# Why Sweat Has an Antimicrobial Effect

**JBC Paper: Impact of the DCD 1L Antimicrobial Peptide on Bacterial Membranes / KIT's Physical Measurement Technology Supplies Data for Bioscience**

**The dermcidin peptide produced by human sweat glands acts like an antibiotic on the skin and fights infections. A team of researchers headed by Professor Birgit Schittek of the University of Tübingen, in cooperation with Professor Anne S. Ulrich from KIT, studied how exactly this works. The peptide forms ion channels in the bacterial membrane, which destroy the membrane potential. Today, the team published its results in the Journal of Biological Chemistry, JBC.**

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Human skin does not only represent a physical barrier against impurities, but also possesses a chemical defense system against bacteria, viruses, and fungi. It produces antimicrobial peptides, i.e. short-chain amino acid compounds that control both growth and composition of the healthy skin flora and fight pathogenic microorganisms. Production of such antimicrobial peptides partly takes place permanently for general protection purposes and partly it is stimulated by infections or inflammations.

Dermcidin, the antimicrobial peptide, is produced in the human sweat glands. It is distributed over the skin's surface with the sweat, remains stable in the acid mantle of the skin, and, like a natural broad-spectrum antibiotic, fights many known germs, such as coli bacteria, staphylococci as well as the yeast fungus Candida albicans. In its active form, dermcidin is cleaved into various fragments, including the anionic amphiphilic – fat- and water-loving – peptide DCD 1L.

Several German scientists, among them Professors Birgit Schittek from the Eberhard-Karl University of Tübingen and Anne S. Ulrich from KIT's Institute for Biological Interfaces have studied the antimicrobial activity of DCD 1L in more detail. Based on their research under the DFG Collaborative Research Center 766 "The bacterial cell shell", it is now possible for the first time to generate a molecular model of the antimicrobial effect of an anionic peptide in

human sweat. The results of the Ph. D. project of the first author Maren Paulmann are now published in JBC, the Journal of Biological Chemistry.

The researchers found that DCD 1L is an extraordinarily long anionic peptide adapted ideally to the salty-acid environment of human sweat. By forming ion channels in the bacterial membrane, it destroys the membrane potential and prevents the cell from extracting energy. Formation of ion channels is favored by the trace element zinc ($Zn^{2+}$) that induces a self-organization of DCD 1L when the latter binds to bacterial lipid double layers.

When studying membrane-bound proteins, it is very difficult to consider the lipids of the biomembrane. The researchers therefore used several tricks. Electrophysiological measurements and structural biology methods played an important role in the determination of the peptide effect. Suat Özdirekcan from the Max Planck Institute for Developmental Biology, Tübingen, studied the self-assembly of DCD 1L via the diffusion properties in a membrane-imitating solvent. Mechanical destruction of membranes was confirmed by Maren Paulmann in cooperation with Thomas Arnold and Dirk Linke from the Max Planck Institute based on electrical conductivity of lipid double layers. It was imaged by Annika Kopp and Thomas Gutsmann of the Borstel Research Center by scanning force microscopy.

The molecular structure of DCD 1L and its embedding in membranes was analyzed by Jochen Bürck at Karlsruhe Institute of Technology using the measurement technology of circular dichroism (CD) with UV light. For such applications, a synchrotron CD beamline was installed recently on KIT Campus North, which will further enhance the quality of measurements by an extended spectral range. These and other beamlines at the ANKA synchrotron source are open for use by structural biologists and chemists from all over the world as so-called user facilities.

*Maren Paulmann, Thomas Arnold, Dirk Linke, Suat Özdirekcan, Annika Kopp, Thomas Gutsmann, Hubert Kalbacher, Ines Wanke, Verena J. Schuenemann, Michael Habeck, Jochen Bürck, Anne S. Ulrich, Birgit Schittek: Structure-activity analysis of the dermcidin-derived peptide DCD-1L, an anionic antimicrobial peptide present in human sweat. JBC, The Journal of Biological Chemistry, March 9, 2012.* http://www.jbc.org/cgi/doi/10.1074/jbc.M111.332270

Portal of the working group of Professor Anne Ulrich
http://www.ibg.kit.edu/nmr/260.php

More information on CD measurements at the ANKA synchrotron source
http://www.kit.edu/besuchen/pi_2010_3950.php
http://ankaweb.fzk.de/website.php?page=instrumentation_beam&id=21

Portal of the working group of Professor Birgit Schittek, Tübingen
http://www.dermonko.de/arbeitsbereiche/forschung/ag-natuerliche-immunitaet-haut.html

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