oxo-propylsulfanyl)-3H-imidazol-1-ium chloride		
Application:	Inhibition of transglutaminases		
Reference:	Bäumel et al., J. Med. Chem. 2019, 62:3513-23; Katt et al., Oncotarget. 2018, 9:34379-97; Kattula et al., Blood Adv. 2018, 2:25-35; Macrae et al., Clin. Invest. 2018, 128:3356-68; Aleman et al., PLoS ONE 2015, 10:e0124448; Aleman et al., J. Clin. Invest. 2014, 124:3590-600; Katt et al., Mol. Pharm. 2015, 12:46-55; Dodt et al., Anal. Biochem. 2013, 439:145-51; Basso et al., J. Neurosci. 2012, 9:6561-9; Van den Akker et al., PLoS ONE 2011, 6:e23067; Matlung et al., Atherosclerosis 2010, 213:77-84; Dale et al., Nature 2002, 415:175-79; Lorand et al., Exp. Eye Res. 1998, 66:531-6; Freund et al., Biochem. 1994, 33:11109-19; Barsigian et al., J. Biol. Chem. 1991, 266:22501-9		
			

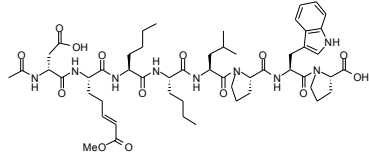
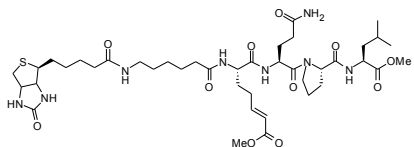
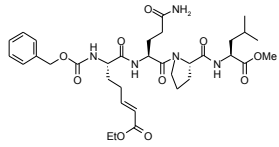
Naturally occurring inhibitors

Art. No.	Name	Unit	Price
T087	Tridegin	200 µg	510 €
	(recombinantly produced in <i>E. coli</i> , gene derived from <i>Haementeria ghilianii</i>)		
Application:	Inhibition of FXIII		
Reference:	Bäumel et al., Eur. J. Med. Chem. 2020, 201:112474 Böhm et al., J. Med. Chem. 2014, 57:10355-65; Finney et al., Biochem. J. 1997, 324:797-805; Wallis et al., Blood Coagul. Fibrinolysis. 1997, 8:291-5; Seale et al., Thromb. Haemost. 1997, 77:959-63		

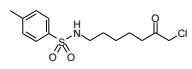




Michael acceptor (MA) inhibitors

Art. No.	Name	Unit	Price
A108	Ac-(D)-Asp-MA-Nle-Nle-Leu-Pro-Trp-Pro-OH	5 mg	500 €
Synonym:	ZED1301		
Application:	Site specific irreversible inhibitor of plasma transglutaminase (factor XIII, FXIII). Peptidic inhibitor containing an electrophilic Michael acceptor (MA) warhead		
Efficacy:	ZED1301 shows 30-fold selectivity for FXIII compared to tTG IC ₅₀ = 100 nM (FXIII, using fluorescent Assay Substance A101) IC ₅₀ = 3000 nM (TG2, using fluorescent Assay Substance A101)		
Reference:	Stieler et al., Angewandte Chemie Int. Ed. 2013, 52:11930-4.		
			
B015	Biotin-Ahx-MA-QPL-OMe	10 mg	500 €
Application:	Site specific irreversible inhibitor of tissue transglutaminase; Peptidic inhibitor containing an electrophilic Michael acceptor (MA) warhead; Biotinyl-analogon to Z013 (Z-MA-QPL-OMe)		
			
Z013	Z-MA-QPL-OMe	10 mg	500 €
Synonym:	ZED754		
Application:	Site specific irreversible inhibitor of tissue transglutaminase; Peptidic inhibitor containing an electrophilic Michael acceptor (MA) warhead; Cbz-analogon (Carboxybenzyl, Z) to B015 (Biotin-Ahx-MA-QPL-OMe)		
Reference:	Protein Data Bank (PDB) entry: 3S3P		
			

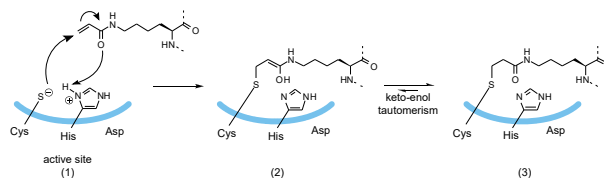
Lysine analogues - chloromethyl ketones

Art. No.	Name	Unit	Price
C094	Tosyl-ε-aminopentyl-CMK	1 mg	450 €
Synonym:	"Compound 47"; 1-Chloro-7-tosylamido heptan-2-one		
Application:	Irreversible inhibitor for transglutaminase		
Reference:	Reinhardt, Ann. N.Y. Acad. Sci. 1981, 370:836-42		
			

"Keillor TG2 Inhibitors" now commercially available at Zedira

Compounds AA9 (Z015), NC9 (Z016) and VA4 (Z017), were developed and produced by Dr. Jeffrey Keillor, Department of Chemistry and Biomolecular Sciences, University of Ottawa, Canada. The mechanism-based blockers carry an irreversible acting acrylamide warhead linked to a lysine side chain. Especially the NC9 and VA4 compounds are valuable tools shown to lock TG2 in the open conformation *in vitro* and in living cells, and to abolish GTP binding. Further, the molecules halt the proliferation and invasion of cancer stem cells. Find more details in the respective PDS.

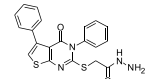
The "Keillor TG2 Inhibitors" bear an acrylamide warhead, being attacked by the active site cysteine residue (1) to form an irreversible complex (2,3).



"Keillor TG2 Inhibitors" (acrylamide compounds)

Art. No.	Name	Unit	Price
Z015	Keillor inhibitor AA9	10 mg	400 €
Application:	Site specific inhibitor of tissue transglutaminase		
	$K_i = 9 \mu\text{M}$; $k_{\text{inact}}/K_i = 0.10 \mu\text{M}^{-1}\text{min}^{-1}$		
Reference:	Akbar et al., J. Med. Chem. 2017, 60:7910–27		
			
Z016	Keillor inhibitor NC9	10 mg	400 €
Application:	Site specific inhibitor of tissue transglutaminase		
	$K_i = 34 \mu\text{M}$; $k_{\text{inact}}/K_i = 0.08 \mu\text{M}^{-1}\text{min}^{-1}$		
Reference:	Akbar et al., J. Med. Chem. 2017, 60:7910–27;		
	Clouthier et al., Angew. Chem. Int. Ed. Engl. 2012, 51:124648;		
	Kerr et al., Oncogene 2017, 36:2981–90; Fisher et al., Oncotarget 2015, 6:20525–39;		
	Adhikary et al., Oncotarget 2018, 9:34495505		
			
Z017	Keillor inhibitor VA4	10 mg	400 €
Application:	Site specific inhibitor of tissue transglutaminase		
	$K_i = 13 \mu\text{M}$; $k_{\text{inact}}/K_i = 0.11 \mu\text{M}^{-1}\text{min}^{-1}$		
Reference:	Akbar et al., J. Med. Chem. 2017, 60:7910–27		
	Kerr et al., Oncogene 2017, 36:2981–90		
			

Also new in Zedira's portfolio: LDN 27219

Art. No.	Name	Unit	Price
D016	LDN 27219	10 mg	400 €
Application:	Reversible, slow-binding Transglutaminase 2 (TG2) inhibitor ($\text{IC}_{50} = 0.25 \mu\text{M}$), binding at the enzyme's GTP site		
Reference:	Case and Stein, Biochemistry 2007, 46:110615;		
	Duval et al., Bioorg. Med. Chem. Lett. 2005, 15:1885–9		
			

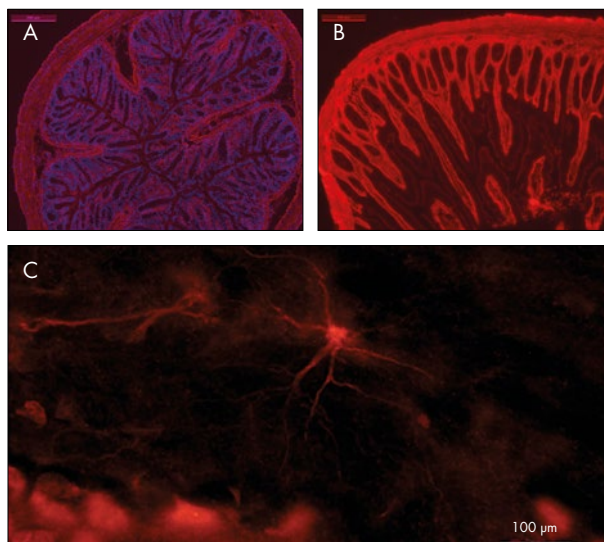
Antibodies & Microarrays

Antibodies

Antibodies are important tools in many research and diagnostic applications.

Zedira offers antibodies – polyclonal as well as monoclonal – raised against:

- All human transglutaminases
- Guinea pig liver transglutaminase
- Bacterial transglutaminase
- The transglutaminase reaction product:
N^ε-(γ-glutamyl)-L-lysine-isopeptide bond
- Fibrinolytic enzymes:
Plasmin and its zymogen (plasminogen)
- Gliadin-variants



Indirect immuno-stainings

- (A) Anti-TG2 (A014): mouse colon section (1:100);
(B) Anti-TG2 (A014): mouse small intestinal mucosa;
(C) Anti-TG6 (A017): astrocyte in mouse corpus callosum.

(A/B) J. Knauer, Fraunhofer Gesellschaft Leipzig

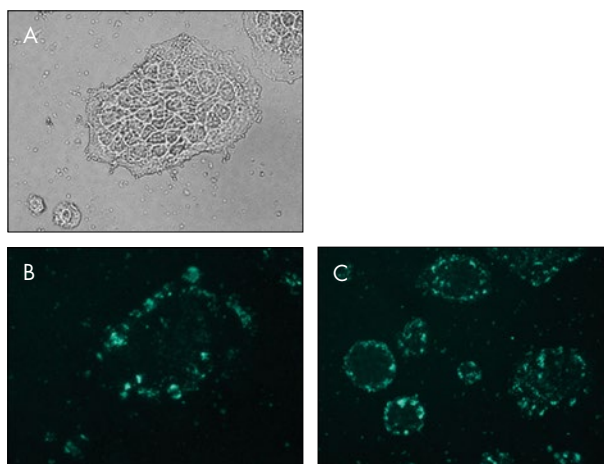
(C) A. Schulze-Krebs, S. v. Hörsten, University Erlangen

Antibodies labeled with fluorescent dyes

In many applications the need for a fluorescently labeled antibody exists, ranging from fluorescence microscopy to fluorescence-activated cell sorting (FACS).

Zedira provides many of its polyclonal antibodies with a fluorescent label like FITC or as a biotinylated version.

Of course antibodies with other tags are available on demand. Just give us a call (+49 6151 66628 0) or send an e-mail (contact@zedira.com).



Direct immuno-stainings

Stimulated CaCo2 cells expressing TG2.

- (A) Transmitted light microscopy, magnification 1:40;
(B) FITC-Anti-TG2 (A028):
fluorescence microscopy, magnification 1:40;
(C) FITC-Anti-TG2 (A028):
fluorescence microscopy, magnification 1:20.

(A-C) W. Dieterich, University Erlangen-Nürnberg

Antibodies & Microarrays

Products

Antibodies against Transglutaminase 1

Art. No.	Name	Unit	Price
A018	Polyclonal antibody to human keratinocyte transglutaminase (TG1)	500 µg	400 €
Immunogen:	rec. human keratinocyte transglutaminase (T035), raised in rabbit		
Format:	Purified IgG		
Reference:	Algarni et al., Biochem. Pharmacol. 2017, 128:55-73; Fischer et al., J. Invest. Dermatol. 2013, 133:1170-7; Itoh et al., J. Histochem. Cytochem. 2013, 61:793-801		
A029	FITC-labeled polyclonal antibody to human TG1	200 µg	425 €
Format:	A018 purified via affinity chromatography on protein A, followed by FITC-labeling		
A042	Monoclonal antibody to human TG1 (clone XTG31)	200 µg	400 €
Immunogen:	rec. human keratinocyte transglutaminase (T035), raised in mouse		
Format:	Purified IgG		
A043	Monoclonal antibody to human TG1 (clone XTG51)	200 µg	400 €
Immunogen:	rec. human keratinocyte transglutaminase (T035), raised in mouse		
Format:	Purified IgG		

Polyclonal antibodies against Transglutaminase 2

Art. No.	Name	Unit	Price
A014	Polyclonal antibody to human tissue transglutaminase (TG2)	500 µg	400 €
Immunogen:	rec. human tissue transglutaminase (T022), raised in rabbit		
Reference:	Dulay et al., Biosens. Bioelectron. 2011, 26:3852-6		
A028	FITC-labeled polyclonal antibody to human TG2	200 µg	425 €
Format:	A014 purified via affinity chromatography on protein A, followed by FITC-labeling		
A053	Biotinylated polyclonal antibody to human TG2	50 µg	400 €
Format:	A014 purified via affinity chromatography on protein A, followed by biotin-labeling		
A072	Polyclonal antibody to mouse tissue transglutaminase	200 µg	400 €
Immunogen:	Mouse tissue transglutaminase (T040), raised in rabbit		
A075	FITC-labeled polyclonal antibody to mouse TG2	200 µg	425 €
Format:	A072 purified via affinity chromatography on protein A, followed by FITC-labeling		





Monoclonal antibodies against TG2 domains

Art. No.	Name	Unit	Price
A033	Monoclonal antibody to human TG2 (Catalytic Domain , clone XTG17)	200 µg	400 €
Immunogen:	rec. human tissue transglutaminase (T051), raised in mouse		
Specificity:	Mouse monoclonal antibody reacts with the Catalytic Domain of transglutaminase 2 (human, guinea pig, rat, mouse and dog TG2)		
Purity:	> 95%, by SDS-PAGE		
Reference:	Kanchan et al., Cell. Mol. Life Sci. 2015, 72:3009-35		
A034	Monoclonal antibody to human TG2 (Beta-Sheet Domain , clone XTG11)	200 µg	400 €
Immunogen:	rec. human tissue transglutaminase (T051), raised in mouse		
Specificity:	Mouse monoclonal antibody reacts with the Beta-Sheet Domain of human transglutaminase 2		
Purity:	> 95%, by SDS-PAGE		
Reference:	Kanchan et al., Cell. Mol. Life Sci. 2015, 72:3009-35		
A036	Monoclonal antibody to human TG2 (Beta Barrel 1 Domain , clone XTG21)	200 µg	400 €
Immunogen:	rec. human tissue transglutaminase (T051), raised in mouse		
Specificity:	Mouse monoclonal antibody reacts with the Beta Barrel 1 Domain of human transglutaminase 2		
Purity:	> 95%, by SDS-PAGE		
Reference:	Kanchan et al., Cell. Mol. Life Sci. 2015, 72:3009-35		
A037	Monoclonal antibody to human TG2 (Beta Barrel 2 Domain , clone XTG18)	200 µg	400 €
Immunogen:	rec. human tissue transglutaminase (T051), raised in mouse		
Specificity:	Mouse monoclonal antibody reacts with the Beta Barrel 2 Domain of human transglutaminase 2		
Purity:	> 95%, by SDS-PAGE		
Reference:	Kanchan et al., Cell. Mol. Life Sci. 2015, 72:3009-35		

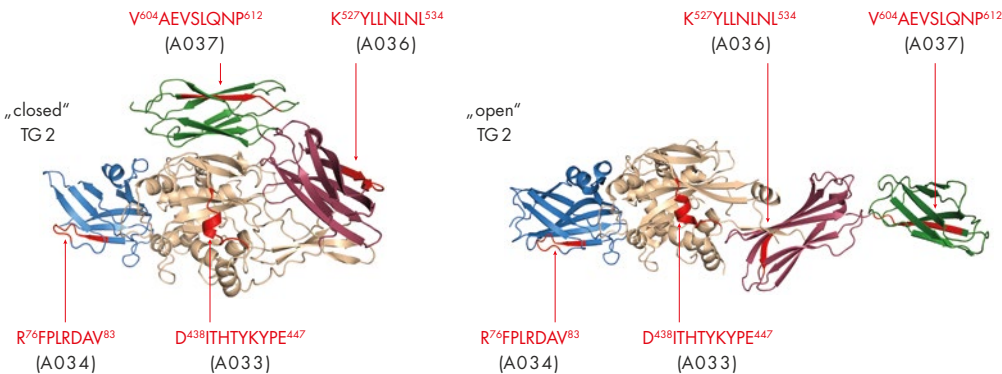


Figure: Epitopes of monoclonal antibodies to the four TG2-domains determined by peptide microarrays (see page 46), marked in the „closed“ and „open“ conformation structure of TG2.

Antibodies & Microarrays

Antibodies against Transglutaminase 3

Art. No.	Name	Unit	Price
A015	Polyclonal antibody to human epidermal transglutaminase (TG3)	500 µg	400 €
Immunogen:	rec. human epidermal transglutaminase (T024) raised in rabbit		
Format:	Purified IgG		
Reference:	Schulze-Krebs et al., Int. J. Mol. Sci. 2021, Hietikko et al., Acta. Derm. Venereol. 2018, 98:366-72; Algarni et al., Biochem. Pharmacol. 2017, 128:55-73; Fischer et al., J. Invest. Dermatol. 2013, 133:1170-7		
A030	FITC-labeled polyclonal antibody to human TG3	200 µg	425 €
Format:	A015 purified via affinity chromatography on protein A, followed by FITC-labeling		
A078	Polyclonal antibody to human epidermal transglutaminase (TG3) (Protein A purified)	250 µg	400 €
A082	Monoclonal antibody to human TG3 (clone XTG45)	200 µg	400 €
Immunogen:	rec. human epidermal transglutaminase (T024), raised in mouse		
Format:	Purified IgG		

Antibody against Transglutaminase 4

Art. No.	Name	Unit	Price
A022	Polyclonal antibody to human prostate transglutaminase (TG4)	500 µg	400 €
Immunogen:	rec. human prostate transglutaminase (T042), raised in rabbit		
Format:	Purified IgG		

Antibodies against Transglutaminase 5

Art. No.	Name	Unit	Price
A008	Polyclonal antibody to human transglutaminase 5 (TG5)	500 µg	400 €
Immunogen:	rec. human Transglutaminase 5 (T086, inclusion body preparation), raised in rabbit		
Format:	Purified IgG		
A044	FITC-labeled polyclonal antibody to human TG5	200 µg	425 €
Format:	A008 purified via affinity chromatography on protein A, followed by FITC-labeling		

Antibodies against Transglutaminase 6

Art. No.	Name	Unit	Price
A031	FITC-labeled polyclonal antibody to human TG6	200 µg	425 €
Format:	Purified via affinity chromatography on protein A, followed by FITC-labeling		
A139	Monoclonal antibody to human TG6 (Catalytic Domain, clone XTG52)	200 µg	400 €
Format:	Protein G-affinity purified IgG		
Specificity:	Mouse monoclonal antibody reacts with the Catalytic Domain of human transglutaminase 6		
A140	Monoclonal antibody to human TG6 (Beta Barrel 1 Domain, clone XTG39)	200 µg	400 €
Format:	Protein G-affinity purified IgG		
Specificity:	Mouse monoclonal antibody reacts with the Beta Barrel Domain 1 of human transglutaminase 6		
A141	Monoclonal antibody to human TG6 (Beta Barrel 1 Domain, clone XTG68)	200 µg	400 €
Format:	Protein G-affinity purified IgG		
Specificity:	Mouse monoclonal antibody reacts with the Beta Barrel Domain 1 of human transglutaminase 6		
A156	Polyclonal antibody to human neuronal transglutaminase (TG6) (Protein A purified)	250 µg	400 €
Immunogen:	rec. human neuronal transglutaminase (T021), raised in rabbit		
A157	Monoclonal antibody to human TG6 (Beta Barrel 1 Domain, clone XTG10)	200 µg	400 €
Immunogen:	rec. human neuronal transglutaminase (T021)		
Format:	Purified IgG		
A158	Monoclonal antibody to human TG6 (Beta Barrel 2 Domain, clone XTG29)	200 µg	400 €
Immunogen:	rec. human neuronal transglutaminase (T021)		
Format:	Purified IgG		
New A165	Monoclonal antibody to human TG6 (clone XTG60)	200 µg	400 €
Immunogen:	rec. human neuronal transglutaminase (T021)		
Format:	Purified IgG		
New A166	Monoclonal antibody to human TG6 (clone XTG71)	200 µg	400 €
Immunogen:	rec. human neuronal transglutaminase (T021)		
Format:	Purified IgG		

Antibodies against Transglutaminase 7

Art. No.	Name	Unit	Price
A040	Polyclonal antibody to human transglutaminase 7 (TG7)	200 µg	400 €
Immunogen:	rec. human Transglutaminase 7 (T011), raised in rabbit		
Format:	Purified IgG		

Antibodies & Microarrays

Antibodies against Factor XIII

Art. No.	Name	Unit	Price
A016	Polyclonal antibody to human factor XIII (A-subunit)	500 µg	400 €
Immunogen:	rec. human blood coagulation factor XIII (T027), raised in rabbit		
Reference:	Mitchell et al., Blood. 2014, 124:3982-90		
A032	FITC-labeled polyclonal antibody to human factor XIII (A-subunit)	200 µg	425 €
Format:	A016 purified via affinity chromatography on protein A, followed by FITC-labeling		
Reference:	Mitchell et al., Blood. 2014, 124:3982-90		
A052	Biotinylated polyclonal antibody to human factor XIII (A-subunit)	50 µg	400 €
Format:	A016 purified via affinity chromatography on protein A, followed by biotin-labeling		
A074	Polyclonal antibody to human blood coagulation factor XIII (B-subunit)	200 µg	400 €
Immunogen:	rec. human blood coagulation factor XIII B-subunit (T050), raised in rabbit		
A077	FITC-labeled polyclonal antibody to human factor XIII (B-subunit)	200 µg	425 €
Format:	A074 purified via affinity chromatography on protein A, followed by FITC-labeling		
A154	Monoclonal antibody to human factor XIII-A (Activation Peptide , clone XTG09)	200 µg	400 €
Specificity:	Mouse monoclonal antibody reacts with the Activation Peptide of human factor XIII		
A155	Monoclonal antibody to human factor XIII-A (Catalytic Domain , clone XTG02)	200 µg	400 €
Specificity:	Mouse monoclonal antibody reacts with the Catalytic Domain of human factor XIII		
A159	Monoclonal antibody to human factor XIII-A (Catalytic Domain , clone XTG04)	200 µg	400 €
Specificity:	Mouse monoclonal antibody reacts with the Catalytic Domain of human factor XIII		

Antibodies against D-dimers

Art. No.	Name	Unit	Price
A076	DD-XLink-mab	100 µg	400 €
	Monoclonal antibody against crosslinked fibrin (" D-dimer ")		
Immunogen:	Human fibrin peptides cross-linked with plasma factor XIIIa, raised in mouse		
A079	Biotin-DD-XLink-mab	50 µg	400 €
	Biotinylated monoclonal antibody against crosslinked fibrin (" D-dimer ") (product derived from A076)		
A046	D-Dimer monoclonal mouse antibody, clone 3B6	100 µg	400 €
Immunogen:	Human cross-linked D-Dimer, raised in mouse		
Purity:	>80% pure protein A-affinity purified mouse monoclonal antibody (Isotype IgG3)		
A047	D-Dimer monoclonal mouse antibody, clone 1D2	100 µg	400 €
Immunogen:	Human cross-linked D-Dimer, raised in mouse		
Purity:	>80% pure protein A-affinity purified mouse monoclonal antibody (Isotype IgG3)		



**Antibodies against Microbial Transglutaminase**

Art. No.	Name	Unit	Price
A020	Polyclonal antibody to microbial pro transglutaminase (pro-MTG)	500 µg	400 €
Immunogen:	Microbial protransglutaminase (T016), raised in rabbit		
Format:	Purified IgG		
A051	Biotinylated polyclonal antibody to microbial transglutaminase (MTG)	50 µg	400 €
Format:	Purified via affinity chromatography on protein A, followed by biotin-labeling		
A143	Monoclonal antibody to microbial transglutaminase (clone XM67, IgG1)	200 µg	400 €
Immunogen:	Microbial protransglutaminase (T016), raised in mouse		
Format:	Purified IgG		
A144	Monoclonal antibody to microbial transglutaminase (clone XM68, IgG2a)	200 µg	400 €
Immunogen:	Microbial protransglutaminase (T016), raised in mouse		
Format:	Purified IgG		
A145	Polyclonal antibody to microbial transglutaminase	200 µg	400 €
Immunogen:	Microbial protransglutaminase (T016), raised in rabbit		
Format:	Purified IgG		
Reference:	Stricker et al., J. Pediatr. Gastroenterol. Nutr. 2019, 68:e43-e50		

Antibody against Transglutaminase reaction product

Art. No.	Name	Unit	Price
A023	Monoclonal antibody to N^ε-(γ-L-glutamyl)-L-lysine-isopeptide bond	100 µg	400 €
Immunogen:	N ^ε -(γ-L-glutamyl)-L-lysine-isopeptide, modified, raised in mouse		
Reference:	Wilhelmus et al., Anal Biochem. 2020, 592:113578; Armstrong et al., Acta Cir. Bras. 2018, 33:991-999; Scarnato et al., LWT - Food Sci. Tech. 2017, 81:101-110; Zhang et al., Mol. Neurobiol. 2016, 53:5066-78; de Jager et al., J. Neurochem. 2015, 134:1116-28; Steppan et al., J. Am. Heart Assoc. 2014, 3:e000599; Shrestha et al., Biomed. Res. Int. 2014, 2014:651608; Nadalutti et al., Cell. Mol. Life Sci. 2014, 71:1315-26; de Jager et al., Neurobiol. Aging. 2013, 34:1159-69; Shaik et al., Eur. J. Cell Biol. 2012, 91:204-15; Elli et al., Lab. Invest. 2011, 91:452-61; Wang et al., PLoS Pathog. 2010, 6:e1000763; Johnson et al., J. Neurosci. Methods. 2004, 134:151-8; Thomas et al., J. Immunol. Methods. 2004, 292:83-95; Kaartinen et al., J. Bone Miner. Res. 2002, 17:2161-73		

Antibody against plasminogen and plasmin

Art. No.	Name	Unit	Price
A021	Polyclonal antibody to human plasminogen (rhPLG)	500 µg	400 €
Immunogen:	Human Lys-Plasminogen (full length protein) recombinantly produced in yeast, raised in rabbit		
Format:	Purified IgG		

Antibodies & Microarrays

Antibodies to gliadin are used in research as well as in diagnostics, e.g. for the detection of gluten in food samples. We offer a range of antibodies to gliadin differing in their specificity. The antibodies may be ordered as a set of 12 monoclonals (100 µg each) (A035) or individually.

Antibodies to deamidated gliadin (A057, A062) are of special interest in the context of celiac disease, as they recognize an immunodominant epitope.

Antibodies against deamidated gliadin

New

Art. No.	Name	Unit	Price
A160	Monoclonal antibody to deamidated gliadin (clone ZDG-01) This product replaces Art. No. A057.	100 µg	780 €
Immunogen:	Deamidated gliadin-related peptide Lys57-Glu65-[α-gliadin (58-73)] (KLQPFQPQ E LPYPQPQ)		
Specificity:	Specific for deamidated 33mer-alpha gliadin peptide (KLQPFQPQ E LPYPQPQ)		
Reference:	Heil et al., J. Agric. Food Chem. 2017, 65:6982-90		

New

A161	Monoclonal antibody to deamidated and non-deamidated gliadin (clone ZDG-02) This product replaces Art. No. A062.	100 µg	780 €
Immunogen:	Deamidated gliadin-related peptide Lys57-Glu65-[α-gliadin (58-73)] (KLQPFQPQ E LPYPQPQ)		
Specificity:	Recognizes Gliadin. Reacts with both the deamidated 33mer-alpha gliadin peptide (KLQPFQPQ E LPYPQPQ) and the non-deamidated 33mer-alpha gliadin peptide (KLQPFQPQ Q LPYPQPQ)		

Antibodies against wheat gliadin

Art. No.	Name	Unit	Price
A086	Monoclonal antibodies to gliadin (test sample set) (Set comprises 10 monoclonal antibodies, 50 µg each)	1 Set	600 €
Clones:	XGY1, XGY4, XGY6, XGY7, XGY9, XGY10, XGY11, XGY15, XGY19, XGY24		
A011-A085	Monoclonal antibody to gliadin (Art. No. and Clones see set A086 and picture next page)	500 µg (each)	400 €
Immunogen:	Mouse monoclonal antibody raised against purified wheat gliadin		

Antibody against barley hordein

Art. No.	Name	Unit	Price
A071	Monoclonal antibody to hordein (clone XH4)	500 µg	400 €
Immunogen:	Mouse monoclonal antibody raised against purified wheat gliadin		

Differences of gliadin antibody clones

Recombinant gliadin and deamidated gliadin peptides (G051-G055 and G005, G006, see section Celiac Disease Products) were analyzed using monoclonal antibodies to

gliadin. The picture below indicates the various antibodies, the corresponding clones and their reactivity to gliadin and deamidated gliadin peptides.

Art. No.	A011		A013		A054		A056		A059		A060		A064		A067		A070		A085		A160		A161	
Clone	XGY1		XGY7		XGY6		XGY11		XGY9		XGY10		XGY4		XGY15		XGY24		XGY19		n.d.		n.d.	
Binds to [µg]	10	1	10	1	10	1	10	1	10	1	10	1	10	1	10	1	10	1	10	1	10	1	10	1
Wheat prolamins																								
26mer gliadin peptide																								
26mer DGP																								
33mer gliadin peptide																								
33mer DGP																								
Carrier protein control																								
DGPx2																								
DGPx4																								

Spotlight - Transglutaminase peptide microarrays for high resolution epitope mapping

Introduction

Poly- and monoclonal antibodies are important research tools for the elucidation of transglutaminase function in physiology and pathophysiology. Furthermore, auto-antibodies e.g. to TG2, TG3 or TG6 may be present in gluten-sensitive disorders and are used as diagnostic biomarkers.

Zedira and PEPperPRINT now offer peptide microarrays for high resolution linear epitope mapping of monoclonal (mabs) and polyclonal antibodies (pabs). Further the arrays may be used for characterization of patients' sera containing anti-transglutaminase auto-antibodies.

PEPperCHIP® Transglutaminase Peptide Microarray is based on PEPperPRINT's unique peptide microarray platform: Transglutaminase sequences translated into 15 aa peptides are synthesized in duplicate with a maximum peptide-peptide overlap of 14 aa for full epitope coverage on a coated glass slide.

The following microarray formats are available for epitope characterization of your antibody or antiserum:

- **Pan-Transglutaminase Peptide Microarray** (P111):
in order to determine the antibodies' epitopes within all human transglutaminases (FXIIIa, TG1, TG2, TG3, TG4, TG5, TG6, TG7 and EBP4.2)
- **Transglutaminase 2 Microarray** (P117):
in order to analyse 5 samples (e.g. patients' sera) on one chip
- **Custom Transglutaminase Microarray** (P112):
in order to design your microarray according to your specific requirements
- We further offer the analysis of your antibody: PEPperCHIP® Transglutaminase Microarray **Service** (P113)

Examples for epitope mapping

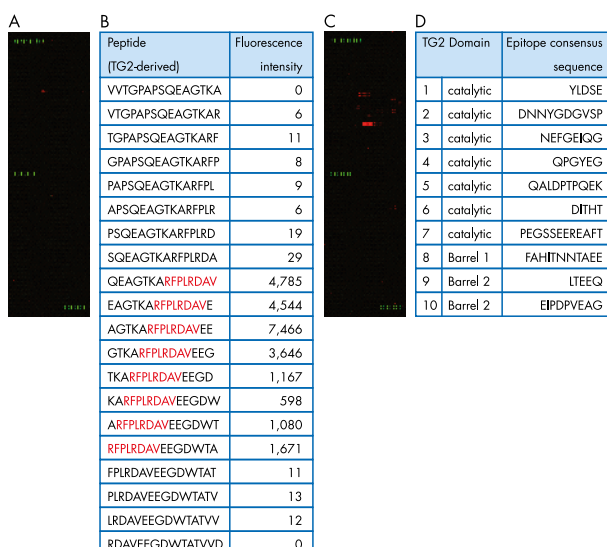
Epitope mapping of 4 monoclonal antibodies raised against full length human TG2 and characterized for their domain-specificity by western blotting using recombinantly produced TG2-domains has been performed using the PEPperCHIP® Transglutaminase Peptide Microarray.

Epitope mapping of polyclonal rabbit anti-human TG2 antibody A014 has been characterized accordingly. Clear signals restricted to TG2-epitopes are given for all mabs as well as for pab A014. Cross-reactivity to other transglutaminase isoenzymes is not observed, confirming specificity data obtained by Western-blotting.

Fig 1A shows the fluorescence read out for monoclonal antibody A034 (specific to the TG2-beta-sheet domain). Fluorescence intensity of the epitope containing peptide spots is given in Fig 1B. Fluorescence image of the microarray for polyclonal ab A014 is shown in Fig 1C. The deduced linear epitopes recognized by A014 are summarized in Fig 1D.

Celiac disease patients' sera

PEPperCHIP® Transglutaminase Peptide Microarray may also be used for characterization of human patients' sera. As an example the linear TG2 epitopes recognized by 3 celiac disease patients' sera (both IgA and IgG) are depicted in Fig 2 (next page), where conserved epitope regions can be deduced. Interestingly, epitopes for domain specific mabs as well as for pab A014 match to those conserved epitope regions. Antibodies did not bind to catalytic site Cys277 and its neighboring amino acids, while the other catalytic triad amino acids (His335 and Asp358) are part of epitope regions. For the 3 sera analyzed we found auto-antibody binding epitopes all over the TG2-sequence.



For further information please go to: www.zedira.com

Figure 1: A) PEPperCHIP® Pan-Transglutaminase Peptide Microarray after incubation with mab A034 (1 µg/mL) and secondary anti-mouse IgG-antibody (DyLight680; red). Control: monoclonal anti-HA-antibody-DyLight800; green). B) Fluorescence intensity of the single spots around the A037 consensus motif RFPLRDAV (red). C) Microarray for pab A014 (10 µg/mL) revealing 10 clear epitope-like spot patterns with weak to strong intensity. D) Epitopes of polyclonal antibody A014.

PEPperCHIP® Microarray

Art. No.	Name	Unit	Price
P111	PEPperCHIP® Pan-Transglutaminase Microarray (Standard microarray)	1 Chip	475 €
Content:	Human transglutaminases FXIIIA, TG1, TG2, TG3, TG4, TG5, TG6, TG7 and B4.2		
P117	PEPperCHIP® Transglutaminase 2 Microarray	1 Chip	475 €
Content:	Human transglutaminase 2		
Samples:	Analyze up to 5 samples with one chip		
P112	PEPperCHIP® Custom Transglutaminase Microarray (Customized transglutaminase microarray layout)	1 Chip	895 €
P113	PEPperCHIP® Transglutaminase Microarray Service (Full service IgG and IgA analysis of one sample)	1 Sample	695 €

PEPperCHIP® Accessories

Art. No.	Name	Unit	Price
P119	MAPIX Analyzer (Software for peptide microarray image analysis)	3-Month License 1-Year License Perpetual License	295 € 745 € 3500 €
P115	PEPperCHIP® Incubation Tray 3/1 (Suitable for microarray P111)	1 Tray	325 €
P116	PEPperCHIP® Staining Kit (Anti-HA (12CA5)-Cy5 or DyLight680)	1 Kit	95 €
P118	PEPperCHIP® Incubation Tray 3/5 (Suitable for microarray P117)	1 Tray	325 €

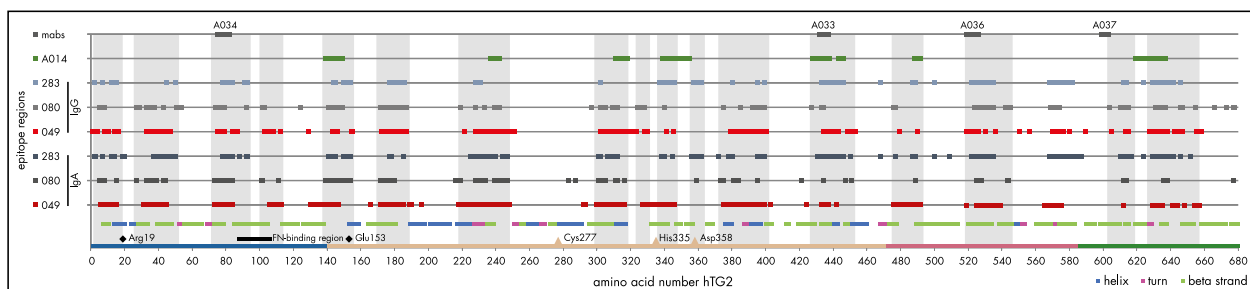


Fig 2: IgA- and IgG-epitope regions for 3 celiac disease patient sera (#283, #080, #049). In addition epitopes for domain specific mabs A033, A034, A036 and A037 as well as pab A014 are indicated. Common epitope regions are highlighted by rectangles.

Proteases

Relationship Proteases - Transglutaminases

Human transglutaminases possess a catalytic triad and the reaction proceeds via a reactive intermediate linked to the nucleophilic cysteine of the enzyme. The mechanism is similar to the proteolysis reaction catalyzed by thiol proteases and obviously the enzyme classes even have an evolutionary relationship.

Biology and physiology are also closely related. The serine protease **thrombin (T056)** activates factor XIII cleaving the activation peptide. Subsequently, **plasmin (P012)** degrades the fibrin clot. Therefore proteases are important in transglutaminase research.

Protease Substrates

Art. No.	Name	Unit	Price
D005	Metalloprotease-Assay-Substance , DABCYL-Ser-Phe-EDANS	2 mg	325 €
Reference:	Weimer et al., Anal. Biochem. 2006, 323:110-9		
D017	Thrombin-Assay Substance , fluorescent, (D)-Phe-Pip-Arg-AMC	10 mg	200 €
Application:	Highly sensitive thrombin substrate, lower limit of detection: 5 pM (picomolar) thrombin		
Z020	Thrombin-Generation-Assay Substance , fluorescent, Z-Gly-Gly-Arg-AMC	25 mg	200 €
Application:	"Slow" acting thrombin substrate for determination of thrombin generation in plasma		
T004	Plasmin substrate Tosyl-GPKpNA , chromogenic	25 mg	350 €
Synonym:	N-(p-Tosyl)-Gly-Pro-Lys-pNA acetate		

Proteases

Art. No.	Name	Unit	Price
P003	Prolylendopeptidase from <i>Myxococcus xanthus</i> (PEP, PEP-Mx), recombinant	150 U	400 €
Source:	Recombinantly produced in <i>E. coli</i>		
Reference:	Schulz et al., Adv. Mater. 2016, 28:1455-60		
P009	human Pro-Glu-Plasminogen, recombinant	100 µg	450 €
Source:	recombinantly produced in insect cells		
P012	human Plasmin , recombinant (from Glu-Plasminogen, activated by Urokinase)	100 µg	450 €
Source:	Recombinantly produced in insect cells		
P014	Urokinase	1 mg	400 €
Synonym:	u-PA		
P016	Tissue Plasminogen Activator	100 µg	400 €
Synonym:	t-PA		
Reference:	Mutch et al., J. Thromb. Haemost. 2003, 1:2000-7		
T056	Human alpha thrombin, highly active	2x 100 U	200 €
Synonym:	Coagulation factor IIa, α-Thrombin		
Source:	(Pro)thrombin from tested human plasma		
T222	Human alpha Thrombin, recombinant	100 NIH Units	200 €
Source:	Full-length DNS sequence for thrombin, IMAGE clone 77998, recombinantly produced serum-free in HEK293 cells		

Cereal Proteins

Background information

Cereals have a protein content of about 10%, which are classified by their solubility according to Thomas Burr Osborne (1919):

Albumin + globulin: soluble in saline

Prolamins soluble in ethanol

Glutelins: soluble in propanol/urea/DTE

Prolamins andutelins like gliadin and glutenin from wheat play a crucial role in celiac disease pathophysiology.

Find in the table below the protein extracts of the most common cereals.



	Barley	Rye	Wheat	Wheat Durum	Spelt	Oat	Millet (Sorghum)	Rice	Corn	Soy*
Albumin + globulin	G018	G021	G036 Leukosin + Edestin	G039	G030	G033	G045	G027	G024	G042
Prolamin	G019 Hordein	G022 Secalin	G037 Gliadin	G040	G031	G034 Avenin	G046 Kafirin	G028 Oryzin	G025 Zein	G043
Glutelin	G020 Hordein	G023 Secalinin	G038 Glutenin	G041	G032	G035 Avenalin	G047	G029 Oryzenin	G026 Zeanin	G044

* corresponding protein extracts

5 mg per unit - 250 €

Antibodies against gliadin and deamidated gliadin are also available, see Section: Antibodies

Other cereal protein products

Art. No.	Name	Unit	Price
P004	PT-Gluten	1 mg	250 €
Definition:	PT-Gluten is based on a wheat gluten preparation which has been proteolyzed by pepsin (porcine) and trypsin (porcine).	10 mg	1200 €
Application:	PT-Gluten may be used in biochemical approaches, e.g. as substrate for transglutaminases or as antigen for gliadin antibodies.		
Reference:	Elli et al., Hum. Immunol. 2012, 73:992-7		
G008	Omega-5 gliadin	500 µg	780 €
Source:	Recombinantly produced in <i>E. coli</i>		

Blood Coagulation

Transglutaminase saves lives!

Blood clot formation is a vital process to prevent life threatening blood loss after trauma. The plasmatic part of blood coagulation cascade can be divided into three steps:

- Cascade leading to activation of prothrombin
- Fibrinogen (**F004**) activation by thrombin (**T056**, **T222**) and fibrin aggregation (soft blood clot)
- Factor XIII activation by thrombin and cross-linking of fibrin fibers as well as covalent decoration with antifibrinolytics

Plasma transglutaminase factor XIII plays an essential role in blood clot formation. In addition, factor XIII is unique in this process, as all the other enzymes involved are proteases. Factor XIII renders the blood clot stiff and resistant against fibrinolytic degradation. Due to the fact that it is the only transglutaminase in the cascade, it offers the opportunity for a unique modulation of coagulation and in consequence promising approaches e.g. to prophylaxis of thrombotic events in risk patients.

An excellent historical account on FXIII in blood clotting is given by Laszlo Lorand: Factor XIII and the clotting of fibrinogen: from basic research to medicine. J. Thromb. Haemost. 2005, 3:1337-48.

Novel compounds developed by medicinal chemists at Zedira guide the way to small molecules targeting selectively coagulation factor XIII. In contrast to the currently available therapies, factor XIII blocking allows formation of a weak fibrin clot. This shall prevent bleeding and therefore reducing the risk of life-threatening complications.

Zedira offers some unique tools and biochemical reagents focusing on the interaction of plasma transglutaminase and fibrin:

- Factor XIII
- Factor XIII inhibitors
- Factor XIII activity assays
- Fibrin aggregation and clotting (Figure 1)
- Fibrin clot degradation (Figure 2)
- Antibodies.

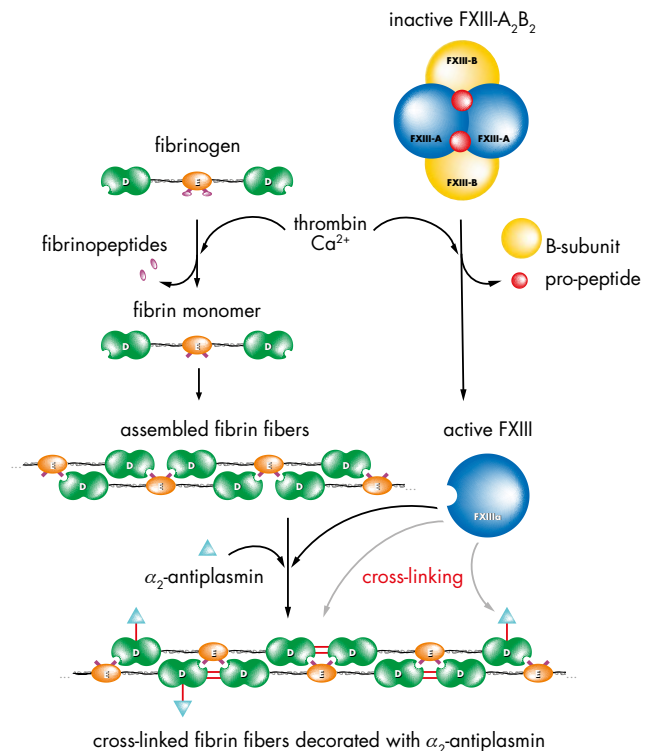


Figure 1) In blood, the FXIII-A₂B₂ heterotetramer is bound to fibrinogen via its carrier B-subunits. Thrombin cleaves the fibrinopeptides forming the self-aggregating and polymerizing fibrin fibers. Concomitantly, thrombin activates FXIII in the presence of fibrin by the cleavage of the propeptide. Binding of calcium ions and dissociation of the B-subunits yield active FXIIIa. The active plasma transglutaminase covalently cross-links fibrin (red lines) and incorporates α₂-antiplasmin (triangle) rendering the clot mechanical and biochemical stable.

Fibrinolysis by plasmin leads to the formation of fibrin degradation products as shown in Figure 2. Most important as diagnostic marker is the so called D-Dimer (compare to page 56/57).

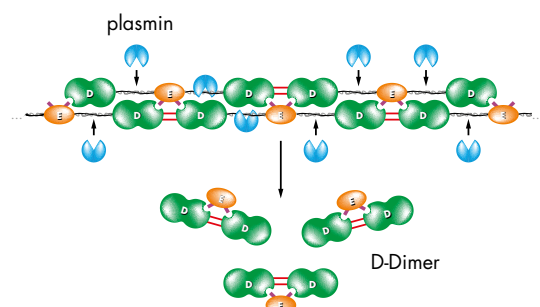


Figure 2) Clot degradation and lysis is mediated by plasmin. Plasmin degrades the coiled-coil structure of fibrin generating xFDPs (cross-linked fibrin degradation products).

Products

Factor XIII

For more details see Section: Transglutaminases

Art. No.	Name	Unit	Price
T027	Human blood coagulation Factor XIII-A₂	200 µg	400 €
T050	Human blood coagulation Factor XIII- B subunit	200 µg	400 €
T063	Human blood coagulation Factor XIII-A ₂ , Val34Leu -mutant	200 µg	400 €
T070	Human Factor XIII a , Thrombin activated	200 µg	550 €
T127	Biotinylated human blood coagulation Factor XIII (product derived from T027)	50 µg	400 €
T197	Coagulation factor XIII, recombinant human Factor XIII-A₂ (Recombinant fibrin stabilizing factor)	100 E 250 E	725 € 1450 €

Factor XIII-Inhibitors

For more details see Section: Inhibitors

Art. No.	Name	Unit	Price
A108 Synonym:	Ac-(D)-Asp-MA-Nle-Nle-Leu-Pro-Trp-Pro-OH ZED1301	5 mg	500 €
D004	1,3-Dimethyl-4,5-diphenyl-2-[(2-oxopropyl)thio]imidazolium trifluorosulfonicacid salt	10 mg	550 €
T087	Tridegin	200 µg	510 €
T101	1,3,4,5-Tetramethyl-2[(2-oxo-propyl)thio] imidazolium chloride	10 mg	500 €

Factor XIII Activity Assays

For more details see Section: Assays and Substrates

Art. No.	Name	Unit	Price
A101 Application:	FXIII-Assay Substance , Abz-NE[CAD-DNP]EQVSPLTLK-OH Fluorescent measurement of transglutaminase activity, optimized for FXIII	10 mg	575 €
F001	FXIII-Assay Kit , Isopeptidase-Fluorogenic Assay, based on substrate A101	1 Kit	600 €
T036	Transglutaminase Assay Kit, fluorescent , Casein, Dansylcadaverine	1 Kit	300 €

Blood Coagulation

Fibrin aggregation and clotting

Art. No.	Name	Unit	Price
F004	Fibrinogen , purified from human plasma	50 mg	125 €
Synonym:	Factor I		
F006	FITC-labeled Fibrinogen (product derived from F004)	5 mg	225 €
G101	Gly-Pro-Arg-Pro-amide	25 mg	375 €
Application:	Fibrin aggregation inhibitor peptide		
T056	Human alpha thrombin, highly active	2x 100 U	200 €
T222	Human alpha Thrombin, recombinant	100 NIH Units	200 €
Source:	Full-length DNS sequence for thrombin, IMAGE clone 77998, recombinantly produced serum-free in HEK293 cells		

Fibrin clot degradation

Art. No.	Name	Unit	Price
F011	Cross-linked fibrin degradation products, xFDPs	200 µg	300 €
F012	Fibrin degradation products, FDPs	200 µg	300 €
P009	Plasminogen , recombinantly produced in insect cells	100 µg	450 €
P012	human Plasmin , recombinantly produced in insect cells	100 µg	450 €
P014	Urokinase , u-PA	1 mg	400 €
P015	Streptokinase (bacterial plasminogen activator)	1 mg	400 €
P016	Tissue Plasminogen Activator , t-PA	100 µg	400 €

Antibodies

For more details see Section: Antibodies

Art. No.	Name	Unit	Price
A016	Polyclonal antibody to human factor XIII (A-subunit)	500 µg	400 €
A032	FITC-labeled polyclonal antibody to human factor XIII (A-subunit)	200 µg	425 €
A052	Biotinylated polyclonal antibody to human factor XIII (A-subunit)	50 µg	400 €
A046	D-Dimer monoclonal mouse antibody, clone 3B6	100 µg	400 €
A047	D-Dimer monoclonal mouse antibody, clone 1D2	100 µg	400 €
A074	Polyclonal antibody to human factor XIII (B-subunit)	200 µg	400 €
A076	"DD-XLink-mab" Monoclonal antibody against crosslinked fibrin ("D-dimer")	100 µg	400 €
A077	FITC-labeled polyclonal antibody to human factor XIII (B-subunit)	200 µg	425 €
A079	Biotin-DD-XLink-mab Biotinylated monoclonal antibody against crosslinked fibrin (" D-dimer ")	50 µg	400 €

Spotlight - "DD-XLink-mab" directed against the crosslinked fibrin neoepitope

Introduction

Since decades, coagulation factor XIII (FXIII) is considered as a scientific qualified target for the development of novel anticoagulants [1-3]. Inhibiting FXIII may lower the current bleeding risk in anticoagulation therapy since neither the thrombin level nor the platelet activation is affected.

Zedira developed small molecule inhibitors to modulate FXIII activity by structure-assisted drug design [4]. To assess the efficacy in blood, we aimed to generate a monoclonal antibody directed against the isopeptide bond ("cross-link") within fibrin as preferred biomarker. After proteolytic activation by thrombin, FXIIIa modifies the soft fibrin clot and thereby generating covalent bonds. First, cross-linking between abutting γ -chains of fibrin is catalyzed and subsequently α_2 -antiplasmin is incorporated to further increase the resistance against fibrinolysis (figure 1A). Plasmin catalyses the retarded clot dissolution and the release of crosslinked fibrin

degradation products (xFDPs/D-dimer). In case of blocking FXIIIa only a soft clot is formed which may be rapidly hydrolyzed yielding non-crosslinked fibrin degradation products (FDPs, figure 1B). SDS-PAGE of those degradation products reveals that the protein pattern differs remarkably under reduced and non-reduced conditions as shown in figure 2A.

Monoclonal "D-dimer" antibodies (e.g. DD-3B6/22) are commercially available and are used in In Vitro Diagnostics (IVD) to exclude thromboembolic events. However, these monoclonals do not detect the crosslink itself but address a portion of polypeptides within the D-domain after plasmin degradation that are conformationally reactive [7]. This hinders for example standardization and comparison of data obtained by different assays [8]. Therefore, we developed "DD-XLink-mab" which directly recognizes the crosslinked fibrin neoepitope.

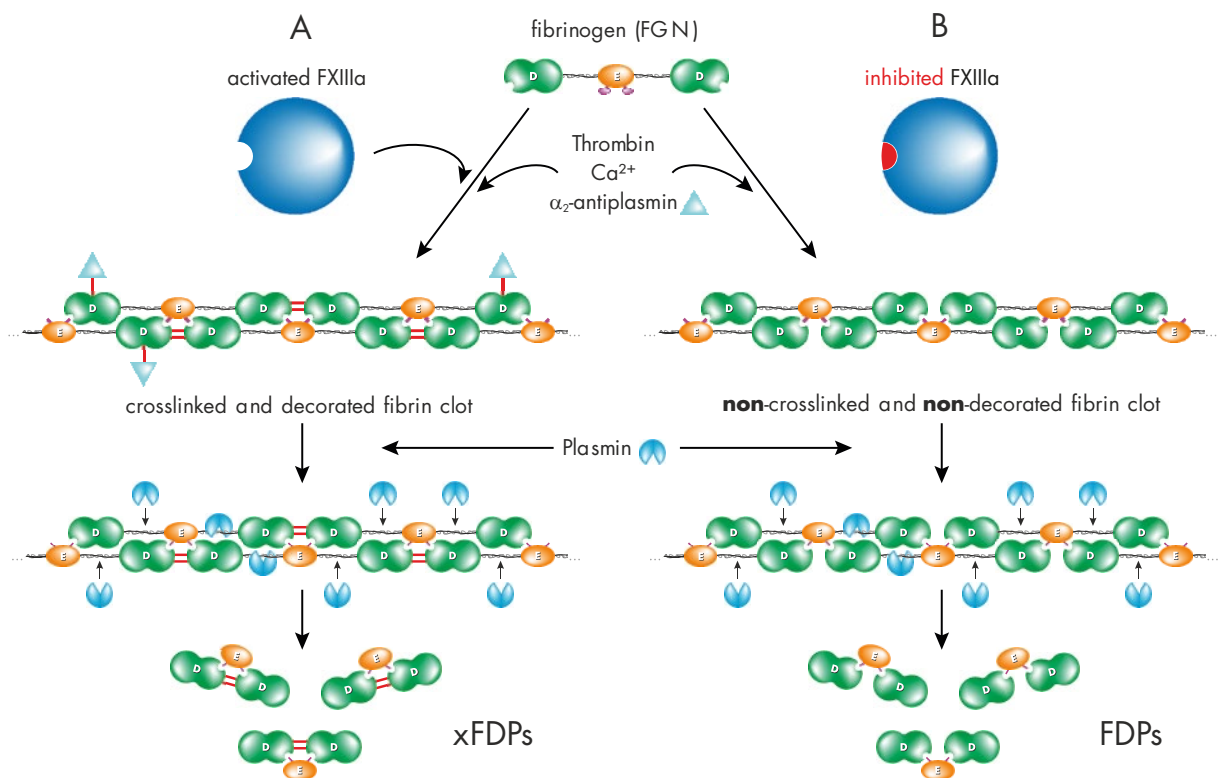


Figure 1: A) Upon clot formation, activated factor FXIII (FXIIIa) modifies the soft fibrin clot by rapidly crosslinking γ -chains of fibrin and incorporation of α_2 -antiplasmin. Thus FXIIIa increases clot stiffness and resistance against fibrinolysis. Plasmin catalyses the retarded release of crosslinked fibrin degradation products (xFDPs) and the characteristic "D-dimers".

Figure 1: B) Inhibition of FXIIIa leads to the fibrin fiber assembly without covalent modification. The so called "soft clot" is highly susceptible for fibrinolysis leading to fibrin degradation products (FDPs).

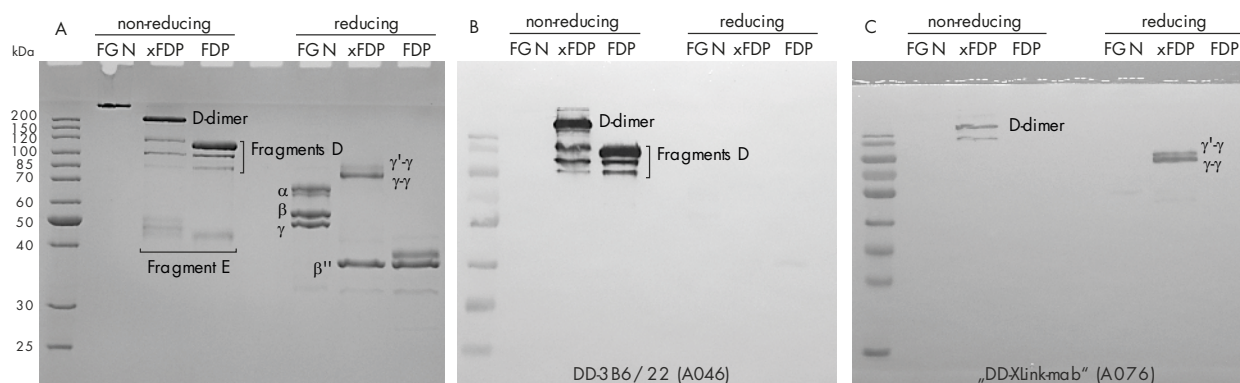


Figure 2: A) Coomassie stained SDS-PAGE of fibrinogen, crosslinked fibrin degradation products (xFDPs) and non-crosslinked fibrin degradation products (FDPs) under non-reduced and reduced conditions. The most characteristic bands are referenced. Western-blotting using B) “D-dimer” (DD-3B6, Zedira A046) and C) our novel “DD-XLink-mab” (Zedira, A076).

Synthesis of the antigen and immunization

A peptide sequence derived from human γ -fibrinogen containing Q398/Q399 and K406 was synthesized by standard solid-phase peptide chemistry. The purified peptide was subsequently cross-linked using thrombin-activated FXIII (FXIIIa, Zedira, T070). Mass spectrometry confirmed the formation of iso-peptide bonds. After conjugation to Keyhole Limpet Hemocyanin (KLH), the conjugate was used for immunization of three mice. Serum of one mouse showed mild reactivity against crosslinked fibrin degradation products (xFDPs), which was used as readout both in ELISA and in Western blotting. Spleen-derived B-cells from this mouse were fused to myeloma cells yielding hybridoma cell lines. Separation and further screening lead to a single clone producing a monoclonal antibody (named A076) with a substantial reactivity against xFDPs in ELISA.

Characterization of the monoclonal antibody (mAb)

The specific requirement for the monoclonal antibody (mAb) is to discriminate between crosslinked and non-crosslinked fibrin. In addition, selectivity against fibrinogen and other blood components is indispensable.

Production of xFDPs and FDPs: coagulation was simulated *in vitro* by adding thrombin to a mixture of human fibrinogen (Zedira, F005) and rhFXIII (Zedira, T027) in physiological concentrations either in the presence or absence of ZED3118, a direct-acting FXIIIa inhibitor. The insoluble fibrin clots were subsequently degraded by rhPlasmin (Zedira, P012) and the soluble proteins were separated by gel filtration chromatography. These protein preparations are used for ELISA and SDS-PAGE with subsequent Western blotting.

Immunostaining of xFDPs and FDPs by commercially available “D-dimer” monoclonal antibody (DD-3B6/22) is shown in figure 2. The pattern reveals that in contrast to our novel “DD-XLink-mab” A076 both xFDPs and FDPs are recognized under non-reducing conditions only, in accordance with the literature [7]. Western blotting using novel “DD-XLink-mab” indicates specificity for the cross-linked fibrin both under non-reducing and reducing conditions (figure 2c). The antibody shows no reactivity against fibrinogen or other plasma proteins.

Conclusion

We developed and characterized “DD-XLink-mab” (A076) directed against the major crosslink within the γ -chains of human fibrin. The recognized neopeptide is clearly distinct from the one recognized by commercial “D-dimer” antibodies used in IVD for exclusion of thrombotic events. We expect that the novel monoclonal antibody will be a valuable tool for basic hemostaseology and transglutaminase research. Further, the evaluation in IVD, for clot imaging, and especially in course of our FXIII drug development program is ongoing.

References

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Celiac Disease Products

Background information

Celiac disease affects about 1% of the population and therefore is the most common chronic inflammation of the small intestine triggered by cereal gluten/gliadin uptake in genetically susceptible individuals. The gluten induced autoimmune disorder is characterized by autoantibodies to tissue transglutaminase (TG2), antibodies to deamidated gliadin and villous atrophy in the final stage.

TG2 plays a central role in celiac disease. Besides being the major autoantigen it is involved in the pathogenesis. Under certain circumstances and in distinct environments as given in the

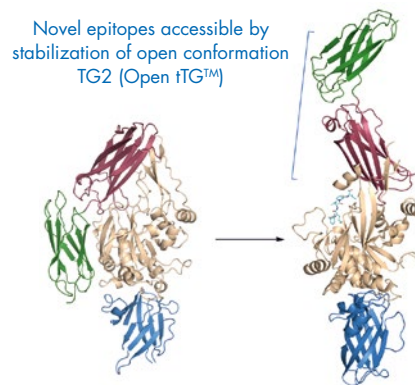
inflamed gut, TG2 catalyzes deamidation of glutamine side chains in gliadin yielding glutamic acid. Deamidated gliadin (DGP) is subsequently recognized by receptors of the immune system breaking oral tolerance and triggering celiac disease. In addition TG2 crosslinks DGP to itself forming hapten-carrier-like complexes, thus breaking self-tolerance by anti-TG2-antibody production.

Related gluten induced autoimmune disorders are dermatitis herpetiformis / Morbus Duhring (autoantigen: epidermal transglutaminase, TG3) and neurological disorders like gluten ataxia (autoantigen: neuronal transglutaminase, TG6).

Open tTG – lift the celiac iceberg

Upon substrate binding TG2 dramatically changes its structure (Pinkas et al., PLoS Biol. 2007). By reacting TG2 with a novel irreversible inhibitor we could stabilize TG2 in the open conformation which we branded Open tTG™.

Open tTG™ – it fits the antigen to the autoantibody – is the key to detect seronegative or borderline celiac disease patients. It is superior to the so far used closed conformation TG2 especially for patient sera with low or negative tTG autoantibody-titers (Lindfors et al., J. Clin. Immunol. 2011, 31:436-42).



For the purified protein products **Open tTG™**, **Inhibited TG3** and **Inhibited TG6** please refer to section Transglutaminases.

Transglutaminase 6-ab ELISA kits

Upon the request of our customers we revised anti-TG6-ELISA kits E003 and E004, now available as ZediXclusive TG6-ab ELISA kits **E103** and **E104**:

The revised kit versions include the following improvements:

- Background subtraction not necessary anymore.
Therefore, now you can measure up to 40 sera in duplicates with one kit (96 wells).
- The calibrators are adapted, so that the more relevant lower titers are covered.
- Cutoffs are redefined based on a sera collective of 86 patients with various neurological disorders, and 38 blood donors, equally distributed by sex and age.
- Titers (U/mL) obtained by the new E103/E104 kits can be translated to titers of old kit versions E003/E004 and vice versa!

Get your serum sample measured for TG6 autoantibodies!

If **low sample numbers** do not account for buying an ELISA-kit, you may contact the following laboratories for sample measurement:

Northern General Hospital

Clinical Immunology and Allergy Unit
care of Graeme Wild

Herries Road, Sheffield S5 7AU, UK

E-mail: Graeme.Wild@sth.nhs.uk

Web: www.sth.nhs.uk/services/a-z-of-services?id=19

Praxis Prof. Dr. med. M. Kramer

Facharzt für Laboratoriumsmedizin

Postfach 103320, 69023 Heidelberg, Germany

E-mail: m.kramer@praxis-dr-kramer-hd.de

Web: www.gluten-ataxie.de; www.gluten-ataxia.com

Products

Neuronal Transglutaminase (TG6) ELISA

TG6 is the novel autoantigen in gluten sensitive neurological disorders like gluten ataxia.

Reference: Mulder et al., Dig. Liver Dis. 2018, 50:96-7; Zis et al., Dig. Liver Dis. 2017, 49:1196-200
Hadjivassiliou et al., Ann. Neurol. 2008, 64:332-43 and Lancet Neurol. 2010, 9:318-30



Art. No.	Name	Unit	Price
E103	ZediXclusive TG6-ab ELISA (IgA)	1 kit/96 wells	550 €
Antigen:	recombinant TG6, insect cells		
E104	ZediXclusive TG6-ab ELISA (IgG)	1 kit/96 wells	550 €
Antigen:	recombinant TG6, insect cells		

Celiac disease related diagnostic antigens



Art. No.	Name	Unit	Price
T051	Open tTG™	250 µg	550 €
Source:	Recombinantly produced in insect cells	1 mg	1650 €
T010	Recombinant TG2 (E. coli)	250 µg	400 €
Source:	Recombinantly produced in E. coli	1 mg	1200 €
T021	Human neuronal transglutaminase (TG6, recombinantly produced in insect cells)	250 µg	500 €
		1 mg	1500 €
T122	Recombinant TG2 (insect cells)	250 µg	400 €
Source:	Recombinantly produced in insect cells	1 mg	1200 €
T024	Human epidermal transglutaminase	200 µg	400 €
Source:	Recombinantly produced in insect cells		
New T246	Recombinant human tissue transglutaminase (Cys-277-Ser, inactive mutant)	250 µg	400 €
Source:	Recombinantly produced in insect cells	1 mg	1200 €

Celiac Disease Products

Further products for celiac disease R+D

Art. No.	Name	Unit	Price
G001	Alpha2-gliadin , 33mer (aa56-88), biotin ylated	5 mg	550 €
Sequence:	Biotin-LQLQPFPPQLPYPQQLPYPQQLPYPQQLPYPQPF-OH		
Reference:	Galipeau et al., Am. J. Gastroenterol. 2014, 109:748-56, Qiao et al., J. Immunol. 2004, 173:1757-62		
G002	Deamidated alpha2-gliadin , 33mer (aa56-88), biotin ylated	5 mg	550 €
Sequence:	Biotin-LQLQPFPPQELPYPQQLPYPQQLPYPQQLPYPQPF-OH		
Reference:	Qiao et al., J. Immunol. 2004, 173:1757-62		
G003	Ac-PLQPEQFPFK (ε- Biotin), Deamidated gliadin peptide	10 mg	350 €
Reference:	Schwartz et al., Clin. Chem. 2004, 50:2370-5		
G004	Ac-PEQLPQFEFK (ε- Biotin), Deamidated gliadin peptide	10 mg	350 €
Reference:	Schwartz et al., Clin. Chem. 2004, 50:2370-5		
G009	Alpha2-gliadin , 33mer (aa56-88)	5 mg	550 €
Sequence:	H-LQLQPFPPQLPYPQQLPYPQQLPYPQQLPYPQPF-OH		
Reference:	Qiao et al., J. Immunol. 2004, 173:1757-62		
G011	Deamidated alpha2-gliadin , 33mer, (Acetyl-aa56-88-amide, Q65E)	5 mg	550 €
Sequence:	Ac-LQLQPFPPQELPYPQQLPYPQQLPYPQQLPYPQPF-NH ₂		
Reference:	Qiao et al., J. Immunol. 2004, 173:1757-62		
G013	QFPQQLPYPQPF-amide , PepQ, alpha2-gliadin (aa60-73)	10 mg	350 €
Reference:	Heil et al., J. Cer. Sci. 2016, 70:47-56; Skovbjerg et al., Biochim. Biophys. Acta. 2004, 1690:220-30		
G014	QFPQQLPYPQPF-amide , PepE, deamidated alpha2-gliadin (aa60-73)	10 mg	350 €
Reference:	Heil et al., J. Cer. Sci. 2016, 70:47-56; Skovbjerg et al., Biochim. Biophys. Acta. 2004, 1690:220-30		
G057	Alpha2-gliadin , 33mer (aa56-88), TAMRA labeled	5 mg	600 €
Sequence:	TAMRA-LQLQPFPPQLPYPQQLPYPQQLPYPQQLPYPQPF-OH		
G058	Alpha2-gliadin , 33mer (aa56-88), TAMRA and Biotin labeled	5 mg	750 €
Sequence:	TAMRA-LQLQPFPPQLPYPQQLPYPQQLPYPQQLPYPQPF-Lys(Biotin)-OH		

Reference: Heil et al., J. Agric. Food Chem. 2017, 65:6982-90

Reference: Heil et al., J. Agric. Food Chem. 2017, 65:6982-90



Services on Transglutaminase in Research and Development

Based on our profound expertise in transglutaminase, we offer to support industrial partners in their respective R&D efforts on a fee-for-service base. Zedira is your reliable partner with highly skilled, motivated and experienced personal. Over the last decade we successfully completed several projects with big or mid-sized Pharma, as well as with diagnostic companies.

Whatever you need — a product or a service around transglutaminase or related fields, please do not hesitate to contact us!

(+49 6151 66628 0 or send an e-mail to contact@zedira.com)

Service categories include, but are not limited to:

- Production of eukaryotic transglutaminases including mutants
- Manufacturing of microbial transglutaminases including mutants and tailor-made formulations
- Modification of transglutaminases (biotinylation, fluorescent labels, and specific conjugates)
- Development of transglutaminase assays for customer specific applications
- Determination of human and animal transglutaminase inhibition in drug development
- Organic synthesis of transglutaminase related small molecules (e.g. substrates, inhibitors, and labels)
- Scientific advice and experts opinion linked to transglutaminase.

Services on determination of Microbial Transglutaminase (MTG)

Microbial Transglutaminase is widely used in food applications. At Zedira we provide services for determination and detection of MTG in your sample.

Please contact us for a quotation!

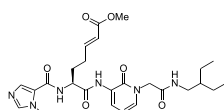
(+49 6151 66628 0 or send an e-mail to contact@zedira.com)

Service categories include, but are not limited to:

- Determination of MTG **activity** in food preparations
- Determination of MTG **protein** in food preparations
- Determination of **gluten/gliadin** content in food and food preparations

Spotlight - Bringing the first transglutaminase inhibitor into the clinic

In March 2015, Dr. Falk Pharma and Zedira announced the start of phase I clinical trials for the drug candidate ZED1227, a direct acting inhibitor of tissue transglutaminase:

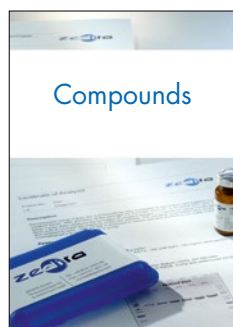


Partnering in drug development

Zedira offers its expertise in the field of transglutaminase to be an ally in drug development for a limited number of partners.

Until now, preclinical and clinical development targeting transglutaminase suffers from a lack of potent and selective blockers. Zedira has overcome this limitation.

Partnering with Zedira will provide access to our transglutaminase-specific drug development platform, which is composed of 4 modules:

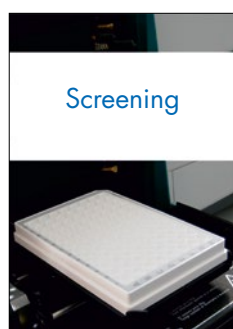


Medicinal chemists synthesized more than 2,500 small molecules targeting either TG2 or FXIIIa covering a remarkable physico-chemical space. We are confident not only having the most potent "drug like" molecules in hand, some of them orally bioavailable, but also having a unique knowledge about candidate drugs tailor-made for distinct indications on the horizon.



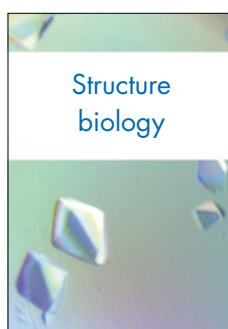
Will inhibitors penetrate into cells and will they inhibit the targeted transglutaminase at intracellular conditions?

These questions are addressed by our cell based assays.



96-well screening platform for hit finding, lead optimization and compound profiling.

Besides the identification of new molecules blocking tissue transglutaminase, the platform allows for profiling selectivity against most important human transglutaminase iso-enzymes (FXIII, TG1, TG2, TG3, and TG6). In addition, animal derived transglutaminases are available for pre-evaluation of inhibitory activities in animal models.



Co-crystals from highly purified transglutaminase-inhibitor-conjugates are the prerequisite for x-ray diffraction and consecutive structure analysis. Understanding the interaction of the inhibitors to the targets on a molecular level allows in silico design of improved transglutaminase inhibitors.

Zedira is a reliable partner complementing the skills of pharmaceutical companies in the transglutaminase sector in order to create extra value and shorten development times. Please contact us for detailed information:

contact@zedira.com or +49 6151 66628 0



Zedi is in the lab now

... and wears a lab coat in an exemplary manner.

Product List (alphanumeric)

Art. No.	Name	Unit	Price	Page
A008	Polyclonal antibody to human transglutaminase 5 (TG5)	500 µg	400 €	42
A011	Monoclonal antibody to gliadin (clone XGY1)	500 µg	400 €	46
A013	Monoclonal antibody to gliadin (clone XGY7)	500 µg	400 €	46
A014	Polyclonal antibody to human tissue transglutaminase (TG2)	500 µg	400 €	40
A015	Polyclonal antibody to human epidermal transglutaminase (TG3)	500 µg	400 €	42
A016	Polyclonal antibody to human blood coagulation factor XIII (A-subunit)	500 µg	400 €	44, 55
A018	Polyclonal antibody to human keratinocyte transglutaminase (TG1)	500 µg	400 €	40
A020	Polyclonal antibody to microbial protransglutaminase (pro-MTG)	500 µg	400 €	16, 45
A021	Polyclonal antibody to human plasminogen (rhPLG)	500 µg	400 €	45
A022	Polyclonal antibody to human prostate transglutaminase (TG4)	500 µg	400 €	42
A023	Monoclonal antibody to N ^ε -(γ-L-glutamyl)-L-lysine-isopeptide bond	100 µg	400 €	45
A028	FITC-labeled polyclonal antibody to human TG2	200 µg	425 €	40
A029	FITC-labeled polyclonal antibody to human TG1	200 µg	425 €	40
A030	FITC-labeled polyclonal antibody to human TG3	200 µg	425 €	42
A031	FITC-labeled polyclonal antibody to human TG6	200 µg	425 €	43
A032	FITC-labeled polyclonal antibody to human factor XIII (A-subunit)	200 µg	425 €	44, 55
A033	Monoclonal antibody to human TG2 (Catalytic Domain, clone XTG17)	200 µg	400 €	41
A034	Monoclonal antibody to human TG2 (Beta Sheet Domain, clone XTG11)	200 µg	400 €	41
A036	Monoclonal antibody to human TG2 (Beta Barrel 1 Domain, clone XTG21)	200 µg	400 €	41
A037	Monoclonal antibody to human TG2 (Beta Barrel 2 Domain, clone XTG18)	200 µg	400 €	41
A040	Polyclonal antibody to human transglutaminase 7 (TG7)	200 µg	400 €	43
A042	Monoclonal antibody to human TG1 (clone XTG31)	200 µg	400 €	40
A043	Monoclonal antibody to human TG1 (clone XTG51)	200 µg	400 €	40
A044	FITC-labeled polyclonal antibody to human TG5	200 µg	425 €	42
A046	D-Dimer monoclonal mouse antibody, clone 3B6	100 µg	400 €	44, 55
A047	D-Dimer monoclonal mouse antibody, clone 1D2	100 µg	400 €	44, 55
A051	Biotinylated polyclonal antibody to microbial transglutaminase (MTG)	50 µg	400 €	16, 45
A052	Biotinylated polyclonal antibody to human factor XIII (A-subunit)	50 µg	400 €	44, 55
A053	Biotinylated polyclonal antibody to human TG2	50 µg	400 €	40
A054	Monoclonal antibody to gliadin (clone XGY6)	500 µg	400 €	46
A056	Monoclonal antibody to gliadin (clone XGY11)	500 µg	400 €	46
A059	Monoclonal antibody to gliadin (clone XGY9)	500 µg	400 €	46
A060	Monoclonal antibody to gliadin (clone XGY10)	500 µg	400 €	46
A064	Monoclonal antibody to gliadin (clone XGY4)	500 µg	400 €	46
A067	Monoclonal antibody to gliadin (clone XGY15)	500 µg	400 €	46
A070	Monoclonal antibody to gliadin (clone XGY24)	500 µg	400 €	46
A071	Monoclonal antibody to hordein (clone XH4)	500 µg	400 €	46
A072	Polyclonal antibody to mouse tissue Transglutaminase	200 µg	400 €	40
A074	Polyclonal antibody to human blood coagulation factor XIII (B-subunit)	200 µg	400 €	44, 55
A075	FITC-labeled polyclonal antibody to mouse TG2	200 µg	425 €	40
A076	DD-XLink-mab	100 µg	400 €	44, 55
A077	FITC-labeled polyclonal antibody to human factor XIII (B-subunit)	200 µg	425 €	44, 55
A078	Polyclonal antibody to human epidermal transglutaminase (TG3) Protein A	250 µg	400 €	42
A079	Biotin-DD-XLink-mab	50 µg	400 €	44, 55
A082	Monoclonal antibody to human TG3 (clone XTG45)	200 µg	400 €	42
A085	Monoclonal antibody to gliadin (clone XGY19)	500 µg	400 €	46
A086	Monoclonal antibodies to gliadin (test sample set)	1 Set	600 €	46
A101	FXIII-Assay Substance, Abz-NE(CAD-DNP)EQVSPLTLK-OH	10 mg	575 €	24, 53
A105	NQEQVSPLTLK, alpha ₂ -Antiplasmin peptide (1-12)	25 mg	500 €	26
A106	(ATTO-488 TM)cadaverine	1 mg	275 €	20, 29

Art. No.	Name	Unit	Price	Page
A108	Ac-[D]-Asp-MA-Nle-Nle-Leu-Pro-Trp-Pro-OH	5 mg	500 €	37, 53
A109	β-Amyloid peptide 1-42 (Aβ 1-42)	1 mg	275 €	27, 29
A112	(ATTO-532™)cadaverine	1 mg	275 €	20, 29
A113	(ATTO-550™)cadaverine	1 mg	275 €	20, 29
A114	(ATTO-647N™)cadaverine	1 mg	325 €	20, 29
A115	(ATTO-700™)cadaverine	1 mg	325 €	20, 29
A125	Factor XIII activation peptide	10 mg	475 €	12
A132	Microbial Transglutaminase (MTG)-substrate peptide Ac-M48	10 mg	350 €	28
A139	Monoclonal antibody to human TG6 (Catalytic Domain, clone XTG52)	200 µg	400 €	43
A140	Monoclonal antibody to human TG6 (Beta Barrel 1 Domain, clone XTG39)	200 µg	400 €	43
A141	Monoclonal antibody to human TG6 (Beta Barrel 1 Domain, clone XTG68)	200 µg	400 €	43
A143	Monoclonal antibody to microbial Transglutaminase (clone XM67)	200 µg	400 €	16, 45
A144	Monoclonal antibody to microbial Transglutaminase (clone XM68)	200 µg	400 €	16, 45
A145	Polyclonal Antibody to microbial Transglutaminase	200 µg	400 €	16, 45
A152	3-Azidopropan-1-amine	100 mg	175 €	20
A153	4-Azidobutan-1-amine	100 mg	175 €	20
A154	Monoclonal antibody to human factor XIII-A (Activation Peptide, clone XTG09)	200 µg	400 €	44
A155	Monoclonal antibody to human factor XIII-A (Catalytic Domain, clone XTG02)	200 µg	400 €	44
A156	Polyclonal antibody to human neuronal transglutaminase (TG6)	250 µg	400 €	43
A157	Monoclonal antibody to human TG6 (Beta Barrel 1 Domain, clone XTG10)	200 µg	400 €	43
A158	Monoclonal antibody to human TG6 (Beta Barrel 2 Domain, clone XTG29)	200 µg	400 €	43
A159	Monoclonal antibody to human factor XIII-A (Catalytic Domain, clone XTG04)	200 µg	400 €	44
A160	Monoclonal antibody to deamidated gliadin	100 µg	780 €	46
A161	Monoclonal antibody to deamidated and non-deamidated gliadin	100 µg	780 €	46
A165	Monoclonal antibody to human TG6 (clone XTG60)	200 µg	400 €	43
A166	Monoclonal antibody to human TG6 (clone XTG71)	200 µg	400 €	43
B001	Biotinyl-Thr-Val-Gln-Gln-Glu-Leu-OH	5 mg 25 mg	175 € 525 €	26
B002	N-(Biotinyl)cadaverine	25 mg 100 mg	175 € 475 €	20, 29
B003	Boc-DON-Gln-Ile-Val-OMe, "Boc-DON"	10 mg	400 €	35
B006	Thr-Val-Gln-Gln-Glu-Leu-OH	25 mg	400 €	26
B007	Keratinocyte transglutaminase (TG1)-substrate-peptide K5	10 mg	350 €	28
B008	Tissue transglutaminase (TG2)-substrate-peptide T26	10 mg	350 €	28
B009	Epidermal transglutaminase (TG3)-substrate-peptide E51	10 mg	350 €	28
B010	Blood coagulation FXIII-substrate-peptide F11KA	10 mg	350 €	28
B013	Neuronal transglutaminase (TG6)-substrate peptide Y25	10 mg	350 €	28
B014	Transglutaminase 7 (TG7)-substrate peptide Z3S	10 mg	350 €	28
B015	Biotin-Ahx-MA-QPL-OMe	10 mg	500 €	37
B017	Microbial Transglutaminase (MTG)-substrate peptide M48	10 mg	350 €	28
B019	Biotin-Ahx-QVPL-OMe	10 mg	400 €	27
C001	Z-Gln-Gly-OH	1 g	100 €	27
C002	Z-Gln-Gly-CAD-DNS	25 mg 100 mg	175 € 400 €	21, 27
C079	Z-Gln-Gly-PEG(3)-N ₃	25 mg	500 €	21
C090	Z-Gln-Gly-CAD-TAMRA	25 mg	500 €	21
C091	Z-Gln-Gly-CAD-Biotin	25 mg	350 €	21
C092	Z-Gln-Gly-(PEG1,088), monodisperse	25 mg	500 €	21
C093	Z-Gln-Gly-(PEG5,000), polydisperse	25 mg	500 €	21
C094	Tosyl-ε-aminopentyl-CMK	1 mg	450 €	37

Product List

Art. No.	Name	Unit	Price	Page
C102	MTG Blocker	10 mg 25 mg	250 € 425 €	15
D001	Dansyl-ε-amino-hexanoyl-Gln-Gln-Ile-Val-OH	25 mg 100 mg	200 € 500 €	26
D002	N-(2,4-Dinitrophenyl)cadaverine	100 mg	175 €	29
D003	1,3-Dimethyl-2-[[2-oxo-propyl]thio]imidazolium chloride	100 mg	500 €	36
D004	1,3-Dimethyl-4,5-diphenyl-2-[[2-oxopropyl]thio]imidazolium	10 mg	550 €	36, 53
D005	Metalloprotease-Assay-Substance, DABCYL-Ser-Phe-EDANS	2 mg	325 €	50
D006	N-(Dansyl)cadaverine	100 mg	175 €	20, 30
D007	Cadaverine	100 mg	75 €	30
D008	"DALP", DNP-amino-hexanoic acid-Lys-aminopropanol	5 mg	350 €	30
D009	"DALP-methyl carbamate"	5 mg	450 €	30
D016	LDN 27219	10 mg	400 €	38
D017	Thrombin-Assay Substance, fluorescent	10 mg	200 €	50
E018	ZediXclusive Tissue Transglutaminase EIA	1 Kit	550 €	24
E021	ZediXclusive Microbial Transglutaminase (MTG) ELISA	1 Kit	425 €	17, 24
E103	ZediXclusive TG6-ab ELISA (IgA)	1 Kit (96 wells)	550 €	59
E104	ZediXclusive TG6-ab ELISA (IgG)	1 Kit (96 wells)	550 €	59
F001	ZediXcite Fluorogenic FXIII-Assay Kit	1 Kit	600 €	24, 53
F004	Fibrinogen, purified from human plasma	50 mg	125 €	31, 54
F006	FITC-labeled Fibrinogen	5 mg	225 €	31, 54
F011	Cross-linked fibrin degradation products, xFDPs	200 µg	300 €	54
F012	Fibrin degradation products, FDPs	200 µg	300 €	54
F014	ZediXcite Fluorogenic TG2-Assay Kit	1 Kit	600 €	24
F015	ZediXcite Fluorogenic MTG-Assay Kit	1 Kit	600 €	24
G001	Alpha2-gliadin, 33mer (aa56-88), biotinylated	5 mg	550 €	60
G002	Deamidated alpha2-gliadin, 33mer (aa56-88), biotinylated	5 mg	550 €	60
G003	Ac-PLQPEQPFPK(ε-Biotin), Deamidated gliadin peptide	10 mg	350 €	60
G004	Ac-PEQLPQFEK(ε-Biotin), Deamidated gliadin peptide	10 mg	350 €	60
G005	DGPx4	250 µg 1 mg	400 € 1200 €	61
G006	DGPx2	250 µg 1 mg	400 € 1200 €	61
G007	DGPx1	250 µg 1 mg	400 € 1200 €	61
G008	Omega-5 gliadin	500 µg	780 €	51
G009	Alpha2-gliadin, 33mer (aa 56-88)	5 mg	550 €	60
G011	Deamidated alpha2-gliadin, 33mer, (Acetyl-aa56-88-amide, Q65E)	5 mg	550 €	60
G013	QPFPPQQLPYPQPQ-amide	10 mg	350 €	60
G014	QPFPPQELPYPQPQ-amide	10 mg	350 €	60
G017	Biotinylated DGPx1	100 µg	400 €	61
G018	Barley albumin and globulin	5 mg	250 €	51
G019	Barley prolamin (Hordein)	5 mg	250 €	51
G020	Barley glutelin (Hordenin)	5 mg	250 €	51
G021	Rye albumin and globulin	5 mg	250 €	51
G022	Rye prolamin (Secalin)	5 mg	250 €	51
G023	Rye glutelin (Secalinin)	5 mg	250 €	51
G024	Corn albumin and globulin	5 mg	250 €	51
G025	Corn prolamin (Zein)	5 mg	250 €	51
G026	Corn glutelin (Zeanin)	5 mg	250 €	51
G027	Rice albumin and globulin	5 mg	250 €	51

Art. No.	Name	Unit	Price	Page
G028	Rice prolamin (Oryzin)	5 mg	250 €	51
G029	Rice glutelin (Oryzenin)	5 mg	250 €	51
G030	Spelt albumin and globulin	5 mg	250 €	51
G031	Spelt prolamin	5 mg	250 €	51
G032	Spelt glutelin	5 mg	250 €	51
G033	Oat albumin and globulin	5 mg	250 €	51
G034	Oat prolamin (Avenin)	5 mg	250 €	51
G035	Oat glutelin (Avenalin)	5 mg	250 €	51
G036	Wheat albumin and globulin (Leukosin and Edestin)	5 mg	250 €	51
G037	Wheat prolamin (Gliadin)	5 mg	250 €	51
G038	Wheat glutelin (Glutenin)	5 mg	250 €	51
G039	Durum wheat albumin and globulin	5 mg	250 €	51
G040	Durum wheat prolamin	5 mg	250 €	51
G041	Durum wheat glutelin	5 mg	250 €	51
G042	Soy protein, saline soluble fraction	5 mg	250 €	51
G043	Soy protein, ethanol soluble fraction	5 mg	250 €	51
G044	Soy protein, propanol/urea/DTE soluble fraction	5 mg	250 €	51
G045	Millet (Sorghum) albumin and globulin	5 mg	250 €	51
G046	Millet (Sorghum) prolamin (Kafirin)	5 mg	250 €	51
G047	Millet (Sorghum) glutelin	5 mg	250 €	51
G051	26mer gliadin peptide	250 µg	400 €	61
G052	33mer gliadin peptide	250 µg	400 €	61
G054	33mer DGP	250 µg	400 €	61
G055	Carrier protein control	250 µg	400 €	61
G056	DGP and Gliadin peptides (Set No 1)	1 Set	780 €	61
G057	Alpha2-gliadin, 33mer (aa56-88), TAMRA labeled	5 mg	600 €	60
G058	Alpha2-gliadin, 33mer (aa56-88), TAMRA and Biotin labeled	5 mg	750 €	60
G101	Gly-Pro-Arg-Pro-amide	25 mg	375 €	54
I001	Involucrine, recombinant human	500 µg	400 €	31
K004	"KxD", Boc-Lys-en-DNS	10 mg	275 €	20, 30
L001	Substrate Finder Kit	1 Kit	390 €	19
L101	Biotin TGase Protein Q-Labeling Kit	1 Kit	550 €	19
L102	PEG1,088 TGase Protein Q-Labeling Kit	1 Kit	550 €	19
L103	PEG5,000 TGase Protein Q-Labeling Kit	1 kit	550 €	19
L104	ATTO-488™ TGase Protein Q-Labeling Kit	1 Kit	610 €	19
L105	ATTO-532™ TGase Protein Q-Labeling Kit	1 Kit	610 €	19
L106	ATTO-550™ TGase Protein Q-Labeling Kit	1 Kit	610 €	19
L107	ATTO-647N™ TGase Protein Q-Labeling Kit	1 Kit	610 €	19
L108	ATTO-700™ TGase Protein Q-Labeling Kit	1 Kit	610 €	19
L201	Biotin TGase Protein K-Labeling Kit	1 Kit	550 €	19
L202	PEG1,088 TGase Protein K-Labeling Kit	1 Kit	550 €	19
L203	PEG5,000 TGase Protein K-Labeling Kit	1 Kit	550 €	19
M001	MTG-ANiTA-Kit	1 Kit	610 €	16, 25
M003	Tissue Transglutaminase Pico-Assay Kit	1 Kit	425 €	25
P003	Prolylendopeptidase from <i>Myxococcus xanthus</i> , recombinant	150 U	400 €	50
P004	PT-Gluten	1 mg 10 mg	250 € 1200 €	31, 51
P009	human Pro-Glu-Plasminogen, recombinant	100 µg	450 €	50, 54
P010	(PEG1,088)amine, monodisperse	10 mg	200 €	20
P011	(PEG5,000)amine, polydisperse	10 mg	200 €	20

Product List

Art. No.	Name	Unit	Price	Page
P012	human Plasmin, recombinant	100 µg	450 €	50, 54
P014	Urokinase	1 mg	400 €	50, 54
P015	Streptokinase (bacterial plasminogen activator)	1 mg	400 €	54
P016	Tissue Plasminogen Activator	100 µg	400 €	50, 54
P111	PEPperCHIP® Pan-Transglutaminase Microarray	1 Chip	475 €	49
P112	PEPperCHIP® Custom Transglutaminase Microarray	1 Chip	895 €	49
P113	PEPperCHIP® Transglutaminase Microarray Service	1 Sample	695 €	49
P115	PEPperCHIP® Incubation Tray 3/1	1 Tray	325 €	49
P116	PEPperCHIP® Staining Kit	1 Kit	95 €	49
P117	PEPperCHIP® Transglutaminase 2 Microarray	1 Chip	475 €	49
P118	PEPperCHIP® Incubation Tray 3/5	1 Tray	325 €	49
P119	MAPIX Analyzer	3-Month License 1-Year License Perpetual License	295 € 745 € 3500 €	49
R001	N-(Tetramethylrhodaminy)cadaverine	10 mg	200 €	20, 30
T001	Recombinant microbial (bacterial) transglutaminase	25 U 1x 250 U 10x 25 U 1x 500 U 20x 25 U	270 € 2140 € 2140 € 3750 € 3750 €	15
T002	Human tissue transglutaminase (TG2)	250 µg 1 mg	400 € 1200 €	6
T004	Plasmin substrate Tosyl-GPKpNA, chromogenic	25 mg	350 €	50
T009	Human keratinocyte transglutaminase (TG1)	150 µg	400 €	5
T010	Recombinant TG2 (<i>E. coli</i>)	250 µg 1 mg	400 € 1200 €	59
T011	Human transglutaminase 7	250 µg	400 €	10
T013	Human epidermal transglutaminase, Dispase activated	200 µg	550 €	9
T016	Microbial (bacterial) Pro-transglutaminase	250 µg	300 €	15
T018	Inactive human tissue transglutaminase	250 µg 1 mg	400 € 1200 €	6
T021	Human neuronal transglutaminase (TG6)	250 µg 1 mg	500 € 1500 €	10, 59
T022	Human tissue transglutaminase (TG2)	250 µg 1 mg	400 € 1200 €	6
T024	Human epidermal transglutaminase (TG3)	200 µg	400 €	9, 59
T027	Human blood coagulation Factor XIII-A ₂ , recombinant	200 µg	400 €	11, 53
T034	Human tissue transglutaminase (TG2)	100 µg	400 €	6
T035	Human keratinocyte transglutaminase (TG1)	150 µg	400 €	5
T036	Transglutaminase Assay Kit, fluorescent, Casein, Dansylcadaverine	1 Kit	300 €	16, 24, 53
T038	Rat tissue transglutaminase	250 µg 1 mg	400 € 1200 €	8
T039	Guinea pig liver transglutaminase, recombinant	10 U	410 €	8
T040	Mouse tissue transglutaminase	250 µg 1 mg	400 € 1200 €	8
T042	Human prostate Transglutaminase (TG4)	100 µg	400 €	9
T050	Human blood coagulation Factor XIII B subunit	200 µg	400 €	11, 53
T051	Open tTG™	250 µg 1 mg	550 € 1650 €	6, 59
T056	Human alpha thrombin, highly active	2x 100 U	200 €	50, 54
T057	Inhibited human epidermal transglutaminase	250 µg	550 €	9
T061	Mouse blood coagulation Factor XIII-A ₂	200 µg	400 €	12
T062	Dog blood coagulation Factor XIII-A ₂	200 µg	400 €	12

Art. No.	Name	Unit	Price	Page
T063	Human blood coagulation Factor XIII-A ₂ , Val34Leu-mutant	200 µg	400 €	11, 53
T064	Inhibited human neuronal transglutaminase	250 µg	685 €	10
T065	Rat blood coagulation Factor XIII-A ₂	200 µg	400 €	12
T066	Pig blood coagulation Factor XIII-A ₂	200 µg	400 €	12
T067	Human tissue transglutaminase (TG2), endotoxin free	250 µg 1 mg	450 € 1350 €	6
T070	Human Factor XIIIa, Thrombin activated	200 µg	550 €	11, 53
T072	Dog tissue transglutaminase	250 µg 1 mg	400 € 1200 €	8
T086	Human Transglutaminase 5	100 µg	400 €	9
T087	Tridegin	200 µg	510 €	36, 53
T092	Human blood coagulation Factor XIII-A ₂	100 µg	450 €	11
T101	1,3,4,5-Tetramethyl-2[(2-oxo-propyl)thio] imidazolium chloride	10 mg	500 €	36, 53
T102	Mouse Open TG2	250 µg 1 mg	550 € 1650 €	8
T106	Biotinylated human tissue transglutaminase (TG2)	100 µg 250 µg	400 € 800 €	6
T108	Cynomolgus tissue transglutaminase	250 µg	550 €	8
T109	Cynomolgus open TG2	100 µg	550 €	8
T114	Blood Coagulation Factor XIII-Microassay Kit, colorimetric	1 Kit	425 €	25
T117	Biotinylated inactive hTG2 (Cys277Ser)	100 µg 250 µg	400 € 800 €	6
T122	Recombinant TG2 (insect cells)	250 µg 1 mg	400 € 1200 €	59
T123	Biotinylated human tissue transglutaminase (TG2)	50 µg	400 €	6
T127	Biotinylated human blood coagulation Factor XIII	50 µg	400 €	11, 53
T134	Open tTG TM	100 µg	550 €	7
T139	Rabbit tissue transglutaminase	250 µg 1 mg	400 € 1200 €	8
T140	Biotinylated human epidermal transglutaminase	100 µg	400 €	9
T141	Biotinylated human neuronal transglutaminase	100 µg	500 €	10
T142	Biotinylated mouse blood coagulation Factor XIII-A ₂	50 µg	400 €	12
T148	Biotinylated human Open tTG TM	50 µg 250 µg	400 € 1600 €	7
T150	Biotinylated mouse open TG2	50 µg 250 µg	400 € 1600 €	8
T152	Rabbit blood coagulation Factor XIII-A ₂	200 µg	400 €	12
T153	Andracon TM – recombinant microbial transglutaminase	25 U 10x 25 U 20x 25 U	370 € 2950 € 5150 €	15
T156	Biotinylated mouse tissue transglutaminase	250 µg 1 mg	550 € 1650 €	8
T159	Pig tissue transglutaminase	250 µg 1 mg	400 € 1200 €	8
T160	Biotinylated cynomolgus tissue transglutaminase	50 µg	400 €	8
T161	Cynomolgus blood coagulation Factor XIII-A ₂	200 µg	400 €	12
T167	Short human tissue transglutaminase, aa 1-475	250 µg	400 €	7
T168	Human tissue transglutaminase, C230A mutant	250 µg 1 mg	400 € 1200 €	7
T169	Human tissue transglutaminase, R580A mutant	250 µg 1 mg	400 € 1200 €	7
T173	Human tissue transglutaminase, R116C mutant	1 mg	1200 €	7

Product List

Art. No.	Name	Unit	Price	Page
T178	Microbial transglutaminase with C-terminal His ₆ -Tag	25 U 10x 25 U 20x 25 U	400 € 3150 € 5550 €	15
T184	Cat tissue transglutaminase	200 µg	400 €	8
T187	Factor XIII activation peptide, recombinant	500 µg	400 €	12
T197	Coagulation factor XIII, recombinant human Factor XIII-A ₂	100 E 250 E	725 € 1450 €	11, 53
T222	Human alpha Thrombin, recombinant	100 NIH Units	200 €	50, 54
T246	Recombinant human tissue transglutaminase (Cys-277-Ser, inactive mutant)	250 µg 1 mg	400 € 1200 €	59
Z004	Z-Gln-Gln-Pro-Leu-OH	25 mg	325 €	26
Z006	Z-DON-Val-Pro-Leu-OMe, "Z-DON"	10 mg	425 €	35
Z009	ZediXclusive Microbial Transglutaminase Assay Kit	1 Kit	390 €	16, 25
Z010	ZediXclusive Tissue Transglutaminase Assay Kit	1 Kit	450 €	25
Z011	Z-(D)-DON-Val-Pro-Leu-OMe	10 mg	450 €	35
Z013	Z-MA-QPL-OMe	10 mg	500 €	37
Z015	Keillor inhibitor AA9	10 mg	400 €	38
Z016	Keillor inhibitor NC9	10 mg	400 €	38
Z017	Keillor inhibitor VA4	10 mg	400 €	38
Z018	Z-Glutamyl-Hydroxamate-Glycine	100 mg	150 €	16
Z020	Thrombin-Generation-Assay Substance, fluorescent	25 mg	200 €	50

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Cover picture: Löwentor (Lions Gate, Darmstadt)

The Löwentor (lions gate) is the entrance to the park Rosenhöhe in Darmstadt. It was built for the 25th anniversary of the artist's colony in 1927 commissioned by Grand Duke Ernst Ludwig.

It is built of six brick double pillars designed by Albin Müller, topped with six lion cast concrete sculptures designed already in 1914 by Bernhard Hoetger. The gates between the pillars are decorated with relief plates made by Darmstadt's artist Hermann Tomada.

Cover picture © Jochen Keute.

