



2019



2021



2024

Gesunder Boden, Gesunder Mensch?

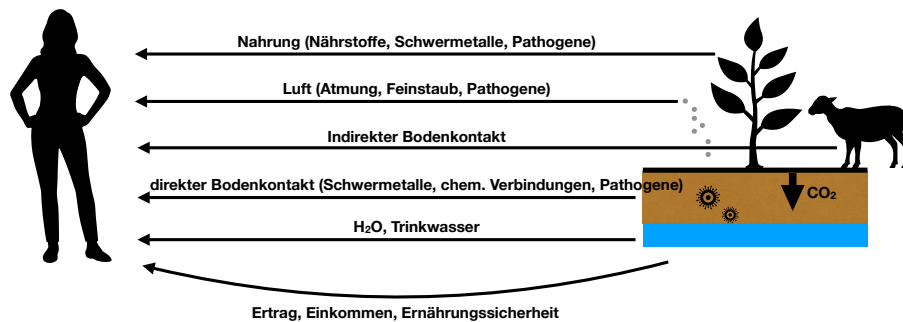
Was sagt die Wissenschaft?

Martin Grassberger



Jerome Irving Rodale

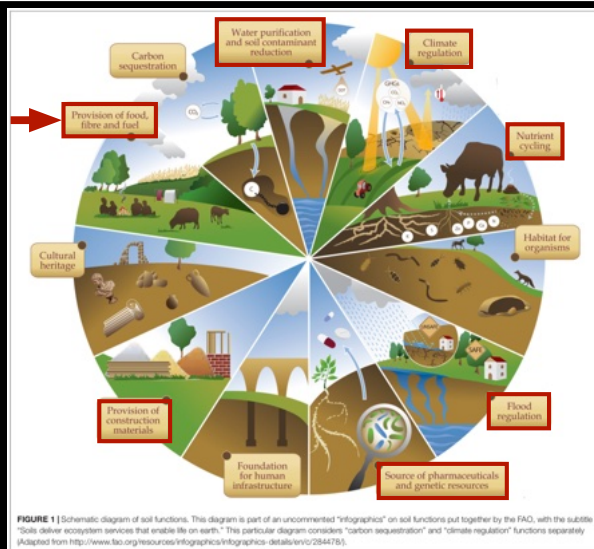
Die Verbindungen sind vielfältig...



Was ist Gesundheit?

• Definition der WHO

„...ein Zustand des vollständigen körperlichen, geistigen und sozialen Wohlergehens und nicht nur das Fehlen von Krankheit oder Gebrechen“



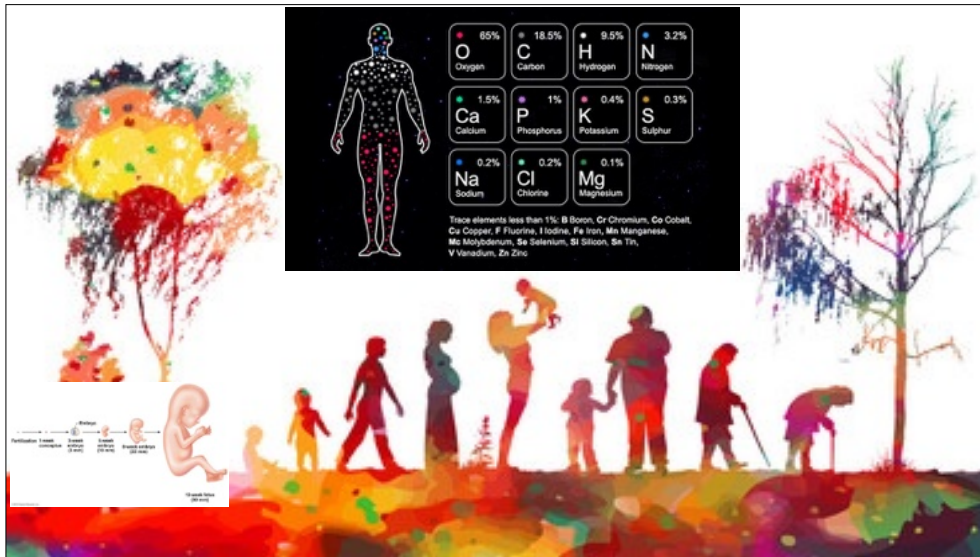
„Etwa 33% der weltweiten Böden sind aufgrund nicht nachhaltiger Bewirtschaftungspraktiken mäßig oder stark degradiert.“

<http://www.fao.org/3/a-bl813e.pdf>

„Eine Nation, die ihren Boden zerstört, zerstört sich selbst“

*– Friedrich Albert Fallou,
deutscher Rechtsanwalt und Bodenkundler, 1862*

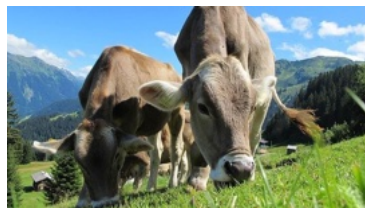




„Du bist, was du isst.“
**„Wir sind, was unsere Lebensmittel
 gegessen haben“**

bzw.

„Wir sind Boden“



 Health effects of dietary risks in 195 countries, 1990–2017:
 a systematic analysis for the Global Burden of Disease Study
 2017
 GBD 2017 Diet Collaborators*

**„Unsere Ergebnisse zeigen, dass eine suboptimale Ernährung
 weltweit für mehr Todesfälle verantwortlich ist als jedes andere
 Risiko, einschließlich des Tabakrauchens...“**

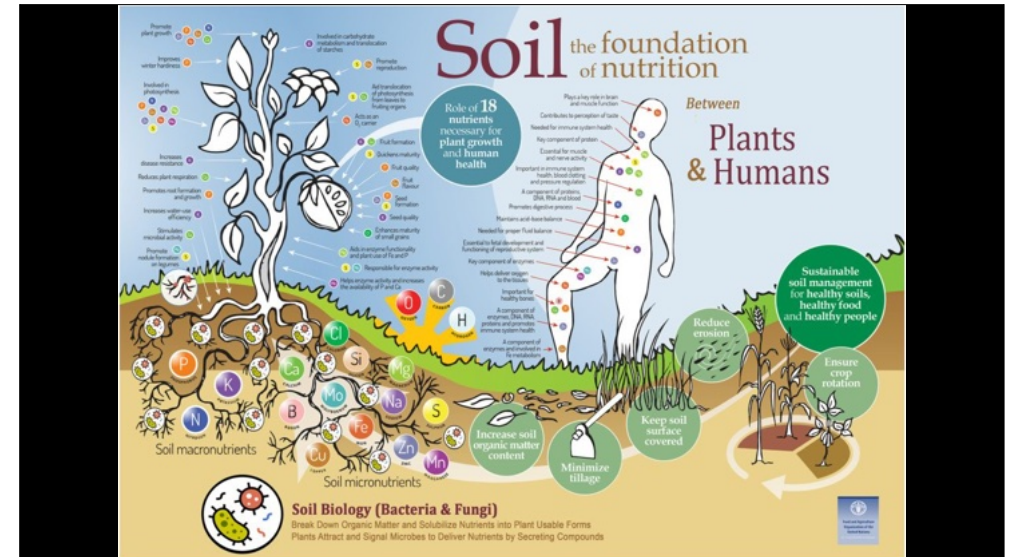
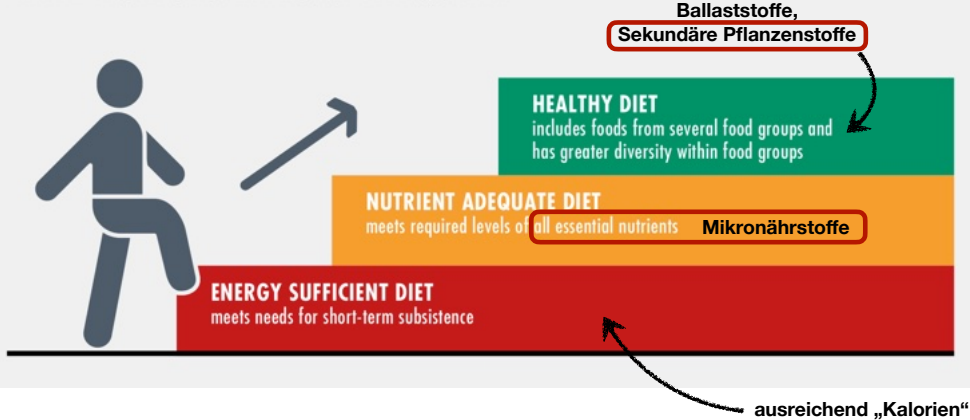
Lancet 2019; 393: 1958–72

Published Online

April 3, 2019

[http://dx.doi.org/10.1016/
 S0140-6736\(19\)30041-8](http://dx.doi.org/10.1016/S0140-6736(19)30041-8)

THREE INCREASING LEVELS OF DIET QUALITY



Verborgener Hunger („Hidden Hunger“)

Wenn **Mikronährstoffe (Vitamine, Mineralstoffe u. Spurenelemente)** fehlen, leiden Gesundheit und Entwicklung. Mehr als **zwei Milliarden Menschen** sind weltweit betroffen.



Mikronährstoffe im Überblick

Mikronährstoffe

Vitamine		Mineralstoffe	
Fettlöslich	Wasserlöslich	Mengenelemente	Spurenelemente
Vitamin A (Retinol)	Vitamin C	Calcium	Chrom
Vitamin D (Calcio)	Thiamin (Vitamin B1)	Phosphor	Eisen
Vitamin E (Tocopherol)	Riboflavin (Vitamin B2)	Magnesium	Jod
Vitamin K (Phyllochinon)	Pyridoxin (Vitamin B6)	Natrium	Zink
	Cobalamin (Vitamin B12)	Chlor	Kupfer
	Niacin (Vitamin B3)	Schwefel ^[6]	Selen
	Pantothenäure (Vitamin B5)		Molybdän
	Biotin (Vitamin B7)		Mangan ^[5]
	Folsäure ^[5]		

Zum Beispiel wird **Selen** in Prozessen benötigt, die DNA herstellen. **Zink** hilft dem Immunsystem des Körpers, richtig zu funktionieren, während **Magnesium** die Nerven-, Muskel- und Herzfunktion aufrechterhält und den Knochen festigt.

<https://www.cbd-vital.at/magazin/cbd-allgemein/warum-mikronaehrstoffe>

Review

An Alarming Decline in the Nutritional Quality of Foods: The Biggest Challenge for Future Generations' Health

Raju Lal Bhardwaj ^{1,*}, Aabha Parashar ², Hanuman Prasad Parewa ¹ and Latika Vyas ³

ENVIRONMENT AND CONSERVATION

Fruits and vegetables are less nutritious than they used to be

Mounting evidence shows that many of today's whole foods aren't as packed with vitamins and nutrients as they were 70 years ago, potentially putting people's health at risk.

BY STACEY COLLINS
PUBLISHED 3 MAY 2023, 14:00 BST

SCIENTIFIC AMERICAN

ENVIRONMENT

Dirt Poor: Have Fruits and Vegetables Become Less Nutritious?

Because of soil depletion, crops grown decades ago were much richer in vitamins and minerals than the varieties most of us get today

April 2, 2023

LETTER

doi:10.1038/nature132179

Rising concentration of atmospheric CO₂ threatens human nutrition

Saman S. Myers^{1,2}, Antonella Zamboni¹, Sai Kheng^{1,3}, Peter Heyburn⁴, Andrew D. B. Leakey⁵, Arnold Blum⁶, Eli Carlisle⁶, Lee H. Drenth⁶, Glenn Flanagan⁶, Imshidhan Haugwa⁷, N. Michele Holbrook⁸, Randall L. Nelson⁹, Michael J. O'Connell¹⁰, Victor Raben¹¹, Helenina Salas¹², Karla A. Sauer¹³, and Schwartz¹⁴, Susan Seneweera¹⁵, Michael Traub¹⁶ & Yoshitaka Umez¹⁷

Dietary deficiencies of zinc and iron are a substantial global public health problem. An estimated two billion people suffer these deficiencies, costing a loss of 60 million life years annually¹. Most of these people depend on C₃ grains and legumes as their primary dietary source of zinc and iron. Here we report that C₃ grains and legumes have lower concentrations of zinc and iron when grown under field conditions at the elevated atmospheric CO₂ concentration predicted for the middle of this century. C₃ crops other than legumes also have lower concentrations of protein, whereas C₄ crops seem to be less affected. Differences between cultivars of a single crop suggest that breeding for decreased sensitivity to atmospheric CO₂ concentration could partly address these new challenges to global health.

In the 1970s, several investigators found that elevated atmospheric CO₂ concentration (hereafter abbreviated to [CO₂]) decreased the concentrations of zinc, iron and protein in grains of wheat^{2,3}, barley⁴ and rice⁵ grown in controlled-environment chambers. However, subsequent studies failed to replicate these results when plants were grown in open-top chambers and free-air CO₂ enrichment (FACE) experiments. A previous study⁶ found no effect of [CO₂] on the concentrations of zinc or iron in rice grown under FACE and suggested that the earlier findings had been influenced by 'pot effects', by which a small testing volume led to nutrient depletion at the root-soil interface. Of the more recent studies^{7–11}, most have indicated lower elemental concentrations in soybean^{7,8}, potato⁹, wheat¹⁰ or barley¹¹ grown at elevated [CO₂], but with the exception of iron in one study on wheat¹⁰, these results were statistically insignificant, perhaps because of small sample sizes.

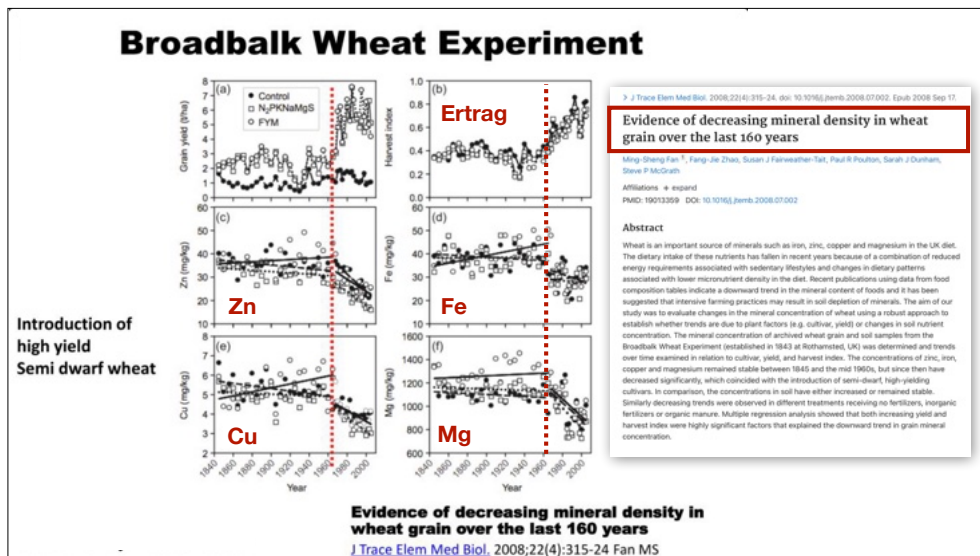
Small sample sizes have limited the statistical power of individual studies of many aspects of plant responses to elevated [CO₂], and meta-analyses involving larger samples of genotypes, environmental conditions and experimental locations have been important in resolving such elements of plant function responsive to elevated [CO₂]^{12–15}. A recent meta-analysis of published data indicated that only nitrogen decreased in grains grown at elevated [CO₂]¹⁶.

Here we report findings from a new analysis of newly acquired data from 143 experiments of the edible portions of crops grown at ambient and elevated [CO₂] from seven different FACE experimental locations in Japan, Australia and the United States involving six food crops (see Table 1). We tested the nutrient concentrations of the edible portions of rice (*Oryza sativa*, 18 cultivars), wheat (*Triticum aestivum*, 8 cultivars), maize (*Zea mays*, 2 cultivars), soybean (*Glycine max*, 7 cultivars), field pea (*Pisum sativum*, 4 cultivars) and sorghum (*Sorghum*

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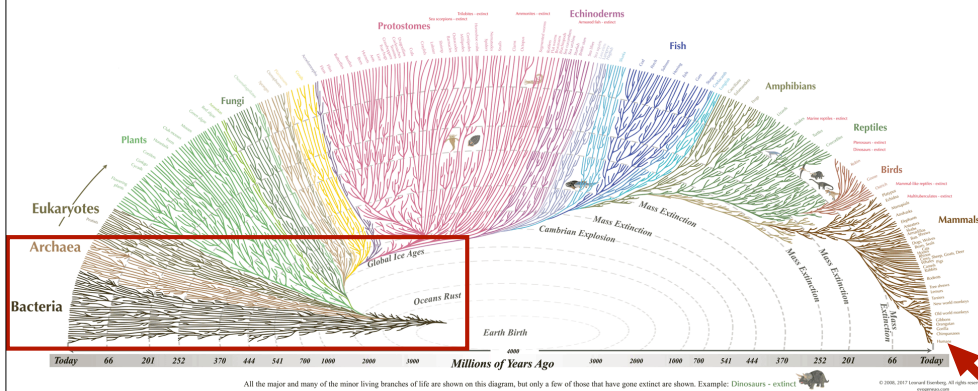
Sekundäre Pflanzenstoffe - „Phytochemicals“

Chemische Gruppen	Bedeutung für Pflanzen (u.a.)	Vorkommen (u.a.)
Phenolische Verbindungen (enthalten eine oder mehrere Phenylgruppen)	Flavonoide Farbstoffe (rot, hellgelb, blau, violett)	Äpfel, Birnen, Trauben, Kirschen, Pflaumen, Beerenobst, Zwiebeln, Grünkohl, Auberginen, Soja, schwarzer und grüner Tee ...
	Phenolsäuren Abwehr von Fressfeinden	Kaffee, Tee, Vollkornprodukte, Wein, Nüsse ...
	Phytoöstrogene Hormonwirkung	Getreide und Hülsenfrüchte (z.B. Soja), Leinsamen ...
Terpene (Enthalten eine oder mehrere Isopren-Einheiten)	Carotinoide Farbstoffe (gelb, orange, rot)	Karotten, Tomaten, Paprika, grünes Gemüse, Grapefruit, Marillen, Melonen, Kürbis ...
	Monoterpene Duft- und Aromastoffe	Zitronen, Minze, Thymian, Kümmel, Rosmarin ...
	Phytosterine Membranbaustoff, Hormonwirkung	Nüsse, Pflanzensamen (z.B. Sonnenblumenkerne, Sesam, Soja), Hülsenfrüchte ...
	Saponine Abwehr von Fressfeinden und Pilzen	Hülsenfrüchte, Soja, Spargel, Hafer, Lakritze ...
Niedermolekulare stickstoffhaltige Verbindungen (Enthalten abgesehen von Stickstoff häufig auch Schwefel)	Glucosinolate Abwehr von Fressfeinden und Pathogenen	Alle Kohlrarten, Rettich, Radieschen, Kresse, Senf ...
	Sulfide (Alliine) Duft- und Aromastoffe	Zwiebel, Lauch, Knoblauch, Schnittlauch ...

https://iem.at/wp-content/uploads/2020/03/Sekundäre_Pflanzenstoffe_Tabelle-2.jpg

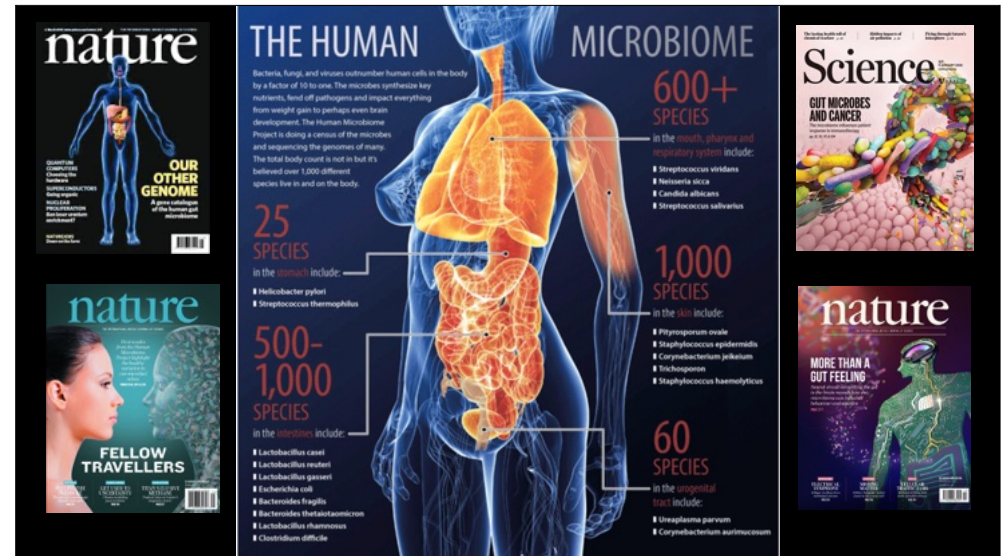


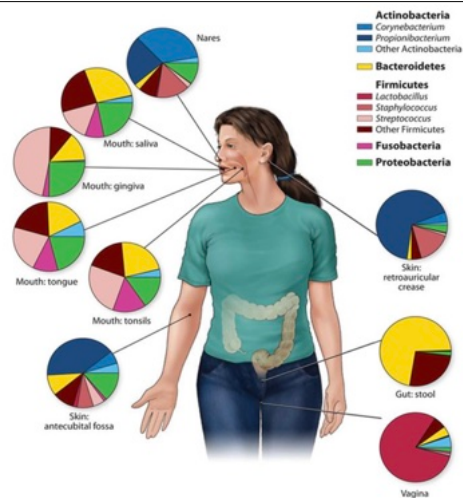
Co-Evolution!



Die Evolution der Landpflanzen begann vor etwa 475 Millionen Jahren.
Die ältesten Pilzfossilien sind 715 bis 810 Millionen Jahre alt.

<http://evogeneao.com/en>





Grice and Segre (2012)

Unser Mikrobiom ist für viele essentielle Prozesse im Körper zuständig!

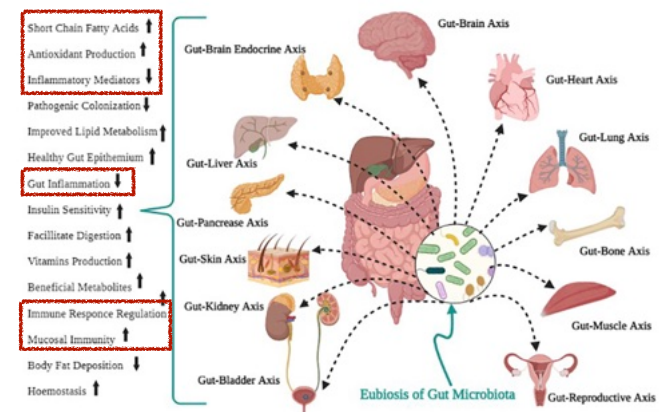
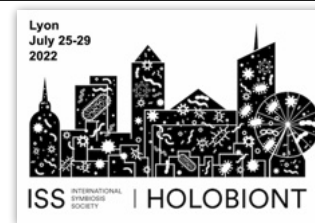
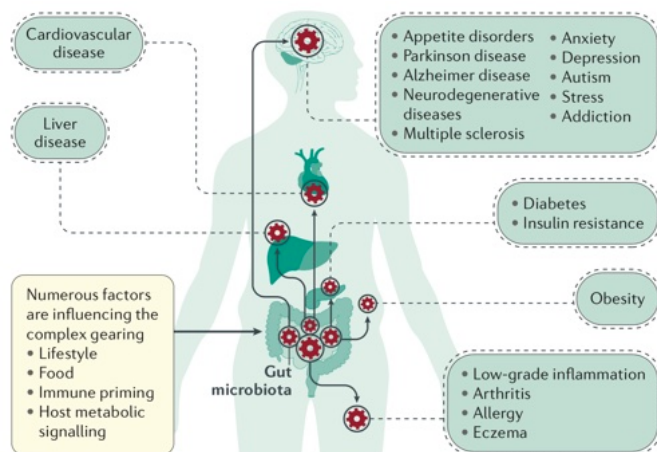


FIGURE 2
Positive health outcomes of gut microbial eubiosis.

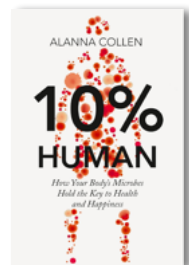
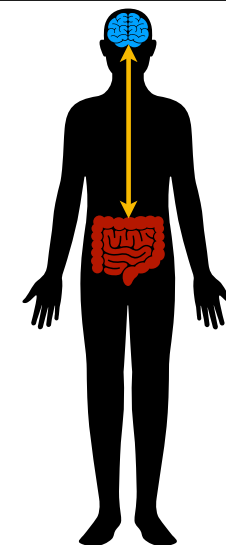
Alzaal M, Saeed F, Shah YA, et al. Human gut microbiota in health and disease: Unveiling the relationship. Front Microbiol. 2022;13:999001. Published 2022 Sep 26. doi:10.3389/fmicb.2022.999001

Mikrobiom bzw. Dysbiose assoziierte Erkrankungen

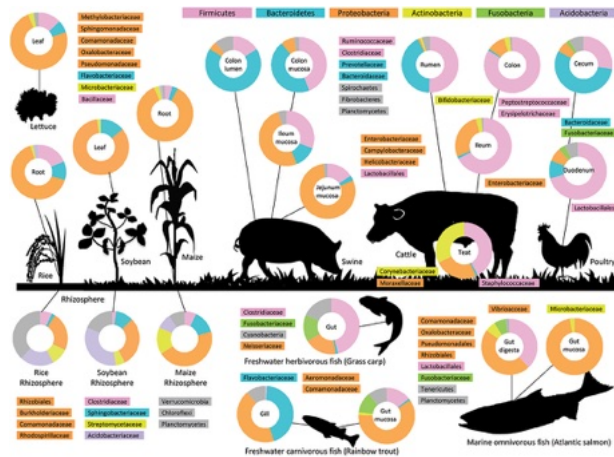


„HoloBiont“ „Gesamtlebewesen“

eukaryoter Wirtsorganismus + symbiotischer Mikroben-Komplex



Eine Welt der Holobionten!



Ikeda-Ohtsubo W, et al. How Can We Define "Optimal Microbiota"? A Comparative Review of Structure and Functions of Microbiota of Animals, Fish, and Plants in Agriculture. Front Nutr. 2018;5:90. Published 2018 Oct 2. doi:10.3389/fnut.2018.00090



Home / Articles / Disappearance of the Human Microbiota: How We May Be Losing Our Oldest Allies

Disappearance of the Human Microbiota: How We May Be Losing Our Oldest Allies

Nov. 8, 2019

SHARE THIS

"The microbiota is not accidental," says Dr. Martin Blaser, Director of the Center for Advanced Biotechnology and Medicine at Rutgers University and author of *Missing Microbes*. "The microbiota has co-evolved with us over very long periods of time, and it performs beneficial functions for us, just as we perform beneficial functions for it...We are all working together as an ecological unit." Since our species—and all of life—has existed on earth, we have been in the company of microbes: microbes reside in our intestines, on our skin, and in the environments we live in. These bugs have at times been opportunistic pathogens, preying on the vulnerabilities of individuals and populations, but they have more frequently been some of our oldest evolutionary friends.

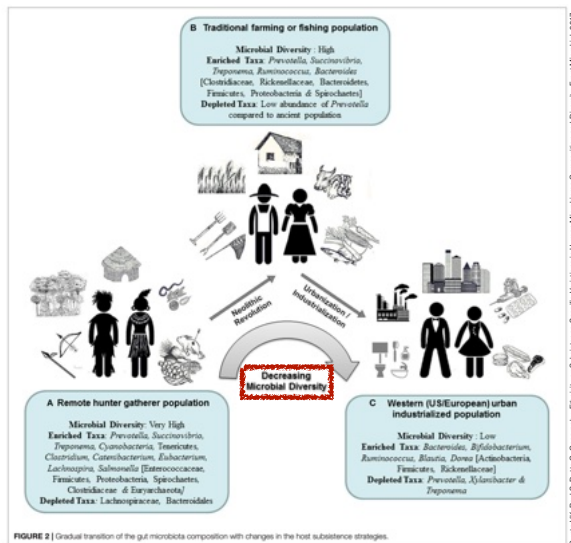
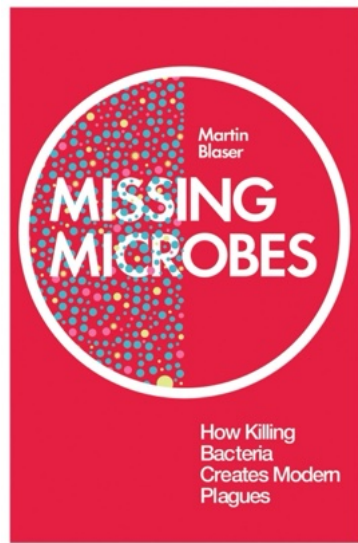


FIGURE 2 | Gradual transition of the gut microbiota composition with changes in the host subsistence strategies.



ARTICLE

Received 22 Nov 2013 | Accepted 14 Mar 2014 | Published 15 Apr 2014

DOI: 10.1038/ncomms4454

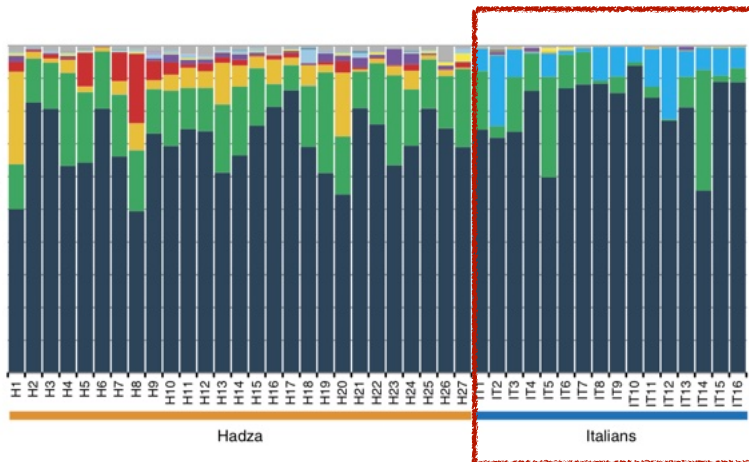
OPEN

Gut microbiome of the Hadza hunter-gatherers

Stephanie L. Schnorr^{1,2}, Marco Candela^{2,3}, Simone Rampelli², Manuela Centanni², Clarissa Consolandi³, Giulia Basaglia², Silvia Turroni², Elena Biagi², Clelia Peano³, Marco Severgnini³, Jessica Fiori², Roberto Gotti², Gianluca De Bellis³, Donata Luiselli⁴, Patrizia Brigidi², Audax Mabulla⁵, Frank Marlowe⁶, Amanda G. Henry¹ & Alyssa N. Crittenden⁷



Other/unclassified
Archaea
TM7
Acidobacteria
Elusimicrobia
Fibrobacteres
Fusobacteria
Gemmatimonadetes
Cyanobacteria
Lentisphaerae
Verrucomicrobia
Tenericutes
Spirochaetes
Proteobacteria
Actinobacteria
Bacteroidetes
Firmicutes



Noch mehr Evidenz...

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Agrichemicals and antibiotics in combination increase antibiotic resistance evolution

Brigitta Kurenbach^{1,2}, Amy M. Hill^{1,2}, William Godsoe¹, Sophie van Hamelsveld¹ and Jack A. Heinemann¹

¹ School of Biological Sciences and Centre for Integrated Research in Biosafety and Centre for Integrative Ecology, University of Canterbury, Christchurch, New Zealand

² Bio-Protection Centre, Lincoln University, Lincoln, New Zealand

³ These authors contributed equally to this work.

ABSTRACT

Antibiotic resistance in our pathogens is medicine's climate change: caused by human activity, and resulting in more extreme outcomes. Resistance emerges in microbial

In this study we report that when bacteria are simultaneously exposed to herbicides and antibiotics, mutants with higher levels of resistance can evolve. In some cases, resistance evolved 100,000 times faster.

previous observation that commonly used herbicides can increase or decrease the minimum inhibitory concentration (MIC) of different antibiotics, we provide the first comprehensive test of the hypothesis that the rate of antibiotic resistance evolution under specified conditions can increase, regardless of whether a herbicide increases or decreases the antibiotic MIC. Short term evolution experiments were used for various herbicide and antibiotic combinations. We found conditions where acquired resistance arises more frequently regardless of whether the exogenous non-antibiotic agent increased or decreased antibiotic effectiveness. This is attributed to the effect of the herbicide on either MIC or the minimum selective concentration (MSC) of a paired antibiotic. The MSC is the lowest concentration of antibiotic at which the fitness of individuals varies because of the antibiotic, and is lower than MIC. Our results suggest that additional environmental factors influence competition between bacteria could

Submitted 3 May 2018
Accepted 21 September 2018
Published 12 October 2018
Corresponding author
Jack A. Heinemann,
jack.heinemann@canterbury.ac.nz

Resistenzbildung!



Indirect Effects of the Herbicide Glyphosate on Plant, Animal and Human Health Through its Effects on Microbial Communities

A. H. C. van Bruggen^{1,2}, M. R. Finckh³, M. He⁴, C. J. Pittsers⁵, P. Harker⁶, D. Knuth⁷ and V. Gieseler⁸

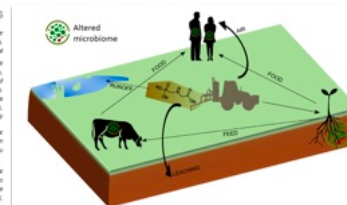
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Edited by:
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Reviewed by:
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Robert Davidson,
Oxford University, United Kingdom
Roberta Giamberini,
University of Milan, Italy

*Correspondence:
A. H. C. van Bruggen,
ahc@wageningenur.nl

Specialty section:
This article was submitted to
Toxicology, Product and the
Environment.



Impact of Agrochemicals on Soil Microbiota and Management: A Review

Ram Swaroop Meena^{1,2,3}, Sandeep Kumar⁴, Rahul Datta^{4,5}, Rattan Lal², Vinod Vijayakumar⁶, Martin Brtnický^{7,8}, Mahaveer Prasad Sharma⁹, Gulab Singh Yadav^{2,7}, Manoj Kumar Jha¹⁰, Chetan Kumar Jangir², Shamina Iman Pathan⁹, Tereza Dokulilova⁴, Václav Pecina⁴ and Theodore Danas Marfo¹⁰

- Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi 221 005, India; meenars@bhu.ac.in
- Carbon Management and Sequestration Centre, The Ohio State University, Columbus, OH 43210, USA; lal.1@osu.edu (R.L.); yadav.1@osu.edu (G.S.)
- ICAR-National Academy of Agricultural Research Management (NAARM), Hyderabad 500030, India; sandeepshug1992@naarm.org.in (S.K.); chetanjangir710@naarm.org.in (C.K.J.)
- Department of Agrochemistry, Soil Science, Microbiology and Plant Nutrition, Faculty of Agrisciences, Mendel University in Brno, Zemedelska 1, Brno 60200, Czech Republic; martin.brtnicky@mendelu.cz (M.B.); tereza.dokulilova@mendelu.cz (T.D.); vladav.pecina@mendelu.cz (V.P.)
- College of Food, Agricultural, and Environmental Sciences, The Ohio State University, Columbus, OH 43210, USA; vinod.vijayakumar@gmail.com
- Microbiology Laboratory, ICAR-Indian Institute of Soybean Research, Khandwa Road, Indore (MP) 452001, India; mahaveer.sharma@icar.gov.in
- ICAR Research Complex for NDH Region, Lembucherra 799210, India
- Department of Farm Forestry, University Teaching Department, Sant Gajra Gursi Vishwavidyalaya (Dumrey, Sarguja University), Surguja, Ambikapur 497001, India; manoj598@gmail.com
- Department of Agri-food, environmental, Forestry Science and Technology (DAGREST), University of Florence, Piazzale delle Cascine 28, 50144 Florence, Italy; shamina.imanpathan@unifi.it
- Department of Geology and Pedology, Mendel University in Brno, Zemedelska 1, Brno 60200, Czech Republic; vsmarfo@mendelu.cz

*Correspondence: rahul.datta@mendelu.cz; Tel.: +420-773-990-283

Received: 31 December 2019; Accepted: 17 January 2020; Published: 23 January 2020



Current perspectives

Disconnection of man and the soil: Reason for the asthma and atopy epidemic?

Leena von Hertzen, PhD, and Tari Haahela, MD, PhD Helsinki, Finland

Intense search has been going on to find factors responsible for the asthma and atopy epidemic in Western societies. Attention has increasingly been devoted to environmental supraphytes, which, in addition to gut commensals, might be the major players in the development and the tuning of immunologic homeostasis. This review outlines current evidence for the role of environmental supraphytes in the development of atopic disease and considers the consequences of urbanization in reducing contacts with soil microorganisms. The major microbial components that have been shown to possess immunomodulatory capacity and their respective Toll-like receptors are also discussed, as are the possible mechanisms underlying the ability of supraphytes to confer protection against atopic disease. (J Allergy Clin Immunol 2006;117:336-44)

Key words: Allergy, asthma, atopy, hygiene hypothesis, supraphytes, urbanization

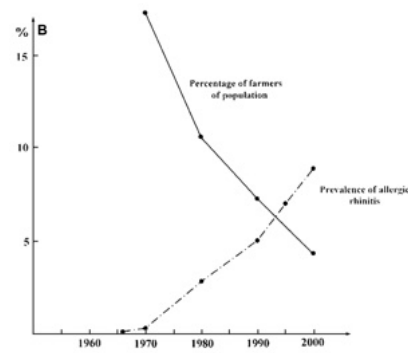
The current asthma and atopy epidemic in Western societies has raised a common concern and questions of factors involved. Although in some countries prevalence rates in atopic diseases appear to have leveled off,¹⁻⁴ trends are still on the increase in many other countries.⁵⁻⁸ Numerous studies have consistently shown that high asthma and atopy rates are associated with urbanization and Western lifestyle.⁹ Accumulating data suggest that something that is necessary for the normal maturation of the immune system might be lacking in our affluence.¹⁰ Conversely, farm environment and a more traditional lifestyle in nonallergic countries appear to confer protection against atopic disease.^{6,11,12} Although the ultimate factors responsible for the asthma and atopy epidemic have remained unidentified, a common denominator for both living on a farm and in a nonallergic environment is the heavy exposure to microorganisms in soil and vegetation. Most of the microorganisms we encounter do not cause any overt infection but are still recognized by the innate immune system. Microbes in this respect need not be alive

Abbreviations and
TLR: Toll-like receptor
Treg cell: Regulatory T cell

because even nonviable microbial components interact with the innate immune system. Persistent and moderate environmental exposure to microbial components might play a decisive role in the normal maturation of the immune system in childhood.¹³ It has been proposed that certain microorganisms that have been present throughout the mammalian evolutionary history are recognized by the innate immune system as "no danger" signals and thus do not trigger inflammatory responses but instead have the ability to induce tolerance through rapid regulatory T (Treg) cell responses.¹⁴ These organisms include saprophytic mycobacteria, lactobacilli, and some intestinal parasites that are able to elicit Treg cell responses *in vitro*^{15,16} and *in vivo*.¹⁷ The list of such microbes will certainly grow in the next few years.

The focus of the research in the context of the hygiene hypothesis has largely shifted from overt infections and the T_H1/T_H2 paradigm to noninfectious organisms, Treg cells, and Toll-like receptors (TLRs), as new data have been accumulated and the paradigm was found to be unable to unambiguously explain some important epidemiologic findings.^{18,19} Indeed, diseases of immune dysregulation, including atopic diseases, are now considered to develop, more or less, as a result of failure in Treg cell function.²⁰ Immune defense mechanisms that evolved during the long history of humankind in a hostile environment appear now to be less appropriate when living in a clean environment.²¹

HYPOTHESIS

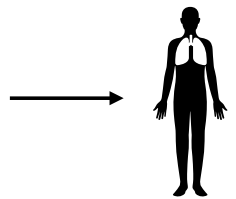


Zuviel Hygiene oder zu wenig „Dreck“ ?

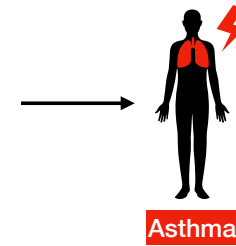
- „Hygienehypothese“
- „Old Friends Hypothesis“
- „Biodiversitäts Hypothese“



Amish

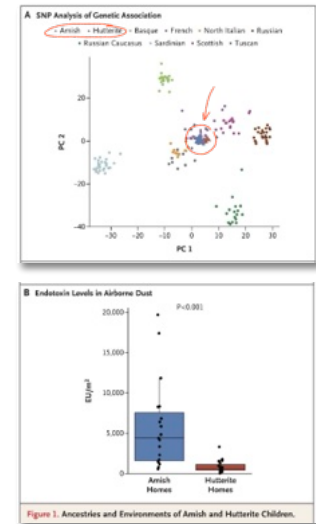


Hutterer



Asthma

Stein et al. (2016) Innate Immunity and Asthma Risk in Amish and Hutterite Farm Children. NEJM 375:411-421



Asthma and lower airway disease

Protection from childhood asthma and allergy in Alpine farm environments—the GABRIEL Advanced Studies

Sabina Illi, PhD,^{2*} Martin Depner, PhD,^{2*} Jon Genuneit, MD,³ Elisabeth Horak, MD,⁴ Georg Loss, MSc,^{4,6} Christine Strunz-Lehner, MPH,⁵ Gisela Büchele, PhD,⁶ Andrzej Bożanski, MD, PhD,⁷ Hanna Danielewicz, MD,¹ Paul Cullinan, MD,⁸ Dick Heederik, PhD,⁹ Charlotte Braun-Fahrlander, MD,^{4,6} Erika von Mutius, MD, MSc,⁶ and the GABRIEL Study Group¹ Munich and Ulm, Germany, Innsbruck, Austria, Basel, Switzerland, Wrocław, Poland, London, United Kingdom, and Utrecht, The Netherlands

Background: Studies on the association of farm environments with asthma and atopy have repeatedly observed a protective effect of farming. However, no single specific farm-related exposure explaining this protective farm effect has consistently been identified.

Objective: We sought to determine distinct farm exposures that account for the protective effect of farming on asthma and atopy.

Methods: In rural regions of Austria, Germany, and Switzerland, 79,888 school-aged children answered a recruiting questionnaire (phase I). In phase II, a stratified random subsample of 8,419 children answered a detailed questionnaire on farming environment. Blood samples and specific IgE levels were available for 7,682 of these children. A broad asthma definition was used, comprising symptoms, diagnosis, or treatment ever.

Results: Children living on a farm were at significantly reduced risk of asthma (adjusted odds ratio [aOR], 0.68; 95% CI, 0.59–0.78; $P < .001$), hay fever (aOR, 0.43; 95% CI, 0.36–0.52; $P < .001$), atopic dermatitis (aOR, 0.80; 95% CI, 0.69–0.93; $P = .004$), and atopic sensitization (aOR, 0.54; 95% CI, 0.48–0.61; $P < .001$) compared with nonfarm children. Whereas this overall

farm effect could be explained by specific exposures to cows, straw, and farm milk for asthma and exposure to fodder storage rooms and manure for atopic dermatitis, the farm effect on hay fever and atopic sensitization could not be completely explained by the questionnaire items themselves or their diversity.

Conclusion: A specific type of farm typical for traditional farming (ie, with cows and cultivation) was protective against asthma, hay fever, and atopy. However, whereas the farm effect on asthma could be explained by specific farm characteristics, there is a link still missing for hay fever and atopy. (J Allergy Clin Immunol 2012;129:1470–7.)

Key words: Asthma, hay fever, atopic dermatitis, atopic sensitization, childhood, farming, farm milk, early life

Discuss this article on the JACI Journal Club blog: www.jaci-online.blogspot.com.

Asthma and allergies constitute complex diseases; their cause involves both genetic and environmental determinants. Moreover, both diseases frequently have their onset in childhood and thus



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https://www.flickr.com/photos/robert_hess/5040400000/

Early Exposure to Dogs and Farm Animals and the Risk of Childhood Asthma

David Hill, PhD, Center for Health Systems Research, PhD, University of York, UK; David Hill, PhD, Center for Health Systems Research, PhD, University of York, UK; David Hill, PhD, Center for Health Systems Research, PhD, University of York, UK

Background: The association between early exposure to animals and childhood asthma is not clear, and previous studies have yielded conflicting results.

Objective: To determine whether exposure to dogs and farm animals confers a risk of asthma.

Design, setting, and participants: In a retrospective cohort study, the association between early exposure to dogs and farm animals and the risk of asthma was evaluated and included all children born in Sweden from January 1, 2001, to December 31, 2002 (N = 1,011,031), using register data on dog and farm registration, asthma medication, diagnosis, and confounders for parents and their children. The association was assessed as the odds ratio (OR) for a current diagnosis of asthma at age 5 years for school-aged children and the hazard ratio (HR) for incident asthma at ages 1 to 5 years for preschool-aged children. Data were analyzed from January 1, 2001, to September 30, 2002.

Exposures: Living with a dog or farm animal.

Measurements and main results: Childhood asthma diagnosis and medication used.

Results: Of the 1,011,031 children born during the study period, 174,638 preschool-aged (17.3%) and 278,298 school-aged (27.5%) children were exposed to dogs and 180,133 (17.8%) and 278,298 (27.5%) children were exposed to farm animals, respectively. In the preschool-aged children, the risk of asthma was significantly increased in those exposed to dogs (OR, 1.08; 95% CI, 1.03–1.13) and farm animals (OR, 1.08; 95% CI, 1.03–1.13). In the school-aged children, the risk of asthma was significantly increased in those exposed to dogs (OR, 1.08; 95% CI, 1.03–1.13) and farm animals (OR, 1.08; 95% CI, 1.03–1.13). Results were comparable when analyzing only first-born children. Farm animal exposure was associated with a reduced risk of asthma in both school-aged children and preschool-aged children (OR, 0.84; 95% CI, 0.79–0.89, and OR, 0.84; 95% CI, 0.79–0.89, respectively).

Conclusions and relevance: In this study, the data support the hypothesis that exposure to dogs and farm animals during the first year of life reduces the risk of asthma in children at age 5 years. This information might be helpful in deciding whether to have a dog and/or pet on the farm and/or in the home.

Supplemental content at jama.com

Author disclosures of potential conflicts of interest and author contributions are found at the end of this article. Address correspondence to David Hill, PhD, Center for Health Systems Research, University of York, UK; David Hill, PhD, Center for Health Systems Research, University of York, UK; David Hill, PhD, Center for Health Systems Research, University of York, UK



doi:10.1111/cei.12327

OPINION

Hunt for the origin of allergy – comparing the Finnish and Russian Karelia

T. Haahtela¹, T. Laatikainen², H. Aaltonen³, R. Aavitsund⁴, R. Fehrius⁵, I. Haahtela⁶, L. von Hertzen⁷, P. Jousilahti⁸, T. U. Koskenvuo⁹, O. Mäkelä¹⁰, M. L. Mäkelä¹¹, V. Penttinen¹², M. Uusitalo¹³, E. Zilber¹⁴, and E. Vartiainen¹⁵

¹Skin and Allergy Hospital, Helsinki University Central Hospital, Helsinki, Finland; ²National Institute for Health and Welfare, Helsinki, Finland; ³Institute of Public Health and Clinical Nutrition, University of Eastern Finland, Helsinki, Finland; ⁴Institute of Occupational Health, Helsinki, Finland; ⁵Institute of Biotechnology, University of Helsinki, Helsinki, Finland; ⁶Department of Biomedicine, University of Helsinki, Helsinki, Finland; ⁷Department of Biotechnology and Immunology, Helsinki University Central Hospital, Helsinki, Finland; ⁸Department of Biostatistics, University of Helsinki, Helsinki, Finland; ⁹Department of Biostatistics, University of Helsinki, Helsinki, Finland; ¹⁰Department of Biostatistics, University of Helsinki, Helsinki, Finland; ¹¹Department of Biostatistics, University of Helsinki, Helsinki, Finland; ¹²Department of Biostatistics, University of Helsinki, Helsinki, Finland; ¹³Department of Biostatistics, University of Helsinki, Helsinki, Finland; ¹⁴Department of Biostatistics, University of Helsinki, Helsinki, Finland; ¹⁵Department of Biostatistics, University of Helsinki, Helsinki, Finland

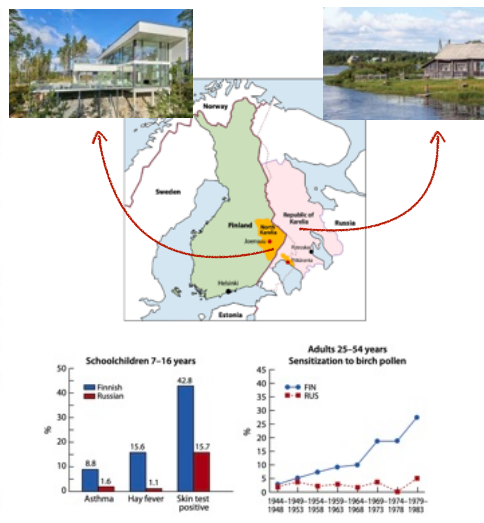
Clinical & Experimental Allergy

Summary

The Finnish and Russian Karelia are adjacent areas in northern Europe, socio-economically distinct but geographically similar. The Karelia Allergy Study was commenced in 1998 to characterize the allergy profiles in the two areas. Allergy prevalence had increased in Finland since the early 1960s, but the situation in Russia was unknown. The key finding was that allergic symptoms and diseases were systematically more common in Finnish children and adults than in their Russian counterparts. For example, in the early 2000s, hay fever in school children was almost non-existent in Russian Karelia, and only 2% were sensitized to birch pollen compared with 27% in Finnish Karelia. Adult birth cohorts showed that among those born in the 1940s, the sensitization to pollen and pets was at the same low level in both countries, but among younger generation born in the late 1970s, the difference was already manifest. Sensitization to some pathogens, microbial content in house dust and drinking water seemed to confer allergy protection in Russia. In subsequent studies, it became apparent that on the Finnish side, healthy children had a more bio-diverse living environment as well as greater diversity of certain bacterial classes on their skin than atopic children. Abundance of skin commensals, especially *Acinetobacter* (gammaproteobacteria), associated with anti-inflammatory gene expression in blood leukocytes. In vivo experiments with the mouse model demonstrated that intradermally applied *Acinetobacter* protected against atopic sensitization and lung inflammation. These observations support the notion that the epidemic of allergy and asthma results from reduced exposure to natural environments with rich microbiota, changed diet and sedentary lifestyle. Genetic studies have confirmed strong influence of lifestyle and environment. With our results from the Karelia study, a 10-year National Allergy Programme was started in 2008 to combat the epidemic in Finland.

Keywords: allergy, epidemic, allergy programme, biodiversity, immune tolerance, Karelia study, skin microbiome

Submitted 12 November 2014; revised 13 January 2015; accepted 16 January 2015



PERSPECTIVE

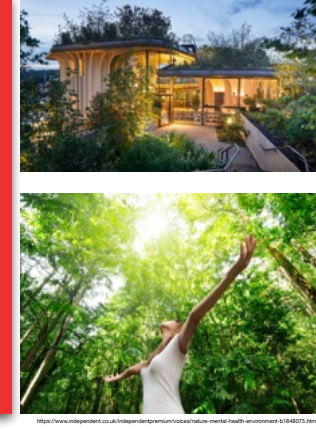
Regulation of the immune system by biodiversity from the natural environment: An ecosystem service essential to health

Graham A. Rook¹

¹Centre for Clinical Microbiology, Department of Infection, and the National Institute for Health Research and University College London Hospitals Biomedical Research Centre, University College London, London NW3 2PF, United Kingdom

Edited by Raul M. Malmgren, Yale University School of Medicine, New Haven, CT, and approved October 1, 2013 (received for review July 23, 2013)

Epidemiological studies suggest that living close to the natural environment is associated with long-term health benefits including reduced death rates, reduced cardiovascular disease, and reduced psychiatric problems. This is often attributed to psychological mechanisms, boosted by exercise, social interactions, and sunlight. Compared with urban environments, exposure to green spaces does indeed trigger rapid psychological, physiological, and endocrinological effects. However, there is little evidence that these rapid transient effects cause long-term health benefits or even that they are a specific property of natural environments. Meanwhile, the illnesses that are increasing in high-income countries are associated with falling immunoregulation and poorly regulated inflammatory responses, manifested as chronically raised C-reactive protein and proinflammatory cytokines. This failure of immunoregulation is partly attributable to a lack of exposure to organisms ('Old Friends') from mankind's evolutionary past that needed to be tolerated and therefore evolved roles in driving immunoregulatory mechanisms. Some Old Friends (such as helminths and infections picked up at birth that established carrier states) are almost eliminated from the urban environment. This increases our dependence on Old Friends derived from our mothers, other people, animals, and the environment. It is suggested that the requirement for microbial input from the environment to drive immunoregulation is a major component of the beneficial effect of green space, and a neglected ecosystem service that is essential for our well-being. This insight will allow green spaces to be designed to optimize health benefits and will provide impetus for health systems for the preservation of ecosystem biodiversity.



Naturally-diverse airborne environmental microbial exposures modulate the gut microbiome and may provide anxiolytic benefits in mice

Craig Liddicoat^{a,*}, Harrison Sydnor^a, Christian Cando-Dumancela^a, Romy Dresken^a, Jiajun Liu^{b,c,2}, Nicholas J.C. Gellie^{a,2}, Jacob G. Mills^{a,2}, Jennifer M. Young^{a,2}, Laura S. Weyrich^{a,2}, Mark R. Hutchinson^{b,c,6}, Philip Weinstein^{a,7}, Martin F. Breed^{a,d,e,8}

^a School of Biological Sciences and the Environment Institute, The University of Adelaide, Adelaide, South Australia 5005, Australia

^b Adelaide Medical School, The University of Adelaide, Adelaide, South Australia 5005, Australia

^c Australian Research Council Centre of Excellence for Nanoscale BioPhotonics, The University of Adelaide, Adelaide, South Australia 5005, Australia

^d College of Science and Engineering, Flinders University, Bedford Park, South Australia 5042, Australia

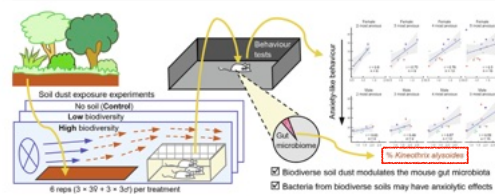
^e Australian Centre for Ancient DNA, The University of Adelaide, Adelaide, South Australia 5005, Australia

^f Australian Research Council Centre of Excellence for Australian Biodiversity and Heritage, The University of Adelaide, Adelaide, South Australia 5005, Australia

HIGHLIGHTS

- The effect of biodiverse aerobiosis on gut microbiota was previously untested.
- We demonstrate that exposure to biodiverse soil dust modulates mouse gut microbiota.
- Biodiverse soil exposure may help supplement butyrate-producing bacteria in the gut.
- These bacteria appear to moderate anxiety-like behaviour in the most anxious mice.
- We suggest a new hypothesis linking biodiverse soils, gut health and mental health.

GRAPHICAL ABSTRACT



Contents lists available at SciVerse ScienceDirect

Behavioural Processes

journal homepage: www.elsevier.com/locate/behavproc

Ingestion of *Mycobacterium vaccae* decreases anxiety-related behavior and improves learning in mice

Dorothy M. Matthews^{a,*}, Susan M. Jenks^b

^a Department of Biology, The Sage Colleges, Troy, NY 12208, USA

^b Departments of Biology & Psychology, The Sage Colleges, Troy, NY 12208, USA

ARTICLE INFO

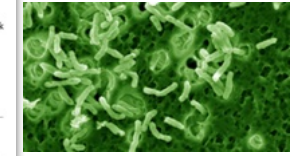
Article history:
Received 5 January 2013
Accepted 18 February 2013

Keywords:
Mycobacterium vaccae
Serotonin
Learning
Memory
Anxiety-related behaviors
Old friends hypothesis

ABSTRACT

Coevolution of microbes and their hosts has resulted in the formation of symbiotic relationships that enable animals to adapt to their environments and protect themselves against pathogens. Recent studies show that contact with tolerogenic microbes is important for the proper functioning of immunoregulatory circuits affecting behavior, emotionality and health. Few studies have examined the potential influence of ambient bacteria, such as *Mycobacterium vaccae* on the gut-brain-microbiota axis. In this preliminary research, we show that mice fed live *M. vaccae* prior to and during a maze learning task demonstrated a reduction in anxiety-related behaviors and maze completion time, when tested at three maze difficulty levels over 12 trials for four weeks. Treated mice given *M. vaccae* in their reward completed the maze twice as fast as controls, and with reduced anxiety-related behaviors. In a consecutive set of 12 maze trials without *M. vaccae* exposure, treated mice continued to run the maze faster for the first three trials, and with fewer errors overall, suggesting a treatment persistence of about one week. Following a three-week hiatus, a final maze run revealed no differences between the experimental and controls. Additionally, *M. vaccae*-treated mice showed more exploratory head-dip behavior in a zero maze, and *M. vaccae* treatment did not appear to affect overall activity levels as measured by activity wheel usage. Collectively, our results suggest a beneficial effect of naturally delivered, live *M. vaccae* on anxiety-related behaviors and maze performance, supporting a positive role for ambient microbes in the immunomodulation of animal behavior.

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Immunization with a heat-killed preparation of the environmental bacterium *Mycobacterium vaccae* promotes stress resilience in mice

Stefan O. Reber^{a,*}, Philipp H. Siebler^{a,1}, Nina C. Donner^{a,1}, James T. Morton^{a,2}, David G. Smith^{a,3}, Jared M. Kopelman^{a,4}, Kenneth R. Lowe^a, Kristen J. Wheeler^{a,5}, James H. Fox^a, James E. Hassell Jr.^{a,6}, Benjamin N. Greenwood^{a,7}, Charline Janssch^{a,8}, Anja Lechner^{a,9}, Dominik Schmidt^{a,10}, Nicole Uschold-Schmidt^a, Andrea M. Fuchs^{a,11}, Dominik Langgartner^{a,12}, Frederick R. Walker^a, Matthew W. Hale^a, Gerardo Lopez Perez^{a,13}, Will Van Treuren^{a,14}, Antonio Gonzalez^{a,15}, Charles L. Halweg-Edwards^a, Monika Flescher^a, Charles L. Reason^{a,16}, Graham A. Rook^{a,17}, Shyamal D. Peddada^{a,18}, Rob Knight^{a,19}, and Christopher A. Lowry^{a,20}

^a Laboratory for Molecular Psychosomatics, Clinic for Psychosomatic Medicine and Psychotherapy, University of Ulm, D-89081 Ulm, Germany; ^b Department of Behavioral and Molecular Neuroscience, University of Regensburg, D-93053 Regensburg, Germany; ^c Department of Integrative Physiology, University of Colorado Boulder, Boulder, CO 80509; ^d Center for Neurobiology, University of Colorado Boulder, Boulder, CO 80509; ^e Institute of Immunology, University of Regensburg, D-93042 Regensburg, Germany; ^f School of Biomedical Sciences and Pharmacy, University of Newcastle, Callaghan 2308, Australia; ^g School of Psychological Science, La Trobe University, Bundoora 3086, Australia; ^h Biometrics Institute, University of Colorado Boulder, Boulder, CO 80509; ⁱ Department of Pediatrics, University of California, San Diego, La Jolla, CA 92093; ^j Computer Science and Engineering, University of California, San Diego, La Jolla, CA 92093; ^k Department of Chemical and Biological Engineering, University of Colorado Boulder, Boulder, CO 80509; ^l School of Human Ecology, University of Wisconsin-Madison, Madison, WI 53706; ^m School of Medicine and Public Health, University of Wisconsin-Madison, Madison, WI 53706; ⁿ Center for Clinical Microbiology, UCL (University College London), London WC1E 6BT, United Kingdom; ^o Computational Biology Branch, National Institute of Environmental Health Sciences, Research Triangle Park, NC 27709; ^p Center for Microbiome Innovation, University of California, San Diego, La Jolla, CA 92093

Edited by Bruce S. McEwen, The Rockefeller University, New York, NY, and approved April 13, 2016 (received for review January 8, 2016)

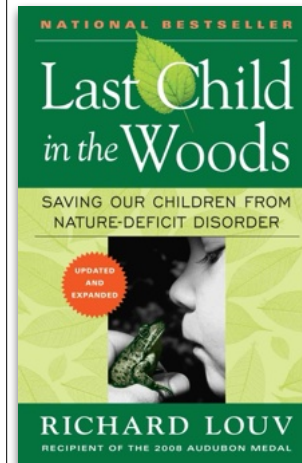
The prevalence of inflammatory diseases is increasing in modern urban societies. Inflammation increases risk of stress-related pathology; consequently, immunoregulatory or anti-inflammatory approaches may protect against negative stress-related outcomes. We show that stress disrupts the homeostatic relationship between the microbiota and the host, resulting in exaggerated inflammation. Repeated immunization with a heat-killed preparation of *Mycobacterium vaccae*, an immunoregulatory environmental microorganism, reduced subordinates, flight, and avoiding behavioral responses to a dominant aggressor in a murine model of chronic psychosocial stress when tested 2–4 wk following the final immunization. Furthermore, immunization with *M. vaccae* prevented stress-induced spontaneous colitis and, in stressed mice, induced anxiolytic or fear-reducing effects as measured on the elevated plus-maze, despite stress-induced gut microbiota changes characteristic of gut infection and colitis. Immunization with *M. vaccae* also prevented stress-induced aggression of colitis in a model of inflammatory bowel disease. Depletion of regulatory T cells negated protective effects of immunization with *M. vaccae* on stress-induced colitis and anxiety-like or fear behaviors. These data provide a framework for developing microbiome- and immunoregulation-based strategies for prevention of stress-related pathologies.

Author contributions: S.O.R., A.E., C.L.R., G.A.R., R.K., and C.A.L. designed research; S.O.R., P.H.S., N.C.D., J.T.M., K.J.W., C.J., A.L., D.S., N.U., A.M.F., D.L., F.W., M.W., G.L.P., W.V., and R.K. performed research; S.O.R., P.H.S., N.C.D., J.T.M., G.S., J.M.R., K.L., J.F., L.E.H., A.G., A.L.F., M.W., M.H., A.L.H., M.F., S.D.P., R.K., and C.A.L. analyzed data and S.O.R. and C.A.L. wrote the paper.

The authors declare no conflict of interest.

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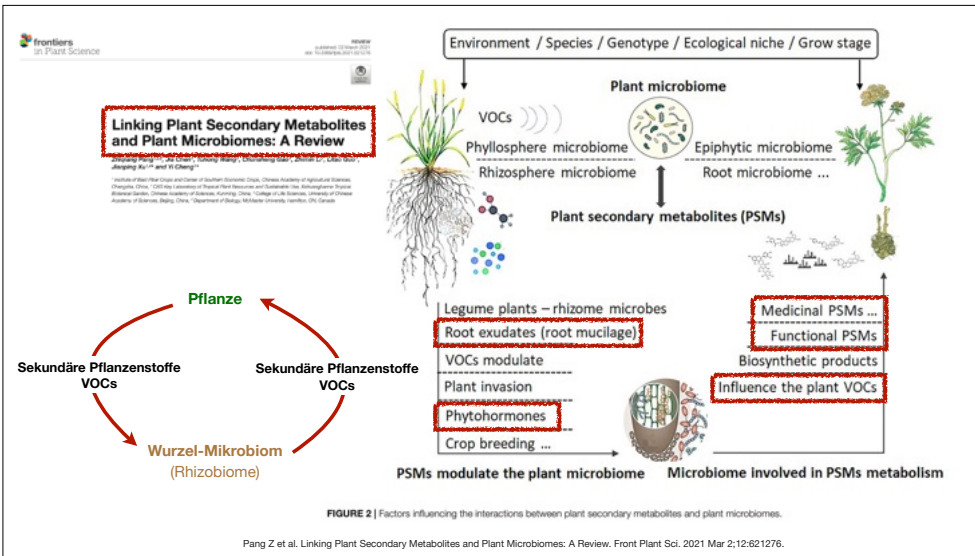
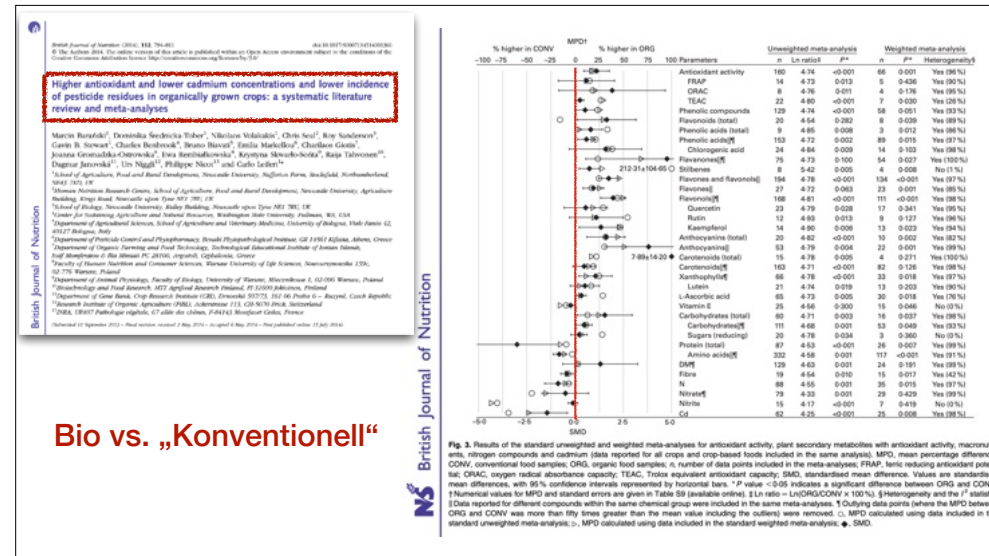
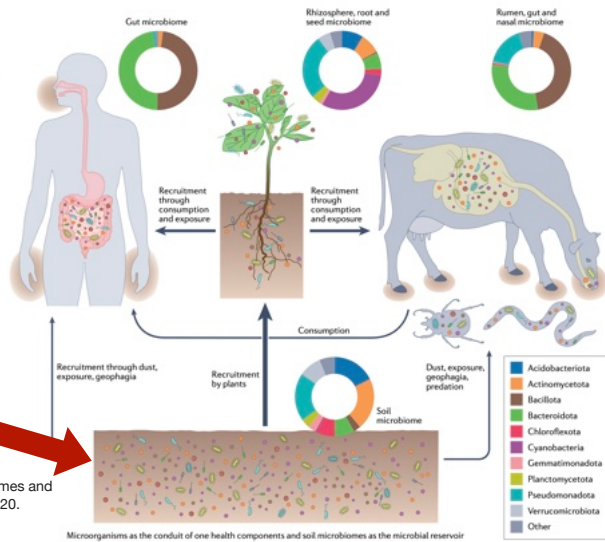
„Nature-Deficit Disorder“

REVIEWS

Soil microbiomes and one health

Abstract The concept of one health highlights that human health is inextricably linked to the health of animals, plants and environments. In this Review, we discuss how soil microbiomes are a cornerstone of one health and a source of novel drugs, vaccines, and nutrients. We also discuss the role of soil microbiomes in the overall microbial diversity in a wide range of organisms and ecosystems. We highlight the role of soil microbiomes in the health of humans, animals, and plants, and the role of soil microbiomes in the health of ecosystems. We also discuss the role of soil microbiomes in the health of ecosystems. We also discuss the role of soil microbiomes in the health of ecosystems.

Banerjee S, van der Heijden MGA. Soil microbiomes and one health. Nat Rev Microbiol. 2023 Jan;21(1):6-20.



RESEARCH PAPER



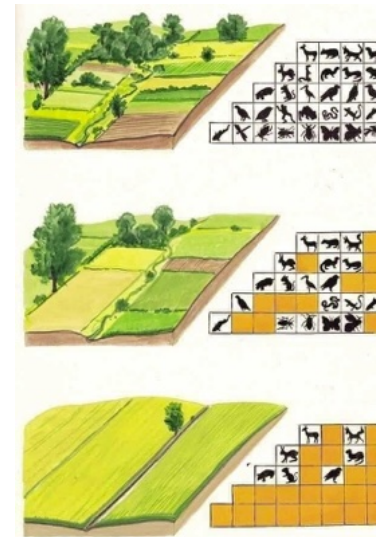
The edible plant microbiome: evidence for the occurrence of fruit and vegetable bacteria in the human gut

Wisnu Adi Wicaksono^a, Tomislav Cernava^{a,b}, Birgit Wassermann^a, Ahmed Abdelfattah^{a,c}, Maria J. Soto-Giron^d, Gerardo V. Toledo^d, Suvi M. Virtanen^{e,f,g,h}, Mikael Knip^{i,j}, Heikki Hyöty^k, and Gabriele Berg^{a,c,l}

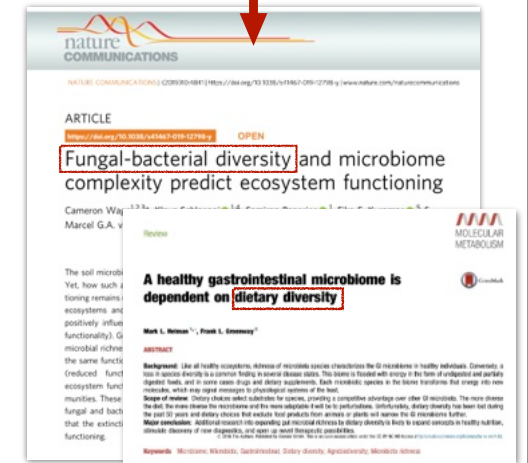


Die Aufnahme von pflanzenassoziierten Bakterien durch den Verzehr von Obst und Gemüse ist eine der Hauptverbindungen zwischen dem menschlichen Mikrobiom und dem Umweltmikrobiom.

Daher können alle Faktoren, die die einheimische Obst- und Gemüse-mikrobiota beeinflussen, d.h. landwirtschaftliche Praktiken, Zucht und Behandlungen nach der Ernte direkt/indirekt die Zusammensetzung der Darmmikrobiota beeinflussen.



← Biodiversität!



Was schadet den Mikroorganismen?

- **Intensive Bodenbearbeitung** verringert die Diversität von Bodenpilzen und Bakterien und stört insbesondere Pilzhyphen, wodurch die Zufuhr von Mineralstoffen durch Pilzsymbionten zu Pflanzen verringert wird. (z.B. Anderson et al., 2017)
- **Synthetischer Stickstoffdünger** reduziert die Häufigkeit und Vielfalt von Mykorrhizapilzen (z.B. Egerton-Warburton & Allen, 2000).
- **Stickstoffreiche Düngemittel** reduzieren die Produktion von sekundären Pflanzenstoffen (z.B. Polyphenole), die für Pflanzenabwehr wichtig sind (z.B. Brandt et al., 2011).

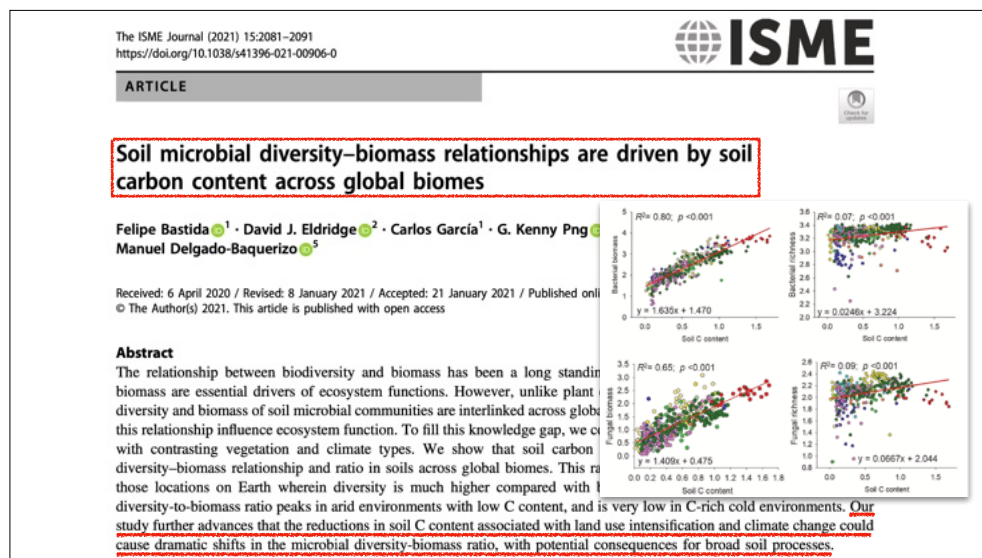
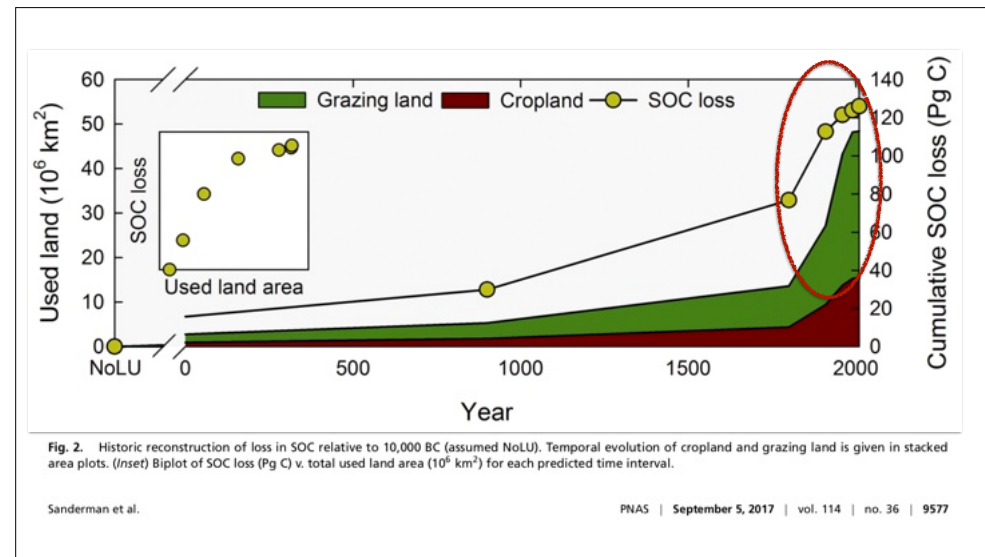
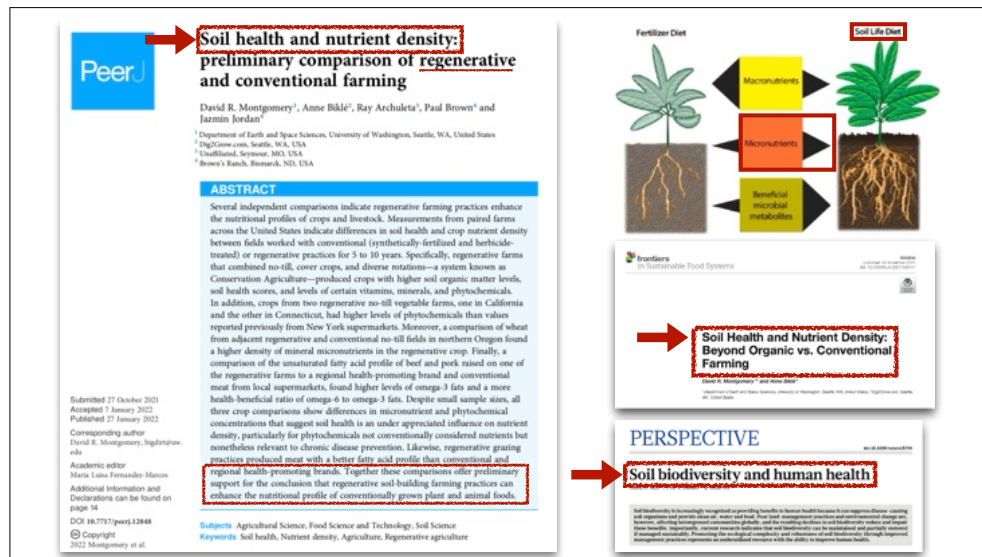
Anderson, C., Beare, M., Buckley, H. L., and Lear, G. (2017). Bacterial and fungal communities respond differently to varying tillage depth in agricultural soils. *PeerJ* 5:e3930. doi: 10.7717/peerj.3930

Egerton-Warburton, L. M., and Allen, E. B. (2000). Shifts in arbuscular mycorrhizal communities along an anthropogenic nitrogen gradient. *Ecol. Appl.* 10, 484–496.

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Pflanzliche Lebensmittel: Bio vs. „Konventionell“

- biologisch angebauter Weizen, Mais, Kartoffeln, Äpfel und Birnen enthalten durchschnittlich **60–125% mehr Eisen, Zink, Kalzium, Phosphor, Magnesium und Kalium** im Vergleich zu konventionell angebauten Lebensmitteln (Smith, 1993)
- **Meta-Analyse 1:** Höherer Gehalt an **Mikronährstoffen (Beta-Carotin, Vitamin C, Bor, Kupfer und Zink)** in Bio-Gemüse und Leguminosen im Vergleich zu konventioneller Produktion (Hunter et al., 2011)
- **Meta-Analyse 2:** Biologischer Anbau —> **signifikant höhere Konzentrationen an Antioxidantien**; Konventioneller Anbau —> höhere Mengen an Pestizidrückständen und Schwermetall Cadmium (Baranski et al., 2014)
- „Menschen, die biologisch angebaute Lebensmittel konsumieren, nehmen 20–60% mehr sekundäre Pflanzeninhaltsstoffe zu sich, als wenn sie konventionelle Lebensmittel essen würden.“



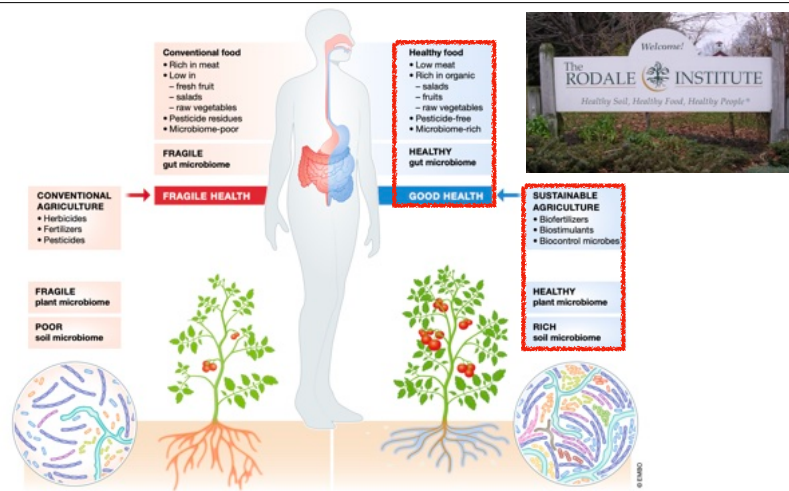
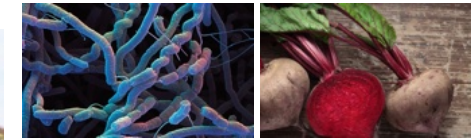


Figure 2. The direct and indirect effects of the plant microbiota on the human gut microbiome.

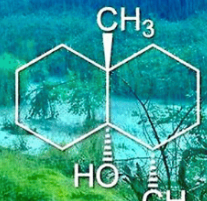
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Petrichor und Geosmin



The smell of rain

“Geosmin has a distinct earthy flavor and aroma, and is responsible for the earthy taste of beets and a contributor to the scent (petrichor) in the air when rain falls after a dry spell of weather. It is produced by a type of Actinobacteria.”



news & views

BACTERIAL ECOLOGY

Streptomyces' scent attracts spore dispersers

Earthy-smelling volatiles produced by sporulating *Streptomyces* attract soil arthropods that eat the bacteria and spread 'hitch-hiking' spores.

Marko Rohlf



„Nach meinem Tode wird der Lehm, der mich bedeckt, alles heilen, was ich zu heilen vermochte, als ich unter euch weilte“

– James McGirr, katholischer Pfarrer und Wunderheiler

NEWS

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Ancient Fermanagh cure gets modern makeover

By Julian Fowler

South West Reporter, BBC News NI

(1) 29 December 2018



Can the soil from this churchyard fight bacteria?

An ancient folk remedy from County Fermanagh could help scientists in the fight against drug-resistant bacteria.

According to local belief, the soil from a churchyard in Boho can cure infections.

A microbiologist who took samples to see if there was any scientific basis for the cure has made an astonishing discovery.



Dr Gerry Quinn said the next step was to identify the antibiotics in the soil.



Professor Banat is hopeful the secrets of the soil could help combat the threat of drug-resistant bacteria.

frontiers in microbiology

ORIGINAL RESEARCH
published: 05 October 2019
doi: 10.3389/fmicb.2019.02149

AMERICAN SOCIETY FOR MICROBIOLOGY

bioRxiv

OBSERVATION

CrossMark

Kisameet Clay Exhibits Potent Antibacterial Activity against the ESKAPE Pathogens

Uthairath Beharathan, Sarah L. Svensson*, Julian Davies
Department of Microbiology and Immunology, University of British Columbia, Vancouver, BC, Canada
*Present address: Sarah L. Svensson, Research Center for Infectious Diseases (RCID), University of Washington, Washington, Germany

ABSTRACT The ESKAPE (*Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Enterobacter species*) pathogens cause an increasing number of nosocomial infections worldwide since they escape the inhibitory effect of the available antibiotics and the immune response. Here, we report the broad-spectrum and potent antibacterial activity of Kisameet clay, a natural clay mined from British Columbia, Canada, against a group of multidrug-resistant ESKAPE strains. The results suggest that this natural clay might be developed as a therapeutic option for the treatment of serious infections caused by these important pathogens.

IMPORTANCE More than 50 years of misuse and overuse of antibiotics has led to a plague of antibiotic resistance that threatens to reduce the efficacy of antimicrobial agents available for the treatment of infections due to resistant organisms. The main threat is nosocomial infections in which certain pathogens, notably the ESKAPE organisms, are essentially untreatable and contribute to increasing mortality and morbidity in surgical wards. The pipeline of novel antimicrobials in the pharmaceutical industry is essentially empty. Thus, there is a great need to seek for new sources for the treatment of nosocomial infectious diseases. We describe experiments that demonstrate the efficacy of a "natural" medicine, Kisameet clay, against all of the ESKAPE strains. We suggest that this material is worthy of clinical investigation for the treatment of infections due to multidrug-resistant organisms.

In an effort to stem the rising tide of multi-resistant bacteria, researchers have turned to niche environments in the hope of discovering new varieties of antibiotics. We investigated an ethnomicrobiological (cultured) from an alkaline/neutral soil in the area of Bono, in the Tienmenshan Mountains (TM) in the presence of Streptomyces, a well-known producer of antibiotics. From this soil we isolated a novel (isolated relative 67% of genome relatedness) Streptomyces sp. capable of growth at high alkaline pH (10.5) and tolerant of genome related to 4-10%. Genomic sequencing identified many alkaline tolerance (antiproteinase/multi-resistance) genes compared to S. coelicolor M145 (at 3:1), hence we designated the strain Streptomyces sp. myophora, isolate MoG1, from the Greek, myo (fragrant) and phora (borne/leaved). In vitro tests demonstrated the ability of the Streptomyces sp. myophora, isolate MoG1 to inhibit the growth of many strains of ESKAPE pathogens, most notably carbapenem-resistant Acinetobacter baumannii (a critical pathogen on the WHO priority list of antibiotic-resistant bacteria), vancomycin-resistant Enterococcus faecium, and methicillin-resistant Staphylococcus aureus (both listed as high priority pathogens). Further in vitro prediction of antimicrobial potential of Streptomyces sp. myophora, isolate MoG1 by anti-SMASH and RAST software identified many secondary metabolite and toxicity resistance gene clusters (25 and 27, respectively) as well as many antibiotic resistance genes potentially related to antibiotic production. Follow-up in vitro tests show that the Streptomyces sp. myophora, isolate MoG1 was resistant to 28 out of 36 clinical antibiotics. Although not a comprehensive analysis, we think that some of the highly tested "repurposed" properties may be linked to the ability of Streptomyces sp. myophora, isolate MoG1 to inhibit ESKAPE pathogens. More importantly, further analysis may elucidate other key components that could alleviate the tide of multi-resistant nosocomial infections.

Keywords: alkaliphilic, antimicrobial, Streptomyces, ESKAPE pathogens, multi-resistant, ethnomicrobiology

OPEN ACCESS

Edited by: Alexander M. Klotzel, The University of Tokyo, Japan

Reviewed by: David M. Williams, National Institute of Allergy and Infectious Diseases, United States of America

***Correspondence:** Sarah L. Svensson, s.svensson@u.washington.edu

Specialty section: This article was submitted to Systems Microbiology, a section of the journal Frontiers in Microbiology

Received: 17 July 2019
Accepted: 21 September 2019
Published: 05 October 2019
Citation: Beharathan U, Svensson SL and Davies J (2019) Kisameet Clay Exhibits Potent Antibacterial Activity against the ESKAPE Pathogens. Front. Microbiol. 10:2149. doi: 10.3389/fmicb.2019.02149



Photo: University of British Columbia

ESKAPE (*Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Enterobacter species*)

Restoration Ecology

THE JOURNAL OF THE SOCIETY FOR RESTORATION ECOLOGY

OPINION ARTICLE

Urban habitat restoration provides a human health benefit through microbiome rewilding: the Microbiome Rewilding Hypothesis

Jacob G. Mills¹, Philip Weinstein¹, Nicholas J. C. Gellie¹, Laura S. Weyrich³, Andrew J. Lowe^{1,2*}, Martin F. Breed^{1,2*}

Restoration aims to return ecosystem services, including the human health benefits of exposure to green space. The loss of such exposure with urbanization and industrialization has arguably contributed to an increase in human immune dysregulation. The Biodiversity and C reduced exposure to di whether restoration of such recovery. Here, we habitats in urban gre human disease. We sup reversed the degradate sequencing of environ The method is rapid, se of green-space restor planners, and restorati outcomes and investme

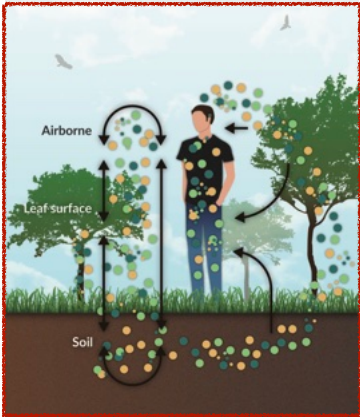
Key words: ecosystem

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nature reviews microbiology

https://doi.org/10.1038/s41579-024-00173-1

Research article

The indoors microbiome and human health

Jack A. Gilbert^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100,101,102,103,104,105,106,107,108,109,110,111,112,113,114,115,116,117,118,119,120,121,122,123,124,125,126,127,128,129,130,131,132,133,134,135,136,137,138,139,140,141,142,143,144,145,146,147,148,149,150,151,152,153,154,155,156,157,158,159,160,161,162,163,164,165,166,167,168,169,170,171,172,173,174,175,176,177,178,179,180,181,182,183,184,185,186,187,188,189,190,191,192,193,194,195,196,197,198,199,200,201,202,203,204,205,206,207,208,209,210,211,212,213,214,215,216,217,218,219,220,221,222,223,224,225,226,227,228,229,230,231,232,233,234,235,236,237,238,239,240,241,242,243,244,245,246,247,248,249,250,251,252,253,254,255,256,257,258,259,260,261,262,263,264,265,266,267,268,269,270,271,272,273,274,275,276,277,278,279,280,281,282,283,284,285,286,287,288,289,290,291,292,293,294,295,296,297,298,299,300,301,302,303,304,305,306,307,308,309,310,311,312,313,314,315,316,317,318,319,320,321,322,323,324,325,326,327,328,329,330,331,332,333,334,335,336,337,338,339,340,341,342,343,344,345,346,347,348,349,350,351,352,353,354,355,356,357,358,359,360,361,362,363,364,365,366,367,368,369,370,371,372,373,374,375,376,377,378,379,380,381,382,383,384,385,386,387,388,389,390,391,392,393,394,395,396,397,398,399,400,401,402,403,404,405,406,407,408,409,410,411,412,413,414,415,416,417,418,419,420,421,422,423,424,425,426,427,428,429,430,431,432,433,434,435,436,437,438,439,440,441,442,443,444,445,446,447,448,449,450,451,452,453,454,455,456,457,458,459,460,461,462,463,464,465,466,467,468,469,470,471,472,473,474,475,476,477,478,479,480,481,482,483,484,485,486,487,488,489,490,491,492,493,494,495,496,497,498,499,500,501,502,503,504,505,506,507,508,509,510,511,512,513,514,515,516,517,518,519,520,521,522,523,524,525,526,527,528,529,530,531,532,533,534,535,536,537,538,539,540,541,542,543,544,545,546,547,548,549,550,551,552,553,554,555,556,557,558,559,560,561,562,563,564,565,566,567,568,569,570,571,572,573,574,575,576,577,578,579,580,581,582,583,584,585,586,587,588,589,590,591,592,593,594,595,596,597,598,599,600,601,602,603,604,605,606,607,608,609,610,611,612,613,614,615,616,617,618,619,620,621,622,623,624,625,626,627,628,629,630,631,632,633,634,635,636,637,638,639,640,641,642,643,644,645,646,647,648,649,650,651,652,653,654,655,656,657,658,659,660,661,662,663,664,665,666,667,668,669,670,671,672,673,674,675,676,677,678,679,680,681,682,683,684,685,686,687,688,689,690,691,692,693,694,695,696,697,698,699,700,701,702,703,704,705,706,707,708,709,710,711,712,713,714,715,716,717,718,719,720,721,722,723,724,725,726,727,728,729,730,731,732,733,734,735,736,737,738,739,740,741,742,743,744,745,746,747,748,749,750,751,752,753,754,755,756,757,758,759,760,761,762,763,764,765,766,767,768,769,770,771,772,773,774,775,776,777,778,779,780,781,782,783,784,785,786,787,788,789,790,791,792,793,794,795,796,797,798,799,800,801,802,803,804,805,806,807,808,809,810,811,812,813,814,815,816,817,818,819,820,821,822,823,824,825,826,827,828,829,830,831,832,833,834,835,836,837,838,839,840,841,842,843,844,845,846,847,848,849,850,851,852,853,854,855,856,857,858,859,860,861,862,863,864,865,866,867,868,869,870,871,872,873,874,875,876,877,878,879,880,881,882,883,884,885,886,887,888,889,890,891,892,893,894,895,896,897,898,899,900,901,902,903,904,905,906,907,908,909,910,911,912,913,914,915,916,917,918,919,920,921,922,923,924,925,926,927,928,929,930,931,932,933,934,935,936,937,938,939,940,941,942,943,944,945,946,947,948,949,950,951,952,953,954,955,956,957,958,959,960,961,962,963,964,965,966,967,968,969,970,971,972,973,974,975,976,977,978,979,980,981,982,983,984,985,986,987,988,989,990,991,992,993,994,995,996,997,998,999,1000}

Research article

Temporary establishment of bacteria from indoor plant leaves and soil on human skin

Gwynne A. Burrell¹, Thomas K. Fahnenstiel², Ron Vandergeet³, Mario E. Mucarella⁴, Roxana Hickey⁵, Ashley C. Satterly⁶, Kevin G. Van Den Wymmenberg⁷ and Benjamin J. M. Bohannan⁸

ABSTRACT Beneficial effects of plant-associated microbes on indoor microbiomes and human health? *Gabriel Berg*¹, *Alexander Mahner*² and *Christine Mueland-Eichinger*³

IMPORTANCE Microbiome interplay: plants alter microbial abundance and diversity within the built environment *Alexander Mahner*¹, *Christine Mueland-Eichinger*² and *Gabriel Berg*³

ABSTRACT Enriching Beneficial Microbial Diversity of Indoor Plants and Their Surrounding Built Environment With Biostimulants *Alexander Mahner*¹, *Christine Mueland-Eichinger*² and *Gabriel Berg*³

PNAS

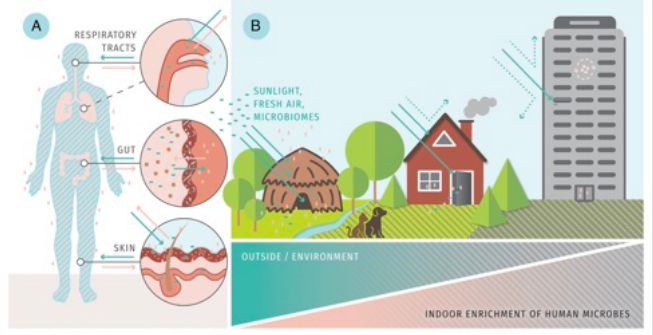
PERSPECTIVE

OPEN ACCESS

The potential importance of the built-environment microbiome and its impact on human health

Thomas C. G. Bosch^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100,101,102,103,104,105,106,107,108,109,110,111,112,113,114,115,116,117,118,119,120,121,122,123,124,125,126,127,128,129,130,131,132,133,134,135,136,137,138,139,140,141,142,143,144,145,146,147,148,149,150,151,152,153,154,155,156,157,158,159,160,161,162,163,164,165,166,167,168,169,170,171,172,173,174,175,176,177,178,179,180,181,182,183,184,185,186,187,188,189,190,191,192,193,194,195,196,197,198,199,200,201,202,203,204,205,206,207,208,209,210,211,212,213,214,215,216,217,218,219,220,221,222,223,224,225,226,227,228,229,230,231,232,233,234,235,236,237,238,239,240,241,242,243,244,245,246,247,248,249,250,251,252,253,254,255,256,257,258,259,260,261,262,263,264,265,266,267,268,269,270,271,272,273,274,275,276,277,278,279,280,281,282,283,284,285,286,287,288,289,290,291,292,293,294,295,296,297,298,299,300,301,302,303,304,305,306,307,308,309,310,311,312,313,314,315,316,317,318,319,320,321,322,323,324,325,326,327,328,329,330,331,332,333,334,335,336,337,338,339,340,341,342,343,344,345,346,347,348,349,350,351,352,353,354,355,356,357,358,359,360,361,362,363,364,365,366,367,368,369,370,371,372,373,374,375,376,377,378,379,380,381,382,383,384,385,386,387,388,389,390,391,392,393,394,395,396,397,398,399,400,401,402,403,404,405,406,407,408,409,410,411,412,413,414,415,416,417,418,419,420,421,422,423,424,425,426,427,428,429,430,431,432,433,434,435,436,437,438,439,440,441,442,443,444,445,446,447,448,449,450,451,452,453,454,455,456,457,458,459,460,461,462,463,464,465,466,467,468,469,470,471,472,473,474,475,476,477,478,479,480,481,482,483,484,485,486,487,488,489,490,491,492,493,494,495,496,497,498,499,500,501,502,503,504,505,506,507,508,509,510,511,512,513,514,515,516,517,518,519,520,521,522,523,524,525,526,527,528,529,530,531,532,533,534,535,536,537,538,539,540,541,542,543,544,545,546,547,548,549,550,551,552,553,554,555,556,557,558,559,560,561,562,563,564,565,566,567,568,569,570,571,572,573,574,575,576,577,578,579,580,581,582,583,584,585,586,587,588,589,590,591,592,593,594,595,596,597,598,599,600,601,602,603,604,605,606,607,608,609,610,611,612,613,614,615,616,617,618,619,620,621,622,623,624,625,626,627,628,629,630,631,632,633,634,635,636,637,638,639,640,641,642,643,644,645,646,647,648,649,650,651,652,653,654,655,656,657,658,659,660,661,662,663,664,665,666,667,668,669,670,671,672,673,674,675,676,677,678,679,680,681,682,683,684,685,686,687,688,689,690,691,692,693,694,695,696,697,698,699,700,701,702,703,704,705,706,707,708,709,710,711,712,713,714,715,716,717,718,719,720,721,722,723,724,725,726,727,728,729,730,731,732,733,734,735,736,737,738,739,740,741,742,743,744,745,746,747,748,749,750,751,752,753,754,755,756,757,758,759,760,761,762,763,764,765,766,767,768,769,770,771,772,773,774,775,776,777,778,779,780,781,782,783,784,785,786,787,788,789,790,791,792,793,794,795,796,797,798,799,800,801,802,803,804,805,806,807,808,809,810,811,812,813,814,815,816,817,818,819,820,821,822,823,824,825,826,827,828,829,830,831,832,833,834,835,836,837,838,839,840,841,842,843,844,845,846,847,848,849,850,851,852,853,854,855,856,857,858,859,860,861,862,863,864,865,866,867,868,869,870,871,872,873,874,875,876,877,878,879,880,881,882,883,884,885,886,887,888,889,890,891,892,893,894,895,896,897,898,899,900,901,902,903,904,905,906,907,908,909,910,911,912,913,914,915,916,917,918,919,920,921,922,923,924,925,926,927,928,929,930,931,932,933,934,935,936,937,938,939,940,941,942,943,944,945,946,947,948,949,950,951,952,953,954,955,956,957,958,959,960,961,962,963,964,965,966,967,968,969,970,971,972,973,974,975,976,977,978,979,980,981,982,983,984,985,986,987,988,989,990,991,992,993,994,995,996,997,998,999,1000}

ABSTRACT The human body is constantly exposed to its microbial environment. (A) Traditional lifestyle buildings that are open to nature allow human exposure to natural microbes and elements. As humans urbanize, dwellings are placed in settings where natural elements are highly reduced compared to the environment we have evolved in (e.g., there is less dirt, fewer trees) and architectural design encloses buildings. In these enclosed, almost impermeable urban buildings humans become the main source of microbes, thus impairing human exposure to nature and its elements. Image credit: Katja Bosch TCG et al.



Bosch TCG et al. The potential importance of the built-environment microbiome and its impact on human health. Proc Natl Acad Sci U S A. 2024 May 14;121(20):e2313971121.



Christian Franz Paullini's „Heylsame“ Dreck-Apotheke (1697)



Shilajit/Mumijo
(Fulvinsäure, Huminsäuren)

Außerdem Mineralstoffe und Spurenelemente wie z.B. Eisen, Kupfer, Kalzium, Molybdän, Chrom und Zink



Reines (Trink)Moor



Heilerde

de Melo BA, Motta FL, Santana MH. Humic acids: Structural properties and multiple functionalities for novel technological developments. Mater Sci Eng C Mater Biol Appl. 2016 May;62:967-74.
Swidsinski A et al. Impact of humic acids on the colonic microbiome in healthy volunteers. World J Gastroenterol. 2017 Feb 7;23(5):885-890.



