

Biofilme und Elektromagnetismus, Quorum sensing, Fröhlich waves, Inter-kingdom communication, Biofilme und Ultraschall, Anti Biofilm Medikamente

Biofilms and electromagnetism, quorum sensing, Frohlich waves, inter-kingdom communication, biofilms and ultrasound, anti-biofilm drugs

Biofilme <http://www.erlebnishaft.de/kommentbiofilmmed.pdf> <http://www.erlebnishaft.de/biofilmmed.pdf> sind deutlich **antibiotika-resistent**, ganz im Gegensatz zu ihren **frei lebenden planktonischen Varianten**.

Quorum sensing ist die Individualsprache der einzelnen artverwandten Bakterien und das Gruppen-Esperanto der Biofilme. <http://www.erlebnishaft.de/kommentbiofilmmed.pdf>. Ursprünglich ist Quorum sensing die Fähigkeit von Bakterien ihre Befalls-Dichte im Wirtsorganismus über **chemische Boten-Stoffe** (Laktame) zu messen.

„**Quorum sensing - Inhibitoren** modifizieren die Wirkung der Chemotherapie weil sie Acyl-homoserin Lacton-Synthase und andere Botenstoffen blockieren, z.B. ändern sie die zyklisch-di-GMP was über Efflux und Diffusion zu Veränderungen in der Zellkommunikation führt, z.B. bei Biofilmen, bei deren Schwarmverhalten, deren Qualität der Effluxpumpen Systeme, PMF, und der Zell-Adhäsion und Kohäsion, etc. " Quelle: Molnar J (2014) Universität Szeged

Biofilme verhalten sich wie organisierte Lebewesen. Sie leben in Rhythmen und Zyklen und in Abhängigkeit von ihrem Milieu. Biofilme sind mechanisch, elektrisch, physikalisch und chemisch therapierbar.

Biofilms <http://www.erlebnishaft.de/biofilmmed.pdf> are relatively **resistant to antibiotics**, in contrast to their **free-living planktonic variants**.

Quorum sensing is the language of each individual congeners and the group Esperanto of biofilms. <http://www.erlebnishaft.de/kommentbiofilmmed.pdf>. Originally quorum sensing is the ability of bacteria to measure their infestation density in the host organism by **chemical messenger substances** (lactams).

„**Quorum sensing inhibitors** are able to modify the effect of chemotherapy through blocking acyl-homoserin lactone synthase, other mediators, or second messenger e.g. cyclic-di-GMP resulting in changes in active efflux or diffusion, changes in cell to cell signal transport, secretion of biofilm, swarming, efflux pump systems, PMF, cell adhesion, cohesion etc.“ Source: Molnar J (2014) [University of Szeged](http://www.university-of-szeged.hu/)

Biofilms behave as organized beings. They live in rhythms and cycles and they are dependent on their environment. Biofilms are mechanically, electrically, physically and chemically treated.

➔ **Bakterien stabilisieren, entwaffnen** http://www.kabilahsystems.de/bakt-stabilis_entwaff.pdf

Im Bose-Einstein Kondensat sind Bosonen vollständig **delokalisiert**. Bosonen vermitteln die Kräfte in der Materie. Die Wahrscheinlichkeit jedes Bosons, es an einem bestimmten Punkt anzutreffen, ist innerhalb des Kondensates überall gleich. Das Bose-Einstein Kondensat ist ein Quantenobjekt. Sein Zustand kann deshalb durch **eine einzige Wellenfunktion** beschrieben werden ([Resonanz-Theorie](#), [Helmholtz Resonanz-Theorie](#)).

Bei Abständen von unter 80 Nanometer geht die reale Welt ganz allmählich in die quanten-elektrodynamische über.

In the Bose-Einstein condensate bosons are completely **delocalized**. Bosons mediate the forces in matter. The probability of any boson to meet it at a given point is the same everywhere within the condensate. The Bose-Einstein condensate is a quantum object. His condition can therefore be described by **a single wave function**.

At distances of less than 80 nanometers in the real world is changing gradually into the quantum - elektrodynamische world.

➔ **Selbstorganisation, selforganization** http://www.erlebnishaft.de/selbst_muster_nano.pdf

Krankheits-Rezidive folgen dem Verhulstischen Wachstumsgesetz:

Verhulst P-F (1838) Notice sur la loi que la population suit dans son accroissement. In: Correspondance Mathématique et Physique, Tome X, 3-21.

Pierre-François Verhulst P-F (1845) Recherches mathématiques sur la loi d'accroissement de la population. In: Nouveaux Mémoires de l'Académie Royale des Sciences et Belles-Lettres de Bruxelles, Tome XVIII, 5-38.

http://gymportalen.dk/sites/lru.dk/files/lru/124_kap6_verhulst_artikel_1844.pdf

Cramer F (1998) Symphonie des Lebendigen. Versuch einer allgemeinen Resonanztheorie. Insel Taschenbuch. Seite 164 ff.

<http://www.amazon.de/Symphonie-Lebendigen-Versuch-allgemeinen-Resonanztheorie/dp/3458338888>

König HL (1977) **Unsichtbare Umwelt**. Der Mensch im Spielfeld elektromagnetischer Kräfte. Eigenverlag Herbert König, München

International Commission on Non-Ionizing Radiation Protection (1998) **ICNIRP GUIDELINES** for Limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 BHz). Health Physics 74(4), 494-522 <http://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf>
<http://www.icnirp.org/>

Bundesamt für Umwelt BAFU Thema Elektromog. (2015)

<http://www.bafu.admin.ch/elektromog/index.html?lang=de>

Biofilme und Elektromagnetismus

Dineur E. (1891) Note sur la sensibilities des leukocytes a l'**electricite**. Bulletin Seances Soc Belge Microscopic (Bruxelles) 18, 113-8.

Livshits MA (1917) vozmozhnosti Boze koodensatsii v biologicheskikh sistemakh (**Possible Bose condensation in biological systems**). Biofizika SSSR 22, 744-6

Moskalenko SA, Pokatilov EP, Miglei MF & Kiselyova ES (1919) **Bose condensation of phonons in biological systems**. Int. J. Quantum Chem. 16, 745-52

Monguio J (1933) Über die polare Wirkung des **galvanischen Stromes** auf Leukozyten. Z Biol 93, 553-9.

Fukushima K, Senda N, Inui H et al. (1953) Studies of **galvanotaxis** of leukocytes. Med J Osaka Univ 4(2-3), 195-208.

Fröhlich H (1968) **Bose condensation of strongly excited longitudinal electric modes**. Phys. Lett.26A, 402-403 <http://www.sciencedirect.com/science/article/pii/0375960168902429>

Frohlich H (1968) **Long Range Coherence and Energy Storage in Biological Systems**. Int. J. Quantum Chem. v.II, 641-649 <http://garfield.library.upenn.edu/classics1988/A1988N102700001.pdf>

Fröhlich H (1970) **Long range coherence and the action of enzymes**. Nature 228, 1093

Hans Selye (1974) **Stress**. Bewältigung und Lebensgewinn. Aus dem Englischen von Hans Th. Asbeck. Piper, München / Zürich [ISBN 3-492-02086-0](https://www.piper.com/de/ISBN-3-492-02086-0).

Babchin AJ, Piliavin AM, Levich VG (1976) **Rheoelectric Effect in a Polar Liquid Interphase Layer**. Journal of Colloid Interface Science 57(1), 1-10

Fröhlich H. (1980) **The biological effects of microwaves and related questions.** Adv. Electron. Phys. 53, 85-152

von Uexküll Th (1981) **Lehrbuch der psychosomatischen Medizin.** Urban und Schwarzenberg München-Wien-Baltimore. ISBN 3-541-08842-7

Del Giudice, Doglia, Milani (1982) **Self-Focusing of Frohlich waves and cytoskeleton dynamics.** Physics Letters 90A 104-106

Pokorný J (1982) **Multiple Fröhlich coherent states in biological systems:** Computer simulation. J. Theoretical Biology 98(1), 21-27

Hasted JB (1985) The biomolecular effects of electromagnetic radiation. Classical or quantum physics? J. Bioelectromagnetics 4, 367-87

Fröhlich H. (1986) **Coherent excitation in active biological systems.** Modern Bioelectrochemistry (Gutman F, Keyzer H eds.) Plenum Press, New York 241-261

Fröhlich H. (1988) Biological coherence and response to external stimuli. Springer, Berlin.

Mascarenhas S (1987) Bioelectrets: electrets in biomaterials and biopolymers. Top. Appl. Phys. 33, 321-46

Tsong T (1989) **Deciphering the language of cells.** Trends Biochem. Sci. 14, 89-92
<https://www.ncbi.nlm.nih.gov/pubmed/2728105>

Pokorný J, Fiala J (1994) **Condensed energy and interaction energy in Fröhlich Systems.** Neural Network World 4, 29-313

Jibu M, Yasue K (1995) **Quantum Brain Dynamics and Consciousness: An Introduction.**
http://books.google.de/books?id=wocfir1GyfYC&pg=PA149&jpg=PA149&dq=Fr%C3%B6hlich+waves&source=bl&ots=j2DJh8MOVm&sig=rDh7J9uQGFYOzU3Gf03_HJmQ72s&hl=de&sa=X&ei=NDUDUp2qDoTJPYvlgfGh&ved=0CE4Q6AEwAw#v=onepage&q=Fr%C3%B6hlich%20waves&f=false

Hölzel R, Lamprecht I (1995) **Optimizing an electronic detection system for radiofrequency oscillations in biological cells.**
https://www.researchgate.net/publication/296953476_Optimizing_an_electronic_detection_system_for_radiofrequency_oscillations_in_biological_cells

Costerton B, Dirckx P (1996) Antibiotic effectiveness has been shown to increase in the presence of even a **weak, intermittent electrical field.**
<http://repositorio-aberto.up.pt/bitstream/10216/11306/2/Texto%20integral.pdf>

Pokorný J, Jelínek F, Trkal V, Lamprecht I, Hölzel R (1997) **Vibrations in Microtubules.** J. Biol. Phys. 23, 171-179.

Ochs CA, Eddy LP (1998) **Effects of UV-A (320 to 399 Nanometers) on Grazing Pressure of a Marine Heterotrophic Nanoflagellate on Strains of the Unicellular Cyanobacteria Synechococcus spp.** Appl Environ Microbiol. 64(1), 287-293. PMID: PMC124707
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC124707/>

Pokorný J, Jelínek F, Trkal V (1998) **Electric field around microtubules.** Bioelectrochem. Bioenerg. 45, 239-245.

Pokorný J., Wu T.-M. (1998) Biophysical Aspects of **Coherence and Biological Order.** Academia, Prague, Springer, Berlin (240 pages)

Issels R (1999) **Hyperthermia** combined with chemotherapy – biological rationale, clinical application, and treatment results. Onkologie. 22, 374-381

Klein E, Kreinin I, Chistyakov A et al. (1999) Therapeutic efficacy of right prefrontal slow repetitive **transcranial magnetic stimulation** in major depression. A double-blind controlled study. Arch Gen Psychiatry. 56, 315-320

Pokorný J, Jelínek F, Trkal V, Šrobár F (1999) **Vibration in Microtubules**. Electricity and Magnetism in Biology and Medicine, Bersani F., Ed., Kluwer Acad./Plenum Publishers 967-970.

Pokorný J (1999) **Conditions for coherent vibrations in the cytoskeleton**. Bioelectrochem. Bioenerg. 48, 267-271.

Tuszynski JA, Brown JA (2000) Models of Dielectric and Conduction Properties of Microtubules. In Abstract Book, pp. 3-4, Int. Symp. **Electromagnetic Aspects of Selforganization in Biology**, Prague, Czech Republic, July 9-12, 2000.

Pokorny J, HaSek J, Jelínek F et al. (2000) **Electromagnetic Field Generated by Microtubules**. Workshop Risk Assessment of Electromagnetic Pollution from Mobile Phone Networks, Int. School of Plasma Phys., Varenna, Italy, May 10

Borovikova LV, Ivanova S, Zhang M, Yang H, Botchkina GI, Watkins LR, Wang H, Abumrad N, Eaton JW, Tracey KJ (2000) **Vagus nerve stimulation** attenuates the systemic inflammatory response to endotoxin. Nature. 405(6785), 458-62. PubMed PMID: 10839541.

<http://www.ncbi.nlm.nih.gov/pubmed/10839541>

„Direct electrical stimulation of the peripheral vagus nerve in vivo during lethal endotoxaemia in rats inhibited TNF synthesis in liver, attenuated peak serum TNF amounts, and prevented the development of shock.“

Hossfeld DK et al (2000) Ganzkörper-Hyperthermie in Kombination mit Chemotherapie; Dt Ärztebl. 97, A 2941–2946 [Heft 44]

Schmidl G (2001) **Experimental Evidence for the Fröhlich Hypothesis**.

<http://www.fourcoffees.com/project/evidence.html> <http://www.fourcoffees.com/project/files/evidence.pdf>

“Fröhlich's Hypothesis will have to remain a hypothesis for the time being”. „Die Fröhlich Hypothese muss eine Hypothese bleiben, vorerst“.

Jelínek F, Pokorný J (2001) **Microtubules** in Biological Cells as Circular Waveguides and Resonators Electro- and Magnetobiology 20, 75-80.

Pokorný J (2001) **Endogenous Electromagnetic Forces in Living Cells**: Implications for Transfer of Reaction Components. Electro- and Magnetobiology 20, 59-73.

Pokorný J (2003) **Viscous Effects on Polar Vibrations in Microtubules**. Electromag. Biol. Med.22, 15-29. <http://ursiweb.intec.ugent.be/Proceedings/ProcGA02/papers/p0880.pdf>

[Pickering SA](#), [Bayston R](#), [Scammell BE](#) (2003) **Electromagnetic augmentation of antibiotic efficacy in infection of orthopaedic implants**. J Bone Joint Surg Br. 85(4), 588-93.

<https://www.ncbi.nlm.nih.gov/pubmed/12793569>

Pokorný J, Hašek J, Jelínek F (2004) **TRANSPORT OF MOLECULES AND ELECTRONS BY ELECTRIC FIELD IN BIOLOGICAL SYSTEMS**.

<http://www.ursi.org/Proceedings/ProcGA05/pdf/K01.4%2801665%29.pdf>

Caubet R, Pendarros-Caubet F, Chu M et al. (2004) A **Radio Frequency Electric Current** Enhances Antibiotic Efficacy against Bacterial Biofilms. Antimicrob Agents Chemother. 48(12), 4662–4664. doi: [10.1128/AAC.48.12.4662-4664.2004](https://doi.org/10.1128/AAC.48.12.4662-4664.2004) <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC529182/>

Pokorný, J (2004) Excitation of vibration in **microtubules** in living cells. Bioelectrochem. 63, 321-326.

Pokorný J, Hašek J, Jelínek F (2005) Electromagnetic Field of **Microtubules**: Effects on Transfer of Mass Particles and Electrons. J. Biol. Phys. 312, 501-514.

Pokorný J, Hašek J, Jelínek F (2005) **Endogenous Electric Field and Organization of Living Matter**. Electromag. Biol. Med. 24, 185-197.

Costerton B., Dirckx P. (2005) Antibiotic effectiveness is increased in the presence of even a **weak, intermittent electrical field**. The Center for Biofilm Engineering, Montana State University, Bozeman. Available from: <http://www.erc.montana.edu>

McLeod B., Dirckx P. (2005) The combination of **electricity plus antibiotic** is more effective against biofilm cells than either is alone. The Center for Biofilm Engineering, Montana State University, Bozeman. Available from: <http://www.erc.montana.edu>

INTERNATIONAL COMMISSION ON NON-IONIZING RADIATION PROTECTION (2006) ICNIRP STATEMENT ON **FAR INFRARED RADIATION EXPOSURE**. HEALTH PHYSICS 91(6), 630-645
<http://www.icnirp.de/documents/infrared.pdf>

[Nuccitelli R](#), [Pliquett U](#), [Chen X](#), et al. (2006) **Nanosecond pulsed electric fields cause melanomas to self-destruct**. *Biochem Biophys Res Commun.* 343(2), 351–360. doi: [10.1016/j.bbrc.2006.02.181](https://doi.org/10.1016/j.bbrc.2006.02.181)
PMCID: PMC1513546 NIHMSID: NIHMS11129
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1513546/>

Jacobi C (2006) **Eine Sammlung der Fröhlich Original-Publikationen**:
<http://www.uni-leipzig.de/~jacobi/GW-CODE/GW-CODE-Publications.pdf>

Pokorný J (2006) Role of **Fröhlich Coherent States** in Cancer Transformation of Cells. Fröhlich Centenary Symposium Herbert Fröhlich FRS, A physicist ahead of his time. Hyland G.J., Rowlands P., Eds., The University of Liverpool, 177-207.

Daeschlein G, Assadian O, Kloth LC et al. (2007) Antibacterial activity of positive and negative polarity **low-voltage pulsed current** (LVPC) on six typical Gram-positive and Gram-negative bacterial pathogens of chronic wounds. *Wound Rep and Reg* 15, 399-403.

Wound EL **wound pacemaker®** (2008) Von der Grundlagenforschung zur therapeutischen Anwendung. http://www.gerromed.de/pages/produkte/Prod_WoundEL/Wiss_Info_weboptimiert.pdf

Pokorný J, Hašek J, Vaniš J, Jelínek F (2008) Biophysical Aspects of **Cancer**: Electromagnetic Mechanism. *Ind. J. Exper. Biol.* 46, 310-321.

Borchard-Tuch C (2008) Mit **Hightech-Wärme** gegen Krebs, *Pharm. Ztg.*, 153. Jahrgang.

Peer AJ et al (2009) Diverse immune mechanisms may contribute to the survival benefit seen in cancer patients receiving **hyperthermia**. *Immunol Res.* Sep 15

Jandová A, Pokorný J, Kobilková J, Janoušek M, Mašata J, Trojan S, Nedbalová M, Dohnalová A, Beková A, Slavík V, Čoček A, Sanitrák J (2009) Cell-Mediated Immunity in **Cervical Cancer** Evolution. *Electromag. Biol. Med.* 28, 1-14.

Pokorný J (2009) Biophysical **Cancer** Transformation Pathway. *Electromag. Biol. Med.* 28, 105-123.

Pokorný J (2009) **Fröhlich's Coherent Vibrations** in Healthy and Cancer Cells. *Neural Net. World* 19, 369-378.

McLeod BR, Sandvik EL (2010) [A biofilm growth protocol and the design of a magnetic field exposure setup to be used in the study of magnetic fields as a means of controlling bacterial biofilms](#)
Bioelectromagnetics, 31(1), 56-63.

Welch V, Brosseau L, Casimiro L, Judd M, Shea B, Tugwell P, Wells GA (2011) Cochrane summaries beta independent high-quality evidence for health care decision making. **Thermotherapy** (heat treatment) for treating rheumatoid arthritis. Published Online
<http://summaries.cochrane.org/CD002826/thermotherapy-heat-treatment-for-treating-rheumatoid-arthritis>

DelGuidice E. (2011) **Video** <http://www.quantica.de/video.php?Video=2103&Teil=01&Sprache=DEU>

[Guloksuz S](#), [Rutten BP](#), [Arts B](#), [van Os J](#), [Kenis G](#). (2014) **The immune system and electroconvulsive therapy for depression.** *J ECT*. 30(2), 132-7. doi: 10.1097/YCT.000000000000127. <http://www.ncbi.nlm.nih.gov/pubmed/24755720>
„To elucidate the possible role of immunological changes mediating the effect of ECT, more prospective controlled studies with larger sample sizes are required.“

- ➔ [DGHT –Deutsche Gesellschaft für Hyperthermie](#), Homepage
- ➔ **Nullquantum** <http://www.grin.com/de/e-book/80450/nullquantum-zahlensymbolik-und-struktur>
- ➔ **Quantenkohärenz** <http://nonlocal.com/hbar/bibliography.html#ho1993>
<http://nonlocal.com/hbar/terms.html> <http://nonlocal.com/hbar/frohlich.html>
<http://nonlocal.com/hbar/coherence.html>
- ➔ **Das Phanes Sound Theorem; Lebendigkeit, Selbstorganisation, Morphogenese, der 5. Hauptsatz der Thermodynamik** <http://www.grin.com/de/e-book/71284/lebendigkeit-selbstorganisation-morphogenese-5-hauptsatz-der-thermodynamik>

Inter-kingdom communication

Quorum sensing

Surette MG, Miller MB Bassler BL (1999) Quorum Sensing in Escherichia coli, Salmonella typhimurium, and Vibrio harveyi: A New Family of Genes Responsible for Autoinducer Production. Proceedings of the National Academy of Sciences of the United States of America, 96, 1639-1644. <http://dx.doi.org/10.1073/pnas.96.4.1639>

Hastings JW, Greenberg EP (1999) "Quorum Sensing: The explanation of a curious phenomenon reveals a common characteristic of bacteria". *J. Bacteriol* 181, 2667–2668.

[de Kievit TR](#), [Iglewski BH](#) (2000) **Bacterial quorum sensing in pathogenic relationships.** *Infect Immun*. 68(9), 839-49. <http://iai.asm.org/content/68/9/4839.full.pdf+html>

Stevenson B, von Lackum K, Wattier RL et al., (2003) **Quorum sensing by the Lyme disease spirochete.** *Microbes Infect* 5, 991–7.

[Hentzer M](#), [Givskov M](#) (2003) **Pharmacological inhibition of quorum sensing for the treatment of chronic bacterial infections.** *J Clin Invest*. 112(9), 1300–1307. doi: [10.1172/JCI200320074](https://doi.org/10.1172/JCI200320074) PMID: PMC228474 <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC228474/>

[Raffa RB](#), [Iannuzzo JR](#), [Levine DR](#) et al. (2005) **Bacterial communication ("quorum sensing") via ligands and receptors: a novel pharmacologic target for the design of antibiotic drugs.** *J Pharmacol Exp Ther*. 312(2), 417-23. Epub 2004 Nov 4. <http://www.ncbi.nlm.nih.gov/pubmed/15528454> <http://jpet.aspetjournals.org/content/312/2/417.full>
<http://jpet.aspetjournals.org/content/312/2/417.full.pdf+html>

Nealson KH, Hastings JW (2006) Quorum sensing on a global scale: massive numbers of bioluminescent bacteria make milky seas. *Appl. Env. Microbiol*. 72, 2295-2297.

[Weber W](#), [Fussenegger M](#) (2011) **Design of synthetic mammalian quorum-sensing systems.** *Methods in molecular biology* (Clifton, N.J.)

[Yang L](#), [Liu Y](#), [Wu H](#), [Song Z](#), [Høiby N](#), [Molin S](#), [Givskov M](#). (2012) **Combating biofilms.** *FEMS Immunol Med Microbiol*. 65(2), 146-57. doi: 10.1111/j.1574-695X.2011.00858.x. <http://www.ncbi.nlm.nih.gov/pubmed/22066868>

[Albuquerque P, Casadevall A \(2012\) Quorum sensing in fungi--a review.](#) Medical mycology : official publication of the International Society for Human and Animal Mycology. 50, 337-345
<http://www.ncbi.nlm.nih.gov/pubmed/22268493>

[Rutherford ST, Bassler BL \(2012\) Bacterial quorum sensing: its role in virulence and possibilities for its control.](#) Cold Spring Harb Perspect Med., 2, Article ID: a012427

[Høyland-Kroghsbo NM, Maerkedahl RB, Svenningsen SL \(2013\) A quorum-sensing-induced bacteriophage defense mechanism.](#) mBio

[Parashar V, Jeffrey PD, Neiditch MB \(2013\) Conformational change-induced repeat domain expansion regulates Rap phosphatase quorum-sensing signal receptors.](#) PLoS biology

[Karavolos MH, Winzer K, Williams P, Khan CM. \(2013\) Pathogen espionage: multiple bacterial adrenergic sensors eavesdrop on host communication systems.](#) Mol Microbiol. 87(3), 455-65. doi: 10.1111/mmi.12110. Epub 2012 Dec 11. <http://www.ncbi.nlm.nih.gov/pubmed/23231070>

“The interactions between bacterial pathogens and their eukaryotic hosts are vital in determining the outcome of infections. Bacterial pathogens employ molecular sensors to detect and facilitate adaptation to changes in their niche. The sensing of these extracellular signals enables the pathogen to navigate within mammalian hosts. Intercellular bacterial communication is facilitated by the production and sensing of autoinducer (AI) molecules via quorum sensing. More recently, AI-3 and the host neuroendocrine (NE) hormones adrenaline and noradrenaline were reported to display cross-talk for the activation of the same signalling pathways. Remarkably, there is increasing evidence to suggest that enteric bacteria sense and respond to the host NE stress hormones adrenaline and noradrenaline to modulate virulence. These responses can be inhibited by α and β -adrenergic receptor antagonists implying a bacterial receptor-based sensing and signalling cascade. ... Here we provide additional hypotheses to reconcile these observations implicating the existence of alternative adrenergic receptors including BasS, QseE and CpxA and their associated signalling cascades with major roles in interkingdom communication.”

[Schaller J, Mountjoy K \(2014\) Combating Biofilms: Why Your Antibiotics and Antifungals Fail: Solutions for Lyme Disease, Chronic Sinusitis, Pneumonia, Yeast Infections, Wounds, Ear ... Bad Breath, Cystic Fibrosis and Implants](#) Paperback – April 11, 2014

<http://www.amazon.com/Combating-Biofilms-Antibiotics-Antifungals-Infections/dp/0991142683>

Thompson JA et al. (2015) **Manipulation of the quorum-sensing signal AI-2 affects the antibiotic-treated gut microbiota.** Cell Reports, doi:10.1016/j.celrep.2015.02.049.

<http://www.cell.com/cell-reports/pdf/S2211-1247%2815%2900207-7.pdf>

<http://www.cell.com/article/S2211-1247%2815%2900207-7/abstract>

Biofilme und Ultraschall, Biofilms and ultrasound

[Qian Z, Stoodley P, Pitt WG. \(1996\) Effect of low-intensity ultrasound upon biofilm structure from confocal scanning laser microscopy observation.](#) Biomaterials. 17(20), 1975-80.

<https://www.ncbi.nlm.nih.gov/pubmed/8894091>

Kashef N, Nejad QB, Dlizaji MM, Tari MS (2005) Synergism between 1-Megahertz therapeutic **ultrasound** plus Ceftacide on growth of pseudomonas aeruginosa. Medical J Durnal of the Islamic Republic of Iran 19(3), 1384 http://mjiri.tums.ac.ir/browse.php?a_id=583&slc_lang=en&sid=1&ftxt=1

Zadik Hazan, Jona Zumeris et al. (2006) Effective prevention of microbial biofilm formation on medical devices by **low-energy surface acoustic waves**. In: Antimicrobial agents and chemotherapy. Bd. 50, Nr. 12, 2006, [ISSN 0066-4804](#), [PMID 16940055](#), [doi:10.1128/AAC.00418-06](#), S. 4144–4152

Bayles KW, Zadik H, Jona Z et al. (2007) Effective prevention of microbial biofilm formation on medical devices by **low-energy surface acoustic waves**. In: Antimicrobial agents and chemotherapy. Opinion: The biological role of death and lysis in biofilm development. Nature Reviews Microbiology 5, 721-726 doi:10.1038/nrmicro1743

Zakharenko AA (2013) Peculiarities Study of **Acoustic Waves Propagation in piezoelectromagnetic (Composite) Materials**. Canadian Journal of pure & applied Sciences 7(2), 2459-2461
http://www.researchgate.net/publication/230757681_Analytical_Investigation_of_Surface_Wave_Characteristics_of_Piezoelectromagnetics_of_Class_6_mm

➔ **Infraschall, infrasound** <http://www.erlebnishaft.de/infrasound.pdf>

Antibiofilm – Medikamente, Anti-biofilm drugs

Gilbert, P., Collier, P J., Brown, M. R. (1990) Influence of growth rate on susceptibility to **antimicrobial agents: biofilms, cell cycle, dormancy, and stringent response**. Antimicrob. Agents Chemother. 34, 1865–1868

Agosta WC. (1994) Dialog der Düfte. Chemische Kommunikation. Heidelberg. Spektrum Akademischer Verlag

Olson ME, Ceri H, Morck DW, Buret AG, Read RR (2002) **Biofilm bacteria: formation and comparative susceptibility to antibiotics**. Can. J. Vet. Res. 66, 86–92.
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC226988/>

Hentzer M, Givskov M (2003) **Pharmacological inhibition of quorum sensing for the treatment of chronic bacterial infections**. The J Clin Investigation 112, 1300-1307

Costerton W, Veeh R, Shirtliff M, Pasmore M, Post C, Ehrlich G. (2003) The application of biofilm science to the study and **control of chronic bacterial infections**. J. Clin. Invest. 112: 1466–1477.

[Rasmussen](#) TB, [Bjarnsholt](#) T, [Skindersoe](#) ME et al. (2005) **Screening for Quorum-Sensing Inhibitors (QSI) by Use of a Novel Genetic System, the QSI Selector**. J Bacteriol. Mar 187(5), 1799–1814. doi: [10.1128/JB.187.5.1799-1814.2005](https://doi.org/10.1128/JB.187.5.1799-1814.2005) PMID: PMC1063990
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1063990/>

Ge T, Sun Z, Fu S, Liang G (2005). Cloning of thrombolytic enzyme (**lumbrokinase**) from earthworm and its expression in the yeast. Protein Expression and Purification 42 (1), 20.
[doi:10.1016/j.pep.2005.04.005](https://doi.org/10.1016/j.pep.2005.04.005)

Pace JL, Rupp ME, Finch RG. (2006) Biofilms, Infection and **Antimicrobial Therapy**. CRC Press. (Can be partially viewed on books.google.com)

Alkawash MA, Soothill JS, Schiller NL. (2006) **Alginate lyase** enhances antibiotic killing of mucoid *Pseudomonas aeruginosa* in biofilms. APMIS_ 114(2), 131-8.

Musk DJ Jr., Hergenrother PJ (2006) Chemical Countermeasures for the **Control of Bacterial Biofilms**: Effective Compounds and Promising Targets. Current Medicinal Chemistry, 2006, 13, 2163-2177 http://www.scs.illinois.edu/~phgroup/pdfs/ref37_CurrMedChem_Musk_PDFReprint.pdf

Rasmussen TB, Givskov M. (2006) **Quorum-sensing inhibitors as anti-pathogenic drugs**. [Int J Med Microbiol.](#) 6(2-3), 149-61. <http://www.ncbi.nlm.nih.gov/pubmed/16503194>

Bayles KW. (2007) Opinion: The biological role of death and lysis in biofilm development. Nature Reviews Microbiology 5, 721-726 doi:10.1038/nrmicro1743

Bjarnsholt T, Givskov M (2007) **Quorum-sensing blockade** as a strategy for enhancing host defences against bacterial pathogens. Philos Trans R Soc Lond B Biol Sci 362: 1213–1222. [this article online](#)

Trautner BW, Hull RA et al. (2007) Coating urinary catheters with an **avirulent strain of Escherichia coli** as a means to establish asymptomatic colonization. In: Infection control and hospital epidemiology. Bd. 28, Nr. 1, [ISSN 0899-823X](#), [PMID 17230395](#), [doi:10.1086/510872](https://doi.org/10.1086/510872), S. 92–94

Girenavar B, Cepeda ML, Soni KA et al. (2008) **Grapefruit juice** and its **furocoumarins** inhibits autoinducer signaling and biofilm formation in bacteria. *Int J Food Microbiol.* 125(2), 204-8. Epub

Bjarnsholt T, Givskov M, (2008) **Quorum Sensing Inhibitory Drugs as Next Generation Antimicrobials: Worth the Effort?** Current Medicine Group LLC 10, 22–28
http://siba.unipv.it/fisica/articoli/C/CurrentInfectiousDiseaseReports2008_10_1_22.pdf

Kociulek MG. (2009) **Quorum-Sensing Inhibitors and Biofilms. Anti-Infective Agents in Medicinal Chemistry** 8, 315-326 <http://benthamscience.com/cmcaia/sample/aiamc8-4/0004Y.pdf>

Falagas ME, Kapaskelis AM, Kouranos VD, et al. (2009) Outcome of **antimicrobial therapy** in documented biofilm-associated infections: a review of the available clinical evidence. *Drugs.* 69(10),1351-61. <http://www.ncbi.nlm.nih.gov/pubmed/19583453>

Gutierrez JA, Crowder T et al (2009) Transition state analogs of **5'-methylthioadenosine nucleosidase** disrupt quorum sensing. In: Nature Chemical Biology. Online-Veröffentlichung. doi:10.1038/nchembio.153

Soscia SJ, Kirby JE, Washicosky KJ, et al. (2010) **The Alzheimer's disease-associated amyloid beta-protein is an antimicrobial peptide.** In: PLoS ONE. 5, Nr. 3, S. e9505. doi:10.1371/journal.pone.0009505. PMID 20209079. Volltext bei PMC: 2831066. <http://de.wikipedia.org/wiki/Methylenblau> <http://news.bbc.co.uk/2/hi/health/7525115.stm>

Rogers SA, Huigens RW, Cavanagh J, Melander C. (2010) Synergistic Effects between Conventional Antibiotics and **2-Aminoimidazole-Derived Antibiofilm Agents.** Antimicrobial Agents And Chemotherapy. 2112–2118 <http://aac.asm.org/content/54/5/2112.short>

Köhler T, Perron GG, Buckling A, van Delden C. (2010) Quorum Sensing Inhibition Selects for Virulence and Cooperation in *Pseudomonas aeruginosa*. *May 2010 Issue of PLoS Pathogens* <http://www.plospathogens.org/article/info:doi/10.1371/journal.ppat.1000883>

Rasmussen TB, Bjarnsholt T, Skindersoe ME et al. (2005) **Screening for Quorum-Sensing Inhibitors (QSI) by Use of a Novel Genetic System, the QSI Selector.** J Bacteriol. Mar 187(5), 1799–1814. doi: 10.1128/JB.187.5.1799-1814.2005 PMID: PMC1063990 <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1063990/>

Lowery CA, Salzameda NT, Sawada D et al. (2010) Medicinal chemistry as a conduit for the modulation of quorum sensing. J Med Chem 53, 7467-7489.

Marsden DM, Nicholson RL, Skindersoe ME et al. (2010) Discovery of a quorum sensing modulator pharmacophore by 3D small-molecule microarray screening. Org Biomol Chem 8, 5313-5323.

Maezono H, Noiri Y, Asahi Y, et al. (2011) Antibiofilm effects of **azithromycin** and **erythromycin** on *Porphyromonas gingivalis*. Antimicrob Agents Chemother 55(12), 5887-92.

Sambanthamoorthy K, Gokhale AA, Lao W. et al. (2011) Identification of a Novel **Benzimidazole** That Inhibits Bacterial Biofilm Formation in a Broad-Spectrum Manner. ANTIMICROBIAL AGENTS AND CHEMOTHERAPY, p. 4369–4378 <https://www.msu.edu/~watersc3/publication.html>

Valenti P, Catizone A, Pantanella F, et al. (2011) **Lactoferrin** decreases inflammatory response by cystic fibrosis bronchial cells invaded with *Burkholderia cenocepacia* iron-modulated biofilm. Int J Immunopathol Pharmacol 24(4), 1057-68. [Abstract](#)

Petrova NV, Shevchenko VP, Pavlov VV, et al. (2012) Criteria of **antibacterials choice** for prophylaxis and therapy of implant-associated infections in **prosthetic joints**. Antibiot Khimioter 57(3-4), 45-9. [Abstract](#)

Worthington RJ, Richards JJ, Melander C. (2012) Small molecule **control of bacterial biofilms.** *Org Biomol Chem.* 10(37), 7457-74. <http://www.ncbi.nlm.nih.gov/pubmed/22733439>

- Lebeaux D, Ghigo JM (2012) **Management of biofilm-associated infections**: what can we expect from recent research on biofilm lifestyles? *Med Sci (Paris)* 28(8-9), 727-39. [Abstract](#)
- Vogel HJ (2012) **Lactoferrin**, a bird's eye view. *Biochem Cell Biol* 90(3), 233-44. [Abstract](#)
- Lönn-Stensrud J, Naemi AO, Benneche T et al. (2012) **Thiophenones** inhibit *Staphylococcus epidermidis* biofilm formation at nontoxic concentrations. *FEMS Immunol Med Microbiol* 65(2), 326-34. [Abstract](#)
- Jakobsen TH, van Gennip M, Phipps R et al. (2012) **Ajoene**, a Sulfur-Rich Molecule from **Garlic**, Inhibits Genes Controlled by Quorum Sensing. *Antimicrobial Agents and Chemotherapy*, 56 (5), 2314 DOI: [10.1128/AAC.05919-11](https://doi.org/10.1128/AAC.05919-11)
- Truchado P, Giménez-Bastida JA, Larrosa M, et al. (2012) Inhibition of Quorum Sensing (QS) in *Yersinia enterocolitica* by an **Orange Extract** Rich in Glycosylated Flavanones. *J Agric Food Chem.* [Abstract](#)
- van Delden C, Köhler T, Brunner-Ferber F, et al. (2012) **Azithromycin** to prevent *Pseudomonas aeruginosa* ventilator-associated pneumonia by inhibition of quorum sensing: a randomized controlled trial. *Intensive Care Med.* [Abstract](#)
- Wang R, Starkey M, Hazan R, et al. (2012) **Honey's** Ability to Counter Bacterial Infections Arises from Both Bactericidal Compounds and QS Inhibition. *Front Microbiol* 144. [Abstract](#)
- Wynendaele E, Pauwels E, Van de Wiele C, et al. (2012) **The potential role of quorum-sensing peptides in oncology**. *Med Hypotheses* 78(6), 814-7. [Abstract](#)
- Shibata S, Suge T, Kimura T, et al. (2012) Antibacterial activity of **ammonium hexafluorosilicate** solution with antimicrobial agents for the prevention of dentin caries. *Am J Dent* 25(1), 31-34. [Abstract](#)
- Quave CL, Estévez-Carmona M, Compadre CM, et al. (2012) **Ellagic acid** derivatives from *Rubus ulmifolius* inhibit *Staphylococcus aureus* biofilm formation and improve response to antibiotics. *PLoS One* 7(1), e28737. [Abstract](#)
- Maianskiĭ AN, Chebotar' IV, Evteeva NI, et al. (2012) Interspecies interaction of bacteria and the formation of mixed (polymicrobial) biofilm. *Zh Mikrobiol Epidemiol Immunobiol* (1), 93-101. [Abstract](#)
- Phillips DS, Leucke DF, Sapi E (2012) Effect of **Nattokinase and EDTA** on *Borrelia burgdorferi* Biofilm. Poster <http://www.newhaven.edu/475531.pdf>
- Cady NC, McKean KA, Behnke J, Kubec R, Mosier AP, et al. (2012) Inhibition of Biofilm Formation, Quorum Sensing and Infection in *Pseudomonas aeruginosa* by **Natural Products-Inspired Organosulfur Compounds**. *PLoS ONE* 7(6): e38492. doi:10.1371/journal.pone.0038492 <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0038492>
- Christensen QH, Grove TL, Booker SJ, Greenberg EP (2013) A high-throughput screen for quorum-sensing **inhibitors that target acyl-homoserine lactone synthases**. *Proc Natl Acad Sci U S A* 110, 13815-13820.
- CheniaHY (2013) Anti-quorum sensing potential of crude **Kigelia africana fruit extracts**. *Sensors* 13, 2802-2817
- [Kalia VC](#) (2013) **Quorum sensing inhibitors: An overview**. *Biotechnology Advances* Volume 31, Issue 2, Pages 224–245 <http://www.sciencedirect.com/science/article/pii/S0734975012001851>
- Kumar et al, (2013) **Novel Quorum-Sensing Peptides Mediating Interspecies Bacterial Cell Death**. *mBio* 4 (3) e000314-13. doi:10.1128/mBio00314-13. <http://mbio.asm.org/content/4/3/e00314-13.full>
- Conlon BP et al. (2013) **Activated ClpP** kills persisters and eradicates a chronic biofilm infection, *Nature*, doi:10.1038/nature12790. <http://www.nature.com/nature/journal/vaop/ncurrent/full/nature12790.html>

Neuartiges Antibiotikum beseitigt hartnäckige Infektionen

http://www.wissenschaft-aktuell.de/artikel/Neuartiges_Antibiotikum_beseitigt_hartnaeckige_Infektionen1771015589395.html

„Als besonders vielversprechend erwies sich die antibiotisch wirksame Substanz ADEP (Acyldepsipeptid)... ADEP4 aktiviert das eiweißspaltende Enzym ClpP der Bakterien. Diese Protease dient normalerweise nur dazu, fehlerhafte Proteine zu entsorgen. Die Anlagerung von ADEP4 hat zur Folge, dass das Enzym unkontrolliert und wahllos zahlreiche Proteine zerstört, so dass die Mikroben absterben. Dieser Effekt trat auch bei nicht wachsenden Zellen von Staphylococcus aureus ein. Zwar ist – wie bei allen Antibiotika – damit zu rechnen, dass sich mit der Zeit Mutanten entwickeln, die gegen ADEP4 resistent geworden sind. Experimente zeigten aber, dass sich diese dann leicht durch bekannte Antibiotika wie Rifampicin oder Ciprofloxacin beseitigen ließen. Mit einer Kombination aus ADEP4 und Rifampicin konnten die Forscher Staphylokokken in Laborkulturen auch dann vollständig eliminieren, wenn sie Biofilme gebildet hatten.“

Burt SA, Ojo-Fakunle VTA, Woertman J, Veldhuizen EJA (2014) The Natural Antimicrobial **Carvacrol** Inhibits Quorum Sensing in Chromobacterium violaceum and Reduces Bacterial Biofilm Formation at Sub-Lethal Concentrations. PLoS ONE 9(4): e93414. doi:10.1371/journal.pone.0093414

<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0093414>

Padmavathi AR, Abinaya B, Pandian SK (2014) **Phenol, 2,4-bis(1,1-dimethylethyl)** of marine bacterial origin inhibits quorum sensing mediated biofilm formation in the uropathogen Serratia marcescens. Biofouling: The Journal of Bioadhesion and Biofilm Research [Volume 30, Issue 9](#), DOI:10.1080/08927014.2014.972386 pages 1111-1122

http://www.tandfonline.com/doi/abs/10.1080/08927014.2014.972386?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed#.VG3FrclkBwt

http://www.tandfonline.com/doi/abs/10.1080/08927014.2014.972386?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed#.VG13youUdD4

http://www.tandfonline.com/doi/abs/10.1080/08927014.2014.972386?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed#.VG13youUdD4

Borges A, Saavedra MJ, Simoes M (2015) **Insights on Antimicrobial Resistance, Biofilms and the Use of Phytochemicals as New Antimicrobial Agents**. Current Medicinal Chemistry 22, 2590-2614

<http://www.ncbi.nlm.nih.gov/pubmed/26028341>

[Nattokinase, Serrapeptase](http://www.serrapeptase.org/serrapeptase-reviews/best-systemic-enzyme/) <http://www.serrapeptase.org/serrapeptase-reviews/best-systemic-enzyme/>

- ➔ **Gesprächs-Therapie, Psychosomatische Medizin** <http://www.xerlebnishaft.de/salutogenese.pdf>
- ➔ **Hyperthermie, Thermotherapie** http://en.wikipedia.org/wiki/Heat_therapy
- ➔ **Lichttherapie** <http://www.lichttherapie.de/>
- ➔ **Hochfrequenz-Therapie s.o.**

- ➔ **Phenothiazine** <http://www.xerlebnishaft.de/phenothiazine.pdf>
- ➔ **Probiotika** <http://www.kabilahsystems.de/probiotika.pdf>

- ➔ **Zytoskelett** <http://www.xerlebnishaft.de/zytoskelett.pdf>
- ➔ **pH – Wert, H2, die Wasserstoff-Ionen-Konzentration** <http://www.kabilahsystems.de/ph.pdf>
- ➔ **Mitochondrien** <http://www.xerlebnishaft.de/mitochondrien.pdf> http://www.kabilahsystems.de/q10_und_l.pdf
- ➔ **Sauerstoff-Therapie, O2 (nach [Manfred von Ardenne](#), u. [Hyperbare Sauerstoff-Therapie](#))**

- ➔ **Phytotherapie** <http://www.xerlebnishaft.de/kraeutertherapie.pdf> <http://www.xerlebnishaft.de/phytotherapie.pdf>
- ➔ **Elektrolyte und Spurenelemente** http://www.xerlebnishaft.de/elektro_spur_ph.pdf
- ➔ **Magnesium** http://www.researchgate.net/publication/18404964_Magnesium_%28physiology_clinical_therapy%29
- ➔ **Hydro-Therapie (nach [Sebastian Kneipp](#))**
- ➔ **Heilwasser Trinkkur (nach [Baeder-Kalender](#))**
- ➔ **Polyphenole** <http://www.kabilahsystems.de/polyphenole.pdf>
- ➔ **Fettsäuren** <http://www.kabilahsystems.de/ungesaettfets.pdf>
- ➔ **Vitamine** <http://www.xerlebnishaft.de/vitamine.pdf> <http://www.xerlebnishaft.de/bildmethyl-arginin.pdf>

- ➔ **Antikoagulationen** <http://www.kabilahsystems.de/hyperkoagulation.pdf>

- ➔ **Symbiogenese** <http://www.erlebnishaft.de/symbiogenese.pdf>
- ➔ **Selbst_muster_nano** http://www.erlebnishaft.de/selbst_muster_nano.pdf

- ➔ **Immunsuppression** <http://www.xerlebnishaft.de/immunsuppression.pdf>

➔ **Costerton B - The "Father" of Biofims (2012)**
https://www.youtube.com/watch?v=M_DWNFFgHbE

[Bernt - Dieter Huismans](#), Letzte Revision April 2017 www.Huismans.click 
Back to top: <http://www.xerlebnishaft.de/quorum.pdf>