

**Publications of the IBG-1 research group**

**„Bacterial Protein Secretion“**

**Head: Prof. Dr. Roland Freudl**

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----- 2019 -----

Hemmerich, J.; Moch, M.; Jurischka, S.; Wiechert, W.; Freudl, R.; Oldiges, M. (2019) Combinatorial impact of Sec signal peptides from *Bacillus subtilis* and bioprocess conditions on heterologous cutinase secretion by *Corynebacterium glutamicum*. *Biotechnol. Bioeng.* 116, 644-655.  
(<https://doi.org/10.1002/bit.26873>)

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----- 2018 -----

Ulfig, A.; Freudl, R. (2018) The early mature part of bacterial twin-arginine translocation (Tat) precursor proteins contributes to TatBC receptor binding. *J Biol. Chem.* 293, 7281-7299.  
(<https://doi.org/10.1074/jbc.RA118.002576>)

Freudl, R. (2018) Signal peptides for recombinant protein secretion in bacterial expression systems. *Microb. Cell Fact.* 17:52.  
(<https://doi.org/10.1186/s12934-018-0901-3>)

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----- 2017 -----

Kleine, B.; Chattopadhyay, A.; Polen, T.; Pinto, D.; Mascher, T.; Bott, M.; Brocker, M.; Freudl, R. (2017) The three-component system EsrISR regulates a cell envelope stress response in *Corynebacterium glutamicum*. *Mol. Microbiol.* 106, 719-741.  
(<http://dx.doi.org/10.1111/mmi.13839>)

Hauer, R. S.; Freudl, R.; Dittmar, J.; Jakob, M.; Klösgen, R. B. (2017) How to achieve Tat transport with alien TatA. *Sci. Rep.* 7:8808.  
(<http://dx.doi.org/10.1038/s41598-017-08818-w>)

Freudl, R. (2017) Beyond amino acids: Use of the *Corynebacterium glutamicum* cell factory for the secretion of heterologous proteins. *J. Biotechnol.* 258, 101-109.  
(<http://dx.doi.org/10.1016/j.jbiotec.2017.02.023>)

Ulfig, A.; Fröbel, J.; Lausberg, F.; Blümmel, A.-S.; Heide, A. K.; Müller, M.; Freudl, R. (2017) The h-region of twin-arginine signal peptides supports productive binding of bacterial Tat precursor proteins to the TatBC receptor complex. *J. Biol. Chem.* 292, 10865-10882.  
(<http://dx.doi.org/10.1074/jbc.M117.788950>)

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2016

Hemmerich, J.; Rohe, P.; Kleine, B.; Jurischka, S.; Wiechert, W.; Freudl, R.; Oldiges, M. (2016) Use of a Sec signal peptide library from *Bacillus subtilis* for the optimization of cutinase secretion in *Corynebacterium glutamicum*. *Microb. Cell Fact.* 15:208. (<http://dx.doi.org/10.1186/s12934-016-0604-6>)

2015

Oertel, D.; Schmitz, S.; Freudl, R. (2015) A TatABC-type Tat translocase is required for unimpaired aerobic growth of *Corynebacterium glutamicum* ATCC13023. *PLoS ONE* 10(4): e0123413.  
(<http://dx.doi.org/10.1371/journal.pone.0123413>)

Freudl, R. (2015) *Corynebacterium glutamicum* as a platform organism for the secretory production of heterologous proteins. In: *Corynebacterium glutamicum: From Systems Biology to Biotechnological Applications*". Burkovsky, A. (Ed.), Caister Academic Press, pp.161-177.  
(<http://dx.doi.org/10.21775/9781910190050.11>)

2013

Freudl, R. (2013) Leaving home ain't easy: protein export systems in Gram-positive bacteria. *Res. Microbiol.* 164, 664-674. (<http://dx.doi.org/10.1016/j.resmic.2013.03.014>)

Scheele, S.; Oertel, D.; Bongaerts, J.; Evers, S.; Hellmuth, H.; Maurer, K.-H.; Bott, M.; Freudl, R. (2013) Secretory production of an FAD cofactor-containing cytosolic enzyme (sorbitol-xylitol oxidase from *Streptomyces coelicolor*) using the twin-arginine translocation (Tat) pathway of *Corynebacterium glutamicum*. *Microb. Biotechnol.* 6, 202-206.  
(<http://dx.doi.org/10.1111/1751-7915.12005>)

2012

Fröbel, J.; Rose, P.; Lausberg, F.; Blümmel, A.-S.; Freudl, R.; Müller, M. (2012) Transmembrane insertion of twin-arginine signal peptides is driven by TatC and regulated by TatB. *Nat. Commun.* 3:1311. (<http://dx.doi.org/10.1038/ncomms2308>)

Rohe, P.; Venkanna, D.; Kleine, B.; Freudl, R.; Oldiges, M. (2012) An automated workflow for enhancing microbial bioprocess optimization on a novel microbioreactor platform. *Microb. Cell Fact.* 11:144. (<http://dx.doi.org/10.1186/1475-2859-11-144>)

Lausberg, F.; Fleckenstein, S.; Kreutzenbeck, P.; Fröbel, J.; Rose, P.; Müller, M.; Freudl, R. (2012) Genetic evidence for a tight cooperation of TatB and TatC during productive recognition of twin-arginine (Tat) signal peptides in *Escherichia coli*. *PLoS ONE* 7(6): e39867. (<http://dx.doi.org/10.1371/journal.pone.0039867>)

Lausberg, F.; Chattopadhyay, A. R.; Heyer, A.; Eggeling, L.; Freudl, R. (2012) A tetracycline inducible expression vector for *Corynebacterium glutamicum* allowing tightly regulable gene expression. *Plasmid* 68, 142-147. (<http://dx.doi.org/10.1016/j.plasmid.2012.05.001>)

Diao, L.; Dong, Q.; Xu, Z.; Yang, S.; Zhou, J.; Freudl, R. (2012) Functional implementation of the posttranslational SecB-SecA protein targeting pathway in *Bacillus subtilis*. *Appl. Environ. Microbiol.* 78, 651-659. (<http://dx.doi.org/10.1128/AEM.07209-11>)

---

2010

---

Yang, C.; Song, C.; Freudl, R.; Mulchandani, A.; Qiao, C. (2010) Twin-arginine translocation of methyl parathion hydrolase in *Bacillus subtilis*. *Environ. Sci. Technol.* 44, 7607-7612. (<http://dx.doi.org/10.1021/es100860k>)

Caspers, M.; Brockmeier, U.; Degering, C.; Eggert, T.; Freudl, R. (2010) Improvement of Sec-dependent secretion of a heterologous model protein in *Bacillus subtilis* by saturation mutagenesis of the N-domain of the AmyE signal peptide. *Appl. Microbiol. Biotechnol.* 86, 1877-1885. (<http://dx.doi.org/10.1007/s00253-009-2405-x>)

Kouwen, T. R. H. M.; Nielsen, A. K.; Denham, E. L.; Dubois, J.-Y. F.; Dorenbos, R.; Rasmussen, M. D.; Quax, W. J.; Freudl, R.; van Dijl, J. M. (2010) Contributions of the pre- and pro-region of a *Staphylcoccus hyicus* lipase to secretion of a heterologous protein by *Bacillus subtilis*. *Appl. Environ. Microbiol.* 76, 659-669. (<http://dx.doi.org/10.1128/AEM.01671-09>)

Yang, C.; Freudl, R.; Qiao, C.; Mulchandani, A. (2010) Cotranslocation of MPH to the periplasm and OPH to the cell surface of *Escherichia coli* by the Tat pathway and the ice nucleation protein

display system. Appl. Environ. Microbiol. 76, 434-440.  
(<http://dx.doi.org/10.1128/AEM.02162-09>)

---

2009

Yang, C.; Freudl, R.; Qiao, C. (2009) Export of methyl parathion hydrolase to the periplasm by the twin-arginine translocation pathway in *Escherichia coli*. J. Agric. Food Chem. 57, 8901-8905.  
(<http://dx.doi.org/10.1021/jf901739g>)

Matsui, D.; Oikawa, T.; Arakawa, N.; Osumi, S.; Lausberg, F.; Stäbler, N.; Freudl, R.; Eggeling, L. (2009) A periplasmic, pyridoxal-5'-phosphate-dependent amino acid racemase in *Pseudomonas taetrolens*. Appl. Microbiol. Biotechnol. 83, 1045-1054. (<http://dx.doi.org/10.1007/s00253-009-1942-7>)

2008

---

Kouwen, T. R. H. M.; Dubois, J.-Y. F.; Freudl, R.; Quax, W. J.; van Dijl, J. M. (2008) Modulation of thiol-disulfide oxidoreductases for increased production of disulfide-bond containing proteins in *Bacillus subtilis*. Appl. Environ. Microbiol. 74, 7536-7545.  
(<http://dx.doi.org/10.1128/AEM.00894-08>)

Caspers, M.; Freudl, R. (2008) *Corynebacterium glutamicum* possesses two *secA* homologous genes that are essential for viability. Arch. Microbiol. 189, 605-610.  
(<http://dx.doi.org/10.1007/s00203-008-0351-0>)

2007

---

Barrett, C. M.; Freudl, R.; Robinson, C. (2007) Twin arginine translocation (Tat)-dependent export in the apparent absence of TatABC or TatA complexes using modified *Escherichia coli* TatA subunits that substitute for TatB. J. Biol. Chem. 282, 36206-36213.  
(<http://dx.doi.org/10.1074/jbc.M704127200>)

Meissner, D.; Vollstedt, A.; van Dijl, J. M.; Freudl, R. (2007) Comparative analysis of twin-arginine (Tat)-dependent protein secretion of a heterologous model protein (GFP) in three different Gram-positive bacteria. Appl. Microbiol. Biotechnol. 76, 633-642.  
(<http://dx.doi.org/10.1007/s00253-007-0934-8>)

Kreutzenbeck, P.; Kröger, C.; Lausberg, F.; Blaudeck, N.; Sprenger, G. A.; Freudl, R. (2007) *Escherichia coli* twin arginine (Tat) mutant translocases possessing relaxed signal peptide recognition specificities. *J. Biol. Chem.* 282, 7903-7911. (<http://dx.doi.org/10.1074/jbc.M610126200>)

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2006

---

Darmon, E.; Dorenbos, R.; Meens, J.; Freudl, R.; Antelmann, H.; Hecker, M.; Kuipers, O. P.; Bron, S.; Quax, W. J.; Dubois, J.-Y. F.; van Dijl, J. M. (2006) A disulfide bond-containing alkaline phosphatase triggers a BdbC-dependent secretion stress response in *Bacillus subtilis*. *Appl. Environ. Microbiol.* 72, 6876-6885. (<http://dx.doi.org/10.1128/AEM.01176-06>)

Brockmeier, U.; Caspers, M.; Freudl, R.; Jockwer, A.; Noll, T.; Eggert, T. (2006) Systematic screening of all signal peptides from *Bacillus subtilis*: A powerful strategy in optimizing heterologous protein secretion in Gram-positive bacteria. *J. Mol. Biol.* 362, 393-402. (<https://doi.org/10.1016/j.jmb.2006.07.034>)

Thiemann, V.; Saake, B.; Vollstedt, A.; Schäfer, T.; Puls, J.; Bertoldo, C.; Freudl, R.; Antranikian, G. (2006) Heterologous expression and characterization of a novel branching enzyme from the thermoalkaliphilic anaerobic bacterium *Anaerobranca gottschalkii*. *Appl. Microbiol. Biotechnol.* 72, 60-71. (<https://doi.org/10.1007/s00253-005-0248-7>)

---

2005

---

Freudl, R. (2005) *Staphylococcus carnosus* and other Gram-positive bacteria. In: Production of Recombinant Proteins (G.Gellissen, Ed), Wiley-VCH, Weinheim, Germany, pp.67-87. (<https://doi.org/10.1002/3527603670.ch4>)

Blaudeck, N.; Kreutzenbeck, P.; Müller, M.; Sprenger, G. A.; Freudl, R. (2005) Isolation and characterization of bifunctional *Escherichia coli* TatA mutant proteins that allow Tat-dependent protein translocation in the absence of TatB. *J. Biol. Chem.* 280, 3426-3432. (<https://doi.org/10.1074/jbc.M411210200>)

---

2003

---

Sandgathe, A.; Tippe, D.; Dilsen, S.; Meens, J.; Halfar, M.; Weuster-Botz, D.; Freudl, R.; Thömmes, J.; Kula, M.-R. (2003) Production of a human calcitonin precursor with *Staphylococcus carnosus*: secretory expression and single-step recovery by expanded bed adsorption. *Process Biochem.* 38, 1351-1363. ([https://doi.org/10.1016/S0032-9592\(02\)00332-1](https://doi.org/10.1016/S0032-9592(02)00332-1))

Blaudeck, N.; Kreutzenbeck, P.; Freudl, R.; Sprenger, G. A. (2003) Genetic analysis of pathway specificity during posttranslational protein translocation across the *Escherichia coli* plasma membrane. J. Bacteriol. 185, 2811-2819. (<https://doi.org/10.1128/JB.185.9.2811-2819.2003>)

---

2001

van Wely, K. H. M.; Swaving, J.; Freudl, R.; Driessen, A. J. M. (2001) Translocation of proteins across the cell envelope of Gram-positive bacteria. FEMS Microbiol. Rev. 25, 437-454. (<https://doi.org/10.1111/j.1574-6976.2001.tb00586.x>)

Dilsen, S.; Paul, W.; Herforth, D.; Sandgathe, A.; Altenbach-Rehm, J.; Freudl, R.; Wandrey, C.; Weuster-Botz, D. (2001) Evaluation of parallel operated small-scale bubble columns for microbial process development using *Staphylococcus carnosus*. J. Biotechnol. 88, 77-84. ([https://doi.org/10.1016/S0168-1656\(01\)00265-6](https://doi.org/10.1016/S0168-1656(01)00265-6))

Blaudeck, N.; Sprenger, G. A.; Freudl, R.; Wiegert, T. (2001) Specificity of signal peptide recognition in Tat-dependent bacterial protein translocation. J. Bacteriol. 183, 604-610. (<https://doi.org/10.1128/JB.183.2.604-610.2001>)

---

2000

van Wely, K. H. M.; Swaving, J.; Klein, M.; Freudl, R.; Driessen, A. J. M. (2000) The carboxyl terminus of the *Bacillus subtilis* SecA is dispensable for protein secretion and viability. Microbiology (UK) 146, 2573-2581. (<https://doi.org/10.1099/00221287-146-10-2573>)

Dilsen, S.; Paul, W.; Sandgathe, A.; Tippe, D.; Freudl, R.; Thömmes, J.; Kula, M.-R.; Takors, R.; Wandrey, C.; Weuster-Botz, D. (2000) Fed-batch production of recombinant human calcitonin precursor protein using *Staphylococcus carnosus* as an expression-secretion system. Appl. Microbiol. Biotechnol. 54, 361-369. (<https://doi.org/10.1007/s002530000406>)

1999

Bolhuis, A.; Matzen, A.; Hyryläinen, H.-L.; Kontinen, V. P.; Meima, R.; Chapuis, J.; Venema, G.; Bron, S.; Freudl, R.; van Dijl, J. M. (1999) Signal peptide peptidase- and ClpP-like proteins of *Bacillus subtilis* required for efficient translocation and processing of secretory proteins. J. Biol. Chem. 274, 24585-24592. (<https://doi.org/10.1074/jbc.274.35.24585>)

Vrljic, M.; Garg, J.; Bellmann, A.; Wachi, S.; Freudl, R.; Malecki, M. J.; Sahm, H.; Kozina, J.; Eggeling, L.; Saier Jr., M. H. (1999) The LysE superfamily: Topology of the lysine exporter LysE of *Corynebacterium glutamicum*, a paradigm for a novel superfamily of transmembrane solute translocators. *J. Mol. Microbiol. Biotechnol.* 1, 327-336.

Halbig, D.; Wiegert, T.; Blaudeck, N.; Freudl, R.; Sprenger, G. A. (1999) The efficient export of NADP-containing glucose-fructose oxidoreductase to the periplasm of *Zymomonas mobilis* depends both on an intact twin-arginine motif in the signal peptide and on the generation of a structural export signal induced by cofactor binding. *Eur. J. Biochem.* 263, 543-551. (<https://doi.org/10.1046/j.1432-1327.1999.00536.x>)

Halbig, D.; Hou, B.; Freudl, R.; Sprenger, G. A.; Klösgen, R. B. (1999) Bacterial proteins carrying twin-R signal peptides are specifically targeted by the ΔpH-dependent transport machinery of the thylakoid membrane system. *FEBS Lett.* 447, 95-98. ([https://doi.org/10.1016/S0014-5793\(99\)00269-0](https://doi.org/10.1016/S0014-5793(99)00269-0))

Leloup, L.; Driessen, A. J. M.; Freudl, R.; Chambert, R.; Petit-Glatron, M.-F. (1999) Differential dependence of levansucrase and α-amylase secretion on SecA (Div) during the exponential phase of growth of *Bacillus subtilis*. *J. Bacteriol.* 181, 1820-1826. (PMCID:[PMC93580](#))

Herbort, M.; Klein, M.; Manting, E.; Driessen, A. J. M.; Freudl, R. (1999) Temporal expression of the *Bacillus subtilis secA* gene, encoding a central component of the preprotein translocase. *J. Bacteriol.* 181, 493-500. (PMCID:[PMC93403](#))

---

-----1997-----

Meens, J.; Herbort, M.; Klein, M.; Freudl, R. (1997) Use of the pre-pro part of *Staphylococcus hyicus* lipase as a carrier for secretion of *Escherichia coli* outer membrane protein A (OmpA) prevents proteolytic degradation of OmpA by cell associated protease(s) in two different Gram-positive bacteria. *Appl. Environ. Microbiol.* 63, 2814-2820. (PMCID:[PMC168578](#))

---

-----1996-----

Klein, M.; Sprenger, G. A.; Freudl, R. (1996) Cloning, nucleotide sequence, and functional expression of the *Escherichia coli* enolase (*eno*) gene in a temperature-sensitive *eno* mutant strain. *DNA Seq.* 6, 351-355.

---

-----1995-----

Klein, M.; Meens, J.; Freudl, R. (1995) Functional characterization of the *Staphylococcus carnosus* SecA protein in *Escherichia coli* and *Bacillus subtilis* secA mutant strains. FEMS Microbiol.Lett. 131, 271-277. (<https://doi.org/10.1111/j.1574-6968.1995.tb07787.x>)

van der Wolk, J. P. W.; Klose, M.; de Wit, J. G.; den Blaauwen, T.; Freudl, R.; Driessen, A. J. M. (1995) Identification of the magnesium-binding domain of the high-affinity ATP-binding site of the *Bacillus subtilis* and *Escherichia coli* SecA protein. J. Biol. Chem. 270, 18975-18982. (<https://doi.org/10.1074/jbc.270.32.18975>)

---

1994

---

Klein, M.; Hofmann, B.; Klose, M.; Freudl, R. (1994) Isolation and characterization of a *Bacillus subtilis* secA mutant allele conferring resistance to sodium azide. FEMS Microbiol. Lett. 124, 393-398. (<https://doi.org/10.1111/j.1574-6968.1994.tb07314.x>)

van der Wolk, J.; Klose, M.; Freudl, R.; Driessen, A. J. M. (1994) Preprotein binding by ATP-binding site mutants of the *Bacillus subtilis* SecA. In: Biological Membranes: Structure, Biogenesis and Dynamics. Op den Kamp, J. A. F. (ed.), NATO ASI Series, Vol. H82, 237-244.

Meens, J.; Klose, M.; Freudl, R. (1994) The *Staphylococcus carnosus* secE gene: cloning, nucleotide sequence, and functional characterization in *Escherichia coli* secE mutant strains. FEMS Microbiol. Lett. 117, 113-120. (<https://doi.org/10.1111/j.1574-6968.1994.tb06751.x>)

---

1993

---

Meens, J.; Frings, E.; Klose, M.; Freudl, R. (1993) An outer membrane protein (OmpA) of *Escherichia coli* can be translocated across the cytoplasmic membrane of *Bacillus subtilis*. Mol. Microbiol. 9, 847-855. (<https://doi.org/10.1111/j.1365-2958.1993.tb01743.x>)

van der Wolk, J.; Klose, M.; Breukink, E.; Demel, R. A.; de Kruijff, B.; Freudl, R.; Driessen, A. J. M. (1993) Characterization of a *Bacillus subtilis* SecA mutant protein deficient in translocation ATPase and release from the membrane. Mol. Microbiol. 8, 31-42. (<https://doi.org/10.1111/j.1365-2958.1993.tb01200.x>)

Klose, M.; Schimz, K. L.; van der Wolk, J.; Driessen, A. J. M.; Freudl, R. (1993) Lysine-106 of the putative catalytic ATP-binding site of the *Bacillus subtilis* SecA protein is required for

functional complementation of *Escherichia coli* secA mutants in vivo. J. Biol. Chem. 268, 4504-4510.

---

1992

---

Tschauder, S.; Driessen, A. J. M.; Freudl, R. (1992) Cloning and molecular characterization of the secY genes from *Bacillus licheniformis* and *Staphylococcus carnosus*. Comparative analysis of nine members of the SecY family. Mol. Gen. Genet. 235, 147-152.

Freudl, R. (1992) Protein secretion in Gram-positive bacteria. J. Biotechnol. 23, 231-240.

([https://doi.org/10.1016/0168-1656\(92\)90072-H](https://doi.org/10.1016/0168-1656(92)90072-H))

---

1991

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Overhoff-Freundlieb, B.; Freudl, R. (1991) Suppression of an *Escherichia coli* secA<sup>ts</sup> mutant by a gene cloned from *Staphylococcus carnosus*. FEMS Microbiol. Lett. 84, 143-150.  
(<https://doi.org/10.1111/j.1574-6968.1991.tb04587.x>)

Overhoff, B.; Klein, M.; Spies, M.; Freudl, R. (1991) Identification of a gene fragment which codes for the 364 amino-terminal amino acid residues of a SecA homologue from *Bacillus subtilis*: Further evidence for the conservation of the protein export apparatus in Gram-positive and Gram-negative bacteria. Mol. Gen. Genet. 228, 417-423.

---

1983 - 1990

---

Freudl, R.; Klose, M.; Henning, U. (1990) Export and sorting of the *Escherichia coli* outer membrane protein OmpA. J. Bioenerg. Biomembr. 22, 441-449.

Freudl, R. (1989) Insertion of peptides into cell-surface-exposed areas of the *Escherichia coli* OmpA protein does not interfere with export and membrane assembly. Gene 82, 229-236.

Freudl, R.; Schwarz, H.; Degen, M.; Henning, U. (1989) A lower size limit exists for export of fragments of an outer membrane protein (OmpA) of *Escherichia coli* K-12. J. Mol. Biol. 205, 771-775.

Klose, M.; Schwarz, H.; MacIntyre, S.; Freudl, R.; Eschbach, M. L.; Henning, U. (1988) Internal deletions in the gene for an *Escherichia coli* outer membrane protein define an area possibly

important for recognition of the outer membrane by this polypeptide. J. Biol. Chem. 263, 13291-13296.

Freudl, R.; Henning, U. (1988) On the role of the mature part of an *Escherichia coli* outer membrane protein (OmpA) in translocation across the plasma membrane. J. Mol. Biol. 203, 517-519.

Freudl, R.; MacIntyre, S.; Degen, M.; Henning, U. (1988) Alterations to the signal sequence of an outer membrane protein (OmpA) of *Escherichia coli* K12 can promote either the cotranslational or the posttranslational mode of processing. J. Biol. Chem. 263, 344-349.

Freudl, R.; Schwarz, H.; Kramps, S.; Hindennach, I.; Henning, U. (1988) Dihydrofolate reductase (*mouse*) and  $\beta$ -galactosidase (*E. coli*) can be translocated across the plasma membrane of *Escherichia coli*. J. Biol. Chem. 263, 17084-17091.

MacIntyre, S.; Freudl, R.; Eschbach, M. L.; Henning, U. (1988) An artificial hydrophobic sequence functions as either an anchor or a signal sequence at only one of two positions within the *Escherichia coli* outer membrane protein OmpA. J. Biol. Chem. 263, 19053-19059.

MacIntyre, S.; Freudl, R.; Degen, M.; Hindennach, I.; Henning, U. (1987) The signal sequence of an outer membrane protein of *Escherichia coli* K12 can mediate translocation of a not normally secreted protein across the plasma membrane. J. Biol. Chem. 262, 8416-8422.

Freudl, R.; Schwarz, H.; Degen, M.; Henning, U. (1987) The signal sequence suffices to direct export of outer membrane protein OmpA of *Escherichia coli* K12. J. Bacteriol. 169, 66-71.

Freudl, R.; Braun, G.; Honore, N.; Cole, S. T. (1987) Evolution of the enterobacterial *sulA* gene: a component of the SOS system encoding an inhibitor of cell division. Gene 52, 31-40.

Freudl, R.; Schwarz, H.; Stierhof, Y. D.; Gamon, K.; Hindennach, I.; Henning, U. (1986) An outer membrane protein (OmpA) of *Escherichia coli* undergoes a conformational change during export. J. Biol. Chem. 261, 11355-11361.

Freudl, R.; MacIntyre, S.; Degen, M.; Henning, U. (1986) Cell surface exposure of the outer membrane protein OmpA of *Escherichia coli* K12. J. Mol. Biol. 188, 491-494.

Freudl, R.; Schwarz, H.; Klose, M.; Movva, N. R.; Henning, U. (1985) The nature of information required for export and sorting, present within the outer membrane protein OmpA of *Escherichia coli* K12. EMBO J. 4, 3593-3598.

Freudl, R.; Braun, G.; Hindennach, I.; Henning, U. (1985) Lethal mutations in the structural gene of an outer membrane protein (OmpA) of *Escherichia coli* K12. Mol. Gen. Genet. 201, 76-81.

Freudl, R.; Cole, S. T. (1983) Cloning and molecular characterization of the *ompA* gene from *Salmonella typhimurium*. Eur. J. Biochem. 134, 497-502.

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