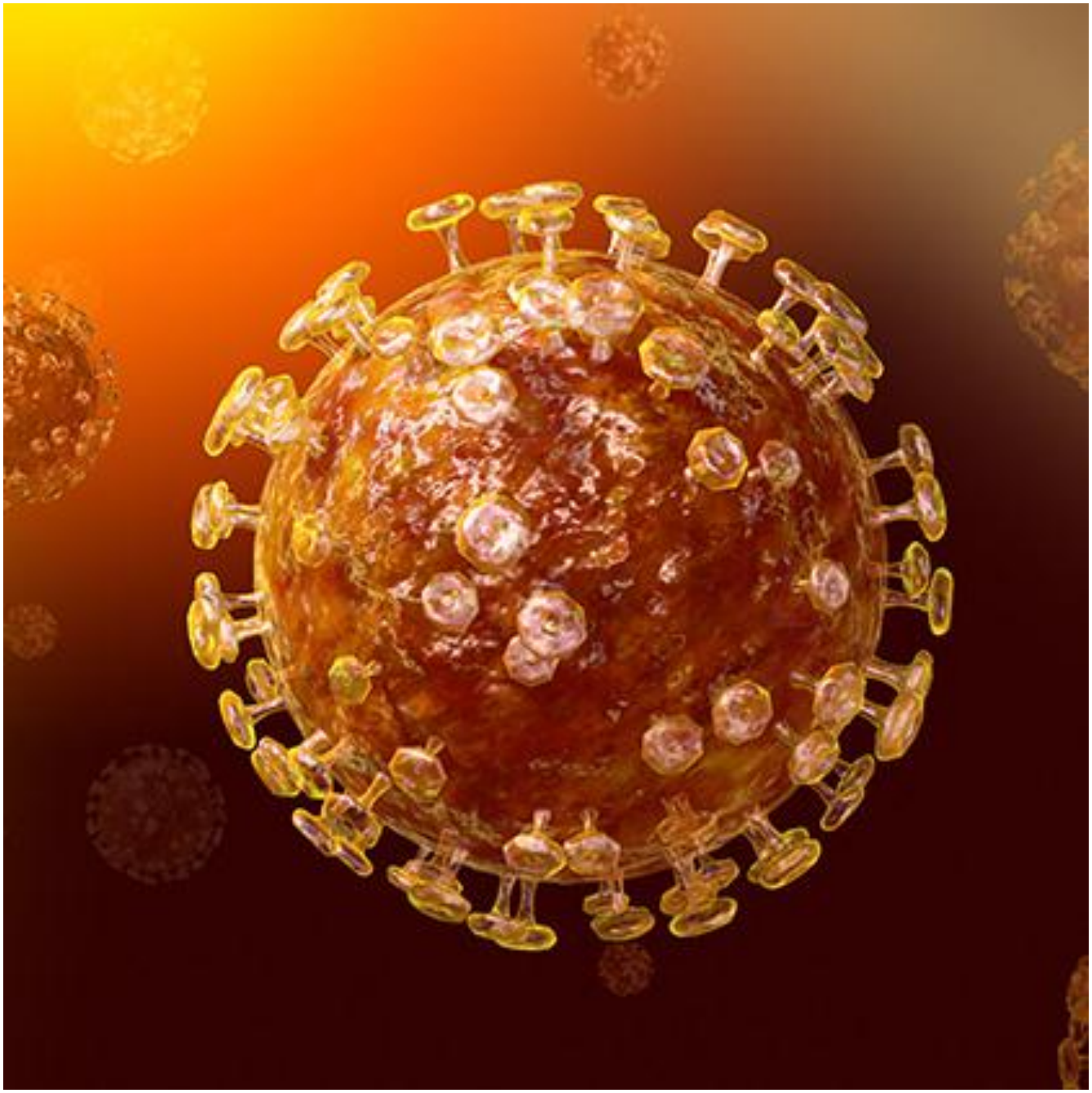
ISSN-0974-1550

ENVIS NEWSLETTER

MICROORGANISMS AND ENVIRONMENT MANAGEMENT

(Sponsored by Ministry of Environment, Forest & Climate Change, Government of India)

VOLUME 13 ISSUE 2 Apr - Jun., 2015



ENVIS CENTRE
Department of Zoology
University of Madras, Guindy Campus, Chennai - 600 025
Telefax: 91-44-22300899; E-mail: dzum@envis.nic.in; enviscoordinator@gmail.com
Websites: www.dzumenvis.nic.in ; www.envismadrasuniv.org; www.envismicrobes.in (Tamil version)

ISSN - 0974 - 1550

Volume 13 | Issue 2 | Apr. - Jun., 2015

PUBLISHED BY

Environmental Information System (ENVIS) Centre

Department of Zoology

University of Madras, Guindy Campus,

Chennai - 600 025, Tamilnadu, India.

SPONSORED BY

Ministry of Environment, Forest & Climate Change

Government of India

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ENVIS Newsletter on 'Microorganisms and Environment Management', a quarterly publication, brings out original research articles, reviews, reports, research highlights, news-scan etc., related to the thematic area of the ENVIS Centre. In order to disseminate the cutting-edge research findings to user community, ENVIS Centre on Microorganisms and Environment Management invites original research and review articles, notes, research and meeting reports. Details of forthcoming conferences / seminars / symposia / trainings / workshops also will be considered for publication in the newsletter.

The articles and other information should be typed in double space with a maximum of 8 - 10 typed pages. Photographs/line drawings and graphs need to be of good quality with clarity for reproduction in the newsletter. For references and other details, the standard format used in refereed journals may be followed.

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The Co-ordinator

ENVIS Centre

Department of Zoology

University of Madras

Guindy Campus, Chennai - 600 025

Tamil Nadu, INDIA

(OR)

Send your articles by e-mail:

dzum@envis.nic.in

enviscoordinator@gmail.com

Cover page : 3-D image of MERS (Middle East Respiratory Syndrome) Coronavirus: MERS is an illness affects the respiratory system (lungs and breathing tubes). Most MERS patients developed severe acute respiratory illness with symptoms of fever, cough and shortness of breath. About 3-4 out of every 10 patients reported with MERS have died.

ENVIS Newsletter
on
Microorganisms and Environment Management

Contents

22 MAY 2015
INTERNATIONAL DAY
FOR BIOLOGICAL DIVERSITY
BIODIVERSITY FOR SUSTAINABLE DEVELOPMENT

Dear Readers,

Nanoparticles are the simplest form of structures with particles between 1 and 100 nanometers. In principle any collection of atoms bonded together with a structural radius of < 100 nm can be considered a nanoparticle and are further classified accordingly. In nanotechnology, a particle is defined as a small object that behaves as a whole unit with respect to its transport and properties. Nanotechnology is helping to considerably improve, even revolutionize many technology and industry sectors and show rapidly growing benefits and applications in the fields of everyday materials process, electronics and IT applications, sustainable energy applications, environmental remedy applications, medical and healthcare applications, transportations etc.

With regard to Environmental remediation, there are many eco-friendly applications for nanotechnology, such as materials that provide clean water from polluted water sources in both large-scale and portable applications, to clean industrial water pollutants in ground water through chemical reactions, nanofabric paper towel, that can absorb 20 times its weight in oil for cleanup applications, mechanical filtration in vehicles, and ones that detect and clean up environmental contaminants. Now, researchers are involved to develop carbon nanotube "scrubbers," and membranes to separate carbon dioxide from power plant exhaust.

This issue includes a research article that evaluates the impact of nanoparticles to remove the highly toxic textile dye using biological component, the microorganisms, from polluted water in a cost effective manner. Other interesting information like bacterial mechanism on soil networking, bacterial raincoat for crop production, the impact of soil fertility are also included.

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Prof. N. Munuswamy

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SCIENTIFIC ARTICLE

Adsorption of textile dyes using biogenic silver nanoparticles modified yeast cells

M. Girilal[1]*, Abraham Varghese[2], V. Krishnakumar[3] and P. T. Kalaichelvan[4]

[1]Department of Biotechnology, SB College, Changanacherry- 686 101 , Kottayam, Kerala. [2] George Clinical, # 333, Nova Miller, Thimmaiah Road, Bangalore- 560052, Karnataka. [3] Department of Zoology, University of Madras, Guindy Campus, Chennai - 600 025, Tamilnadu. [4]. Alka Research Foundation, Anna Nagar, Maruthamalai Adivaaram, Coimbatore - 641 046, Tamilnadu.

e-mail: girilal@gmail.com

*For correspondence

Abstract

Silver nanoparticles were synthesized biologically from the fungal species *Trichoderma viridae*. The synthesized biogenic silver nanoparticles were immobilized using yeast cells as well as sodium alginate beads and were used to decolourize dye. The rate of decolourization was effective using silver nano particles modified yeast cells, *Saccharomyces cerevisiae*. Decolourization was due to adsorption of textile dyes by silver nanoparticles modified yeast cells and adsorption capacity was enhanced up to 500 ppm within 2 hours for selected test dyes. Silver nanoparticles modified yeast cells were immobilized in sodium alginate and can be introduced to the dye treatment plant when going for a large scale dye treatment applications. Since the dye is properly attached by ionic interaction with the immobilized modified yeast cells, it can be removed easily, releasing back the treated waste water. Adsorption was mainly due to the ionic interaction of silver nanoparticles modified yeast cells with dyes. A schematic diagram is proposed explaining the ionic interactions between silver nanoparticles modified yeast cells and dye.

Keywords: Silver nanoparticles, *Saccharomyces cerevisiae*, adsorption, textile dyes.

Introduction

Pollution control is one of the prime concerns of today's society. With economic constraints on pollution, affordable and effective methods have become a necessity to control the pollution. Untreated or partially treated wastewaters and industrial effluents are discharged into natural ecosystems that pose serious problems to the ecosystem and life forms. Among the various types of organic pollutants present in the ecosystems, chemical colouring agents or dyes are the most difficult to decompose and may act as carcinogens. Textile industries are the main source of dye that pollutes the environment. As the production of textile industry increase, volume of wastewater containing processed textile dyes also increases steadily (Bhole *et al*., 2004; Mohamed , 2004).

Different approaches have been used to reduce the textile dye pollution in aquatic medium. Generally chemical and physical treatment procedures are used to treat the textile pollution (Hao *et al*., 2000); but they are less effective and highly expensive. Among various adsorbents used for the removal of dyes from polluted waters, the use of biological materials, (live or dead microorganisms) are more efficient due to their biosorption and biodegradation properties and cost effectiveness.

Although dye decolourization can be achieved by bacterial (Kumar *et al*., 1997) and fungal (Sathiyamoorthi *et al*., 2006) degradation, increasing demands for effective and economical technologies have led to research into a biosorption-based process and have been used effectively in the effluent treatment processes mainly for heavy metals and dyes. In this study, adsorption of some common textile dyes were carried out using biogenic silver nanoparticles modified *Saccharomyces cerevisiae* immobilized in sodium alginate.

Materials and methods

Silver nanoparticles (AgNPs) were synthesized from fungus *Trichoderma viride*, as per the optimized protocol by Fayaz *et al*. (2009). To prepare the biomass for biosynthesis of AgNPs, the fungus was grown aerobically and the fungal biomass was mixed with 100 ml of sterile double distilled water and agitated on an orbital shaker at 150 rpm for 48h at 27°C. After incubation, the cell filtrate was filtered through Whatman filter paper no. 1 and to 100ml of cell filtrate $AgNO_3$ was added and kept undisturbed for 24 h in dark conditions to get an overall Ag^+ ion concentration of 10^{-3} M.

The yeast, *Saccharomyces cerevisiae* was procured from Rhibozen chemicals, India and it was modified by the following optimized procedure as given below. The yeast cell pellets (1.5 g) were suspended in 2 ml of de-ionised water and centrifuged at 5000 rpm. The pellet was resuspended with 2 ml of 0.1M acetate buffer (pH 4.6). The suspension was centrifuged and finally the pellet was dissolved in acetate buffer. Yeast cell suspension was kept in boiling water bath and the killing time was optimized at 5 minutes interval (5 to 20 min). The silver nanoparticle and heat

killed yeast cell suspension ratio was optimized. The suspension was vortexed and incubated at room temperature (27˚C) for one hour in an orbital shaker. After incubation, the modified yeast cells were washed with de-ionized water and it can be used for further experimental works.

The textile dye stock solution was prepared from the selected anionic dyes like Reactive Black 5, Remazol Brilliant Blue R, Reactive Navy Blue and Acid Red at the concentration of 100 –500ppm.

The modified yeast cells were immobilized using calcium alginate beads and blended in 2 % (w/v) sodium alginate solution. Calcium alginate beads were prepared using 0.2 M calcium chloride. The beads were allowed for curing in calcium chloride solution (one hour). The hardened beads were washed with sterile de-ionised water in order to remove excess $CaCl_2$. The treated dye solutions were incubated in orbital shaker at 120 rpm.

Dye decolorization rate was measured in a Spectrophotometer (Milton Roy Spectronic 601) at 498nm for Reactive Black 5, 630nm for Remazol Brilliant Blue R, 607nm for Reactive Navy Blue and at 507nm for Acid Red. The readings were taken every 10 minutes interval up to 120 minutes. The rate of decolorization was calculated by the following formula:

$$\textbf{Decolourization Percentage} = \frac{(A_0 - A)}{A_0} \times 100$$

Where A_0 is the absorbance of untreated dye, A is absorbance after treatment

All values are expressed as means ± standard deviation. The results were analyzed using one-way analysis of variance (ANOVA) and the differences of the decolorization percentage among the dye were analyzed using the Tukey-Kramer multiple comparison test. *P* value <0.001 was considered as significant. The software GraphPad InStat was employed for the statistical analysis.

Results and discussion

Although various adsorbents and materials have been tested and used for the removal of dyes from polluted water, biological based procedures (living or dead microorganisms) found to be cost effective and eco-friendly. Both adsorption on the surface of the cell (Mahmoud, 2014; Nilanjana and Charumathi, 2002) and exploitation of cell's enzymes for biodegradation (Sathiyamoorthi *et al*., 2006) were used for removal of textile dyes from wastewater.

Nanoparticles were also reported to be used in dye treatment (Poedji *et al*., 2013) but had the problem of more environmental pollution due to the discharge of particles in nanoscale dimensions and it is unpredictable how these nanoparticles will react once it comes to the outer environment.

Since many biodegradation processes proved to be cumbersome and difficult to operate at a large scale because of lack of proper optimization and stringent conditions. The current work was an attempt to remove the textile dye using silver nanoparticles modified yeast cells immobilized in sodium alginate, by optimizing various parameters.

For getting stabilized modified yeast cells and to avoid the problem of colonizing the yeast cell in the waste water, dead yeast cells were used in the experiment. The heat killing time of yeast cell was optimized and a significant effect was found to be 15 minutes for all the dyes tested (*P*<0.001) (Table-1).

Time (min)	% of decolourization			
	Reactive Black 5	Remazol Brilliant Blue R	Reactive Navy Blue	Acid Orange
5	75.46±3.24[a]	65.31±2.17[a]	61.93±2.82[a]	67.14±3.96[a]
10	82.3±3.45[b]	81.76±3.35[b]	81.94±3.27[b]	82.33±4.12[b]
15	96.23±4.35[c]	92.31±4.75[c]	90.65±4.63[c]	92.07±3.93[c]
20	79.31±3.78[a]	83.21±3.54[b]	78.49±3.84[b]	77.64±3.64[d]

Table - 1. Different heat killing time of yeast cells on percent decolourization. Values (x±s.d) with different letters are significantly different (*P*<0.001) for the same day.

The heat killed yeast cell suspension and silver nanoparticle ratio was optimized and significant result was obtained from the ratio of 2:1 (Table-2).

Yeast : Nano particles	% of decolourization			
	Reactive Black 5	Remazol Brilliant Blue R	Reactive Navy Blue	Acid Orange
1:1	76.34±3.66[a]	64.33±2.45[a]	61.21±2.45[a]	63.12±3.24[a]
2:1	95.11±3.19[b]	92.11±4.87[b]	90.14±4.2[b]	91.49±4.77[b]
1:2	81.24±4.33[c]	75.21±4.18[c]	76.81±3.71[c]	79.34±3.81[c]
3:1	83.46±3.36[c]	84.22±3.84[d]	74.12±2.89[c]	81.24±3.46[c]

Table - 2. Ratio of heat killed yeast vs nanoparticle on percent decolourization. Values (X±s.d) with different letters are significantly different (*P*<0.001) for the same day.

The experiments were carried out with heat killed yeast cells immobilized in sodium alginate (Control), silver nanoparticles modified yeast cells immobilized in sodium alginate against the four different test dyes and the results were compared. All the dyes were tested from 100 – 500 ppm concentrations. Significant results were obtained from all the four dyes treated with modified yeast cells when compared to yeast cells without nanoparticles. In all the dyes tested, faster dye adsorption rate was obtained in the lower dye concentrations (100- 200ppm) when compared to higher dye concentration (400- 500ppm). But 75% of dye adsorption was achieved within 40 minutes of incubation for all the yeast cell treatments even at the concentration of 500 ppm. In the previously reported works, only 56.57% and 52.57 % of decolourization were achieved by treating with *Pleuortus florida* and *Trametes hirsuta* and that too on the fifth day of incubation (Sathiyamoorthi *et al*., 2006) and by the addition of 2% glucose on the dye effluent.

The results obtained for control and silver nanoparticles modified yeast cells at 500 ppm of the test dye were plotted as graph and discussed. The maximum decolourization rate was observed in the Reactive Black 5, showed 98.89% with modified yeast cells and the control 66.34% (500 ppm) within 120 minutes of incubation (Fig.1).

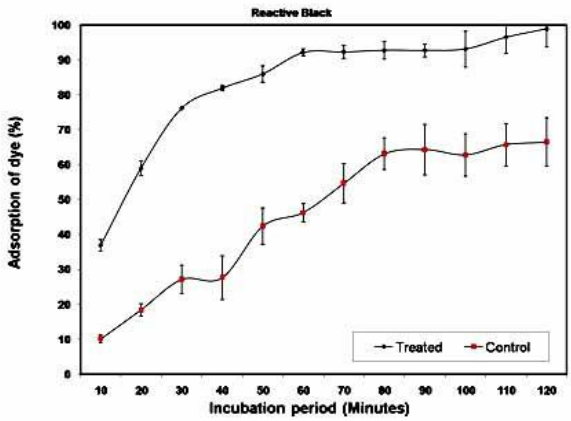

Figure 1. Rate of decolourization of reactive black dye using silver nanoparticles modified yeast cell and control yeast cells

In the case of Remazol Brilliant Blue R, 86.2% and 66.47% of decolourization was obtained in 500 ppm by modified yeast cell and control respectively (Fig.2).

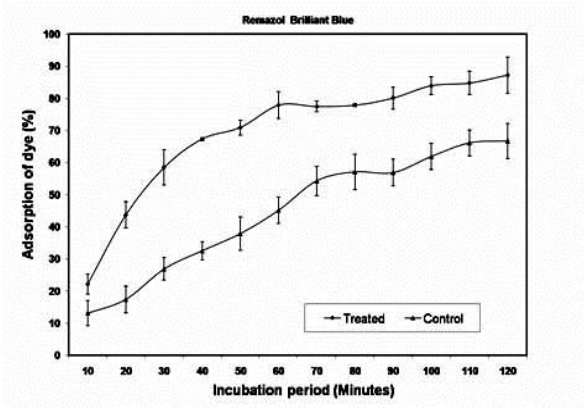

Figure 2. Rate of decolourization of Remazol Brilliant Blue R dye using silver nanoparticles modified yeast cell and control yeast cells.

In case of Reactive Navy Blue, an effective dye adsorption was found to be 87.21% by modified yeast cells and control was 66.76% in 500 ppm (Fig.3).

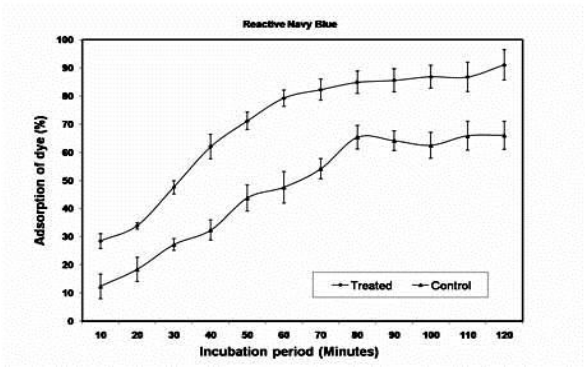

Figure 3. Rate of decolourization of Reactive Navy Blue dye using silver nanoparticles modified yeast cell and control yeast cells.

The maximum dye adsorption was recorded in Acid Orange dye treatment as 91.09% and 66.13% by modified yeast cell and the control respectively at 500ppm concentration (Fig.4).

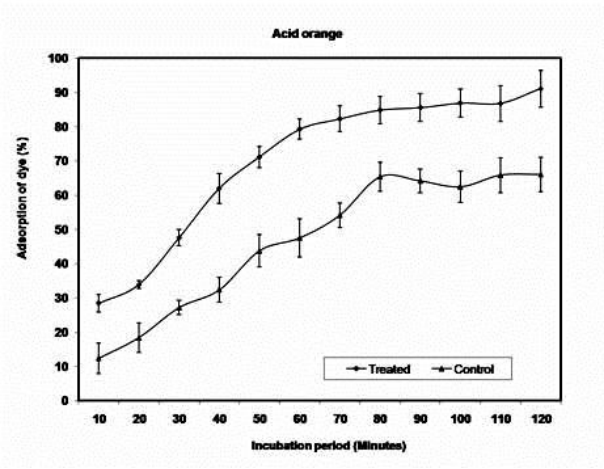

Figure 4. Rate of decolourization of Acid Orange dye using silver nanoparticles modified yeast cell and control yeast cells.

The ionic interaction of biogenic silver nanoparticles and the dyes played a pivotal role in the efficient dye adsorption. Sliver nanoparticles were synthesized biologically from *T. viridae* and the proteins plays a critical role in synthesizing and stabilizing the silver nanoparticles and thus giving a net negative charge to the nanoparticles (Fayaz *et al*., 2011). These negatively charged silver nanoparticles form an ionic binding with the positively charged dye particles and make the adsorption efficient. A possible mechanism of interaction of the silver nanoparticles modified yeast cells and dye is illustrated as a schematic diagram (Fig.5)

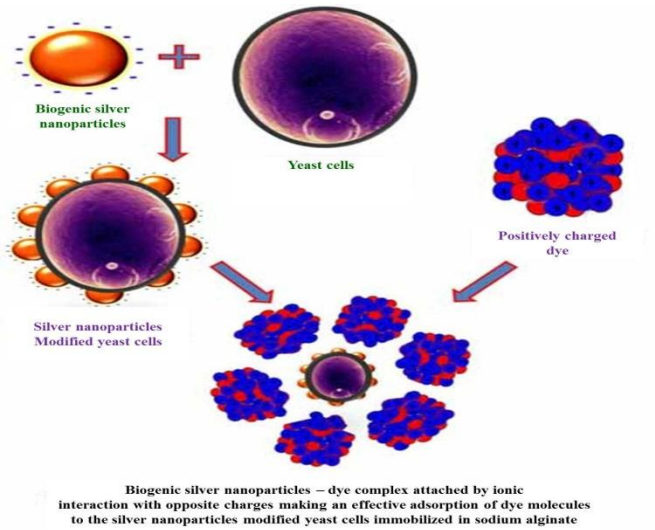

Figure 5. Schematic diagram illustrating the ionic interaction between silver nanoparticles modified yeast cell with dye molecules.

The significance of the present work is that decolourization of all the selected dye were achieved in very short course of time (120 mins) for the concentration of 500ppm, using modified yeast cells. Since the modified yeast cells are immobilized using sodium alginate beads, it will settle after incubation time with adsorbed dye and will remain settled in the bottom of the tank. The beads along with the dye can be easily removed without disturbing the clear water and the treated water can be released back to water sources.

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RESEARCH REPORTS

New mechanisms of 'social networking' in bacteria discovered

Bacteria have traditionally been viewed as solitary organisms that "hang out on their own," says molecular biologist Kevin Griffith of the University of Massachusetts Amherst. However, scientists now realize that in fact, bacteria exhibit social behavior within groups.

As he explains, "Individual bacteria within a population communicate with members of the group through a process called quorum sensing, where chemical signals and extracellular peptides serve as the language for bacterial communication." It is not just "social" networking, he adds. Bacterial communities use quorum sensing to control a variety of biomedically relevant biological processes.

In a new paper of *Molecular Microbiology*, he and his co-authors Kristina Boguslawski and Patrick Hill describe how they deciphered this bacterial communication to reveal new mechanisms of regulating gene expression in the model bacterium *Bacillus subtilis*.

"Research in my lab is devoted to deciphering these different bacterial languages, understanding how bacteria perceive these signals, and determining how bacteria use this information to regulate biological processes at the molecular level," says Griffith. "In this paper, we have expanded the range of biological processes known to be controlled by a plasmid-encoded quorum response pair known as Rap60-Phr60.

Using biochemical approaches, the authors found that Rap60 regulates the activity of two important transcription factors by "mechanisms never before observed for Rap proteins," says Griffith. "This work changes the way we think about these important regulatory proteins. The implications likely extend beyond *Bacillus* biology as they represent potential novel targets for the development of antibiotic and therapeutics in pathogenic bacteria."

In addition to providing fundamental knowledge about how this regulation occurs in a non-pathogenic bacterium like *B. subtilis*, understanding these pathways has the potential to provide new insight into how pathogenic bacteria regulate virulence factors and colonize hosts, which can have a profound impact on human health, he adds.

He explains, "Bacteria within a population secrete extracellular signals that provide the cue to coordinate biological processes as a group. Many pathogenic bacteria use these extracellular signals to regulate the production of

Last month was hottest May in modern history, US scientists say

Last month marked the hottest May in modern history, continuing a troubling trend of rising global temperatures, US government scientists said.

"This was the warmest May on record," said Derek Arndt, chief of the monitoring branch at the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information, during a conference call with reporters.

When global air and sea surface temperatures were averaged, May was 1.57-degrees Fahrenheit (0.87-degree celsius) warmer than the 20th century average, said the NOAA monthly report.

Source: www.timesofindia.indiatimes.com./

antibiotics and virulence factors, the timing of which is important in disease."

Each species of bacteria has its own unique language, the authors say. In addition, there are "universal signals, analogous to Morse telegraphic code, used for communication between different species of bacteria," says Griffith. "In microbial communities, bacteria within a similar group communicate with one another, while other groups are eavesdropping or even disrupting others' communication. It is biological espionage. Bacteria that can communicate with one another and work together as a group will be more successful in competing for resources than individuals."

The researchers found, in addition to controlling the production of degradative enzymes, which was already known, that the Rap60 protein inhibits sporulation, genetic competence (the uptake of foreign DNA), and biofilm formation. Phr60 acts as an extracellular cell-cell signaling peptide that coordinates the activity of Rap60 with population density, says Griffith.

Source: www.sciencedaily.com

Mathematics reveals how fluid flow affects bacteria

Researchers from the University of Liverpool have used mathematical equations to shed new light on how flowing fluid hinders the movement of bacteria in their search for food.

Many bacteria are mobile and inhibit a variety of dynamic fluid environments: from turbulent oceans to medical devices such as catheters.

Mathematicians from the Universities of Liverpool and Manchester developed a new set of equations to study how flowing fluid affected the movement of bacteria and how the swimming behaviour of the bacteria themselves affected their travel.

Bacteria can change their swimming direction when they encounter a chemical cue which allows them to move towards preferable environments and away from harmful chemicals.

Since the first attempts at classifying bacteria in the 17th century, shape has been an important feature, yet it is still not fully understood how shape affects the ability of bacteria to navigate their environments.

Slender bacteria

The equations showed, in regions where there are strong gradients in the fluid velocity (high shear), that the majority of slender bacteria (rod-shaped bacteria), but not spherical bacteria, swim in the same direction in which the fluid is flowing.

This means that slender bacteria get trapped in these high shear regions because it is too difficult for them to swim against the direction of the flow.

This may negatively affect their ability to find food because they are no longer able to perform an efficient search strategy when trapped. Conversely it may positively affect their ability to colonise surfaces because they may become trapped in regions close to surfaces.

Dr. Rachel Bearon, from the Department of Mathematical Sciences and lead author on the paper, said: "Our findings build on recent and surprising research which found that moving water impeded bacteria movement, which isn't what you would expect.

"Using a new set of mathematical equations we were able to show that this happened because of the interplay between swimming behaviour, bacterial shape, and fluid dynamics.

"These findings could have implications for nutrient acquisition in marine microbial ecosystems and also for the formation of biofilms formed in medical devices, as high shear is typically found at walls."

The study, published in *Journal of Fluid Mechanics Rapids*, further explains recent research by Massachusetts Institute of Technology (MIT) scientists which found that fluid flow reduces the ability of microbes to chase food and helps microbes to find surfaces.

Many bacteria live in dynamic fluid environments such as the turbulent seawater along this coast.

(Image Credit: Vibe Images/Fotolia)

Source: www.sciencedaily.com

Bacterial raincoat discovery paves way to better crop protection

Fresh insights into how bacteria protect themselves by forming a waterproof raincoat could help develop improved products to protect plants from diseases.

Researchers have discovered how communities of beneficial bacteria form a waterproof coating on the roots of plants, to protect them from microbes that could potentially cause plant disease.

Their insights could lead to ways to control this shield and improve its efficiency, which could help curb the risk of unwanted infections in agricultural or garden plants, the team says.

Scientists at the Universities of Edinburgh and Dundee studied the protective film formed by the common soil bacterium *Bacillus subtilis*. They found it incorporates proteins that change shape as they reach the film surface. This exposes an impervious surface on the protein molecules, enabling them to slot together like a jigsaw puzzle, to protect bacteria underneath.

The film is able to repel water which means other potentially harmful molecules also bounce off. Researchers say that being able to control the production of the biofilm in agricultural products could enable improved protection for plants.

The study, funded by the Engineering and Physical Sciences Research Council and the Biotechnology and Biological Sciences Research Council, is published in *Proceedings of the National Academy of Sciences*. The team behind the finding plans to research further applications for their discovery.

Professor Cait MacPhee, of the University of Edinburgh's School of Physics and Astronomy, said: "Such a controlled shape change in a protein is unusual. This protein only responds in exactly the right way and in the right place. It protects microbes from the outside world, but the ability to control the creation of a water-repellent film has many possible applications."

Dr. Nicola Stanley-Wall, of the University of Dundee's Division of Molecular Microbiology, said: "Our findings highlight one of the amazing mechanisms that bacteria have evolved to provide protection from changes in their environment. It also demonstrates the advances that can be made when biologists and physicists work together on a problem of mutual interest."

Source: www.sciencedaily.com

What bacteria sense in their surroundings

Knowing how environmental signals modulate bacterial behavior could help combat biofouling and antibiotic resistance.

A new, rapid method is helping to detect how bacteria sense and respond to changes in their environment.

Bacteria can pick up external signals, which then relay to internal signaling pathways that direct their behavior. This surveillance also can trigger survival tactics for a variety of harsh situations, such as lack of nutrients or the presence of antibiotics.

In a cover article published in *Science Signaling*, microbiologists expressed particular interested in the sensing done by the food-poisoning bacteria, *Salmonella*. The pathogen is adapt at adjusting to different locations and surrounding conditions. One of its safety strategies is to gather into a biofilm: a collection of bacteria huddled together in a protective coating.

Salmonella biofilms can grow persistently on many surfaces and can make the pathogen resistant to infection control measures. This is a significant problem in the food-processing industry. According to the Centers for Disease Control and Prevention, *Salmonella* causes more than 1.2 million episodes of illness a year in the United States alone.

To adapt so readily, noted the authors of the report, *Salmonella typhimurium* bacteria need to figure out if they are in the stomach, within cells, or on a plant or on the other surface. *Salmonella typhimurium* is the most studied bacterial pathogen; yet, the researchers added, little is known about what *Salmonella typhimurium* senses in the environment.

The researchers Erez Mills, Erik Petersen, and Bridget R. Kulasekara, in the University of Washington laboratory of Samuel I. Miller describe a new screen they designed to identify the environmental cues *Salmonella* picks up and that, in turn, modulate the production of a second messenger molecule.

This molecule, cyclic-di-GMP, governs bacterial motility and biofilm formation in many species of bacteria in response to environmental conditions, but up to now specific signals that modulate cyclic-di-GMP in *Salmonella* were largely unknown.

The researchers discovered that many environmental signals modulate cyclic-di-GMP in *Salmonella typhimurium* and subsequently altered its biofilm formation.

Their screen for these signals and their actions was based on a combination of leading-edge technologies, including a genetically engineered biosensor for cyclic-di-GMP, used with either microscopy or flow cytometry, a laser-based measurement on single cells suspended in a fluid.

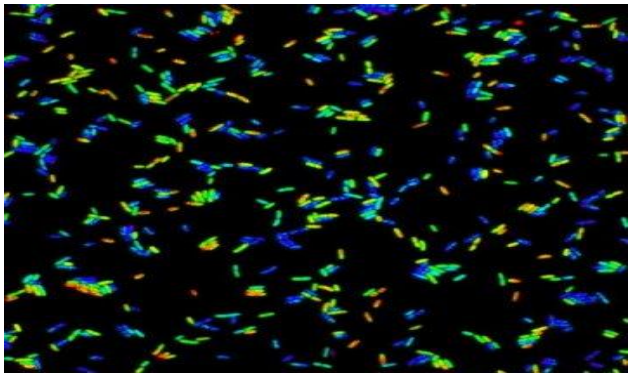
"The most interesting signal we identified was L-arginine, one of the twenty commonly used amino acids," the researchers noted. They explained that *Salmonella typhimurium* specifically responds to very low concentrations of L-arginine, in amounts too little to be utilized as a nutrient source.

The researchers think the sensing of these low levels of L-arginine tells the bacterium that it is in a certain type of environment and prompts the bacterium to adapt accordingly.

Future work, they said, will be aimed at determining the types of environments where L-arginine is sensed, as well as the bacterium's behavior in response to L-arginine.

In addition to provide new information on how *Salmonella typhimurium* senses chemical signals in its environment, the method the scientists designed can be used in studies of other bacterial species to increase knowledge about microbial sensing.

Possible applications range from combating antibiotic resistant bacteria to ameliorating agricultural and industrial biofouling.



In a screening method to detect signals that regulate bacteria behavior, a biosensor is at work in *Salmonella*.

(**Image Credit:** Erez Mills/Miller Lab/Univ. of Wash)

Source: www.sciencedaily.com

Metabolic link between bacterial 'biofilms' and colon cancer found

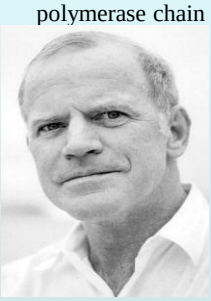
A team led by scientists at The Scripps Research Institute (TSRI) and Johns Hopkins University School of Medicine has uncovered a big clue to how bacteria may promote some colon cancers.

The study, reported in *Cell Metabolism* used novel metabolomic technologies to reveal molecular evidence suggesting a vicious circle in which cancerous changes in colon cells promote the growth of bacterial conglomerations called biofilms, and biofilms in turn promote cancer development.

On the whole, the findings suggest that removing bacterial biofilms could be a key strategy for preventing and treating colon cancers, which currently kill about 50,000 Americans per

KNOW A SCIENTIST

Kary Banks Mullis, joined as a DNA chemist in 1979, after completing Ph.D. degree in biochemistry from the University of California, Berkeley, postdoctoral research in pediatric cardiology at the University of Kansas Medical School and pharmaceutical chemistry at the University of California, San Francisco. During his seven years there, he conducted research on oligonucleotide synthesis and invented the polymerase chain reaction.



Dr. Mullis received **Nobel Prize in Chemistry** in 1993, for his invention of the **polymerase chain reaction (PCR).** The process, which Dr. Mullis conceptualized in 1983, is hailed as one of the monumental scientific techniques of the twentieth century. A method of amplifying DNA, PCR multiplies a single, microscopic strand of the genetic material billions of times within hours. The process has multiple applications in medicine, genetics, biotechnology, and forensics. PCR, because of its ability to extract DNA from fossils, is in reality the basis of a new scientific discipline, Paleobiology.

Dr. Mullis has authored several major patents include the PCR technology and UV-sensitive plastic that changes color in response to light. His most recent patent application covers a revolutionary approach to instantly mobilize the immune system to neutralize invading pathogens and toxins, leading to the formation of his latest venture, Altermune Technologies, of which he is the Chief Scientific Advisor. Dr. Mullis was awarded the **Japan Prize in 1993** for the PCR invention. It is one of international science's most prestigious awards.

His publications include "The Cosmological Significance of Time Reversal" (Nature), "The Unusual Origin of the Polymerase Chain Reaction" (Scientific American), "Primer-directed Enzymatic Amplification of DNA with a Thermostable DNA Polymerase" (Science), and "Specific Synthesis of DNA In Vitro via a Polymerase Catalyzed Chain Reaction" (Methods in Enzymology).

year. The study also revealed an apparent metabolic marker of biofilm-associated colon cancers.

A Wide Net

The research, which used sophisticated "metabolomics" techniques, was a collaboration between groups led by Gary Siuzdak, professor of chemistry, molecular and computational biology and senior director of the Scripps Center for Metabolomics at TSRI, Cynthia L. Sears, professor of medicine, oncology and molecular microbiology and immunology at the Johns Hopkins University School of Medicine and Bloomberg School of Public Health, and David Edler, associate professor at the Karolinska Institute.

A previous study led by Sears and colleagues provided evidence that the tissue in and around cancers of the ascending colon, on the right side of the abdomen, almost always harbors bacterial conglomerations called biofilms.

"In the current study, we wanted to understand more about what was happening," said Caroline H. Johnson, member of the Scripps Center for Metabolomics and co-first author of the new report with Christine M. Dejea of Johns Hopkins. "In particular, we wanted to determine if there was a metabolic link between the biofilm and colon cancer.“

Metabolites are small molecules in blood and tissues that are products of the myriad metabolic processes in cells. More than 10,000 distinct metabolites normally can be found in humans.

The team began the search with an "unbiased screen," a wide-net technique -- using advanced liquid chromatography and mass spectrometry and their XCMS metabolomic cloud-based platform -- that registered the levels of thousands of metabolites in a set of colon tissue samples from patients at Johns Hopkins and at the Karolinska Institute in Sweden.

The data showed that polyamines were important in general and one metabolite N1, N12-diacetylspermine was particularly prominent, on average about nine times more abundant in cancerous tissue, compared to nearby non-cancerous tissue.

A Vicious Circle

In further tests, the team found that even among cancerous samples, the same metabolite was four times more abundant in the presence of biofilms. In other words, the cancerous cells and the biofilms both seemed to be contributing to its overproduction.

With a sophisticated technique called "nanostructure imaging mass spectrometry" (NIMS), the team was able to map the precise locations of N1, N12-diacetylspermine in tissue samples, confirming its higher levels in both tumors and biofilms.

The researchers also carried out a technique called "global isotope metabolomics," using an isotope of N1, N12-diacetylspermine to trace its metabolic fate in cells in an unbiased manner, finding that it appears to be a metabolic end-product.

That colon tumors would produce abnormally high amounts of N1, N12-diacetylspermine is not surprising. The molecule belongs to a family of metabolites called polyamines, which are known to have roles in driving cell growth and which are commonly upregulated in cancers as well as in healthy fast-growing tissues. N1, N12-diacetylspermine itself has been observed at higher levels in colon cancer and is considered a potential biomarker for early cancer diagnosis.

But why would bacterial biofilms also be linked to higher levels of N1, N12-diacetylspermine? It turns out that bacteria, too, use polyamines to drive their own cells' proliferation and to build biofilms. Polyamines are such ancient, ubiquitous molecules that bacteria apparently can even use those produced by their animal hosts.

Thus, biofilms may promote cancer in the colon by inducing chronic inflammation and associated cell proliferation. That increased cell proliferation would be accompanied by a rise in the production of polyamines. Resident bacteria, in turn, could use this abundance of polyamines to make more biofilms -- completing the vicious circle. Along the way, levels of the by-product N1, N12-diacetylspermine would be driven higher and higher.

The Way Forward

The researchers now want to find out more about the molecular pathways through which polyamines contribute to tumor growth and biofilm construction. They want to know as well why bacterial biofilms are found frequently in association with tumors of the ascending colon, but less frequently in tumors further along in the colon.

"We'd also like to look at samples from other populations that have a low level of colon cancer and different traditional diets, because we know that diet can influence polyamine

levels," said Johnson.

In the meantime, treatment with antibiotics may be an option for removing colonic biofilms and reducing the cancer risks they bring. The scientists found that colon cancer samples from patients who had taken oral antibiotics 24 hours prior to surgery harbored no biofilms and no cultivable bacteria and exhibited significantly less N1, N12-diacetylspermine, on average, than samples from patients who had not taken antibiotics.

Source: www.sciencedaily.com

NEWS

Soil fertility in Tamil Nadu reduced by half in 30 years, says govt paper

Indiscriminate fertilizer and pesticide usage, coupled with mono-cropping and non-application of base manure like cow dung and green manure (dead plants), has taken a severe toll on the organic content in soil and thereby soil fertility across the state, says the draft organic farming policy of the state government, which is yet to be rolled out. The issue has come into focus now in the wake of Kerala raising concerns of high pesticide level on vegetables grown in Tamil Nadu.

Experts in the field say organic matter in the soil dropped from 1.2% in 1971 to 0.68% in 2002. Organic matter has further reduced to 0.5 % in several districts, according to a study conducted a year ago by the Department of Soil Science and Agriculture Chemistry of Tamil Nadu Agricultural University. This is against a desirable level of 0.8% to 1.3% of organic carbon, say experts.

Madurai area is the worst with just 0.23% of organic content in soil, followed by Krishnagiri (0.36). Erode and Vellore are well above the ideal limit with 4.04% and 4.2% respectively. Scientists at Tamil Nadu Agricultural University say that carbon content of soil depends on the amount of carbon matter that is replenished. "Is some districts in the Cauvery delta region, farmers leave behind the rest of the crop after harvest. This recharges the carbon content. However, this practice is dwindling across the state," said Vice Chancellor of TNAU K Ramasamy.

Organic matter in soil includes humus - which is made of decaying plant and animal matter - as well as insects, earthworms and micro-organisms. Healthy soil ideally has 25% air and between 5% and 10% of living organisms and organic matter like dead leaves and animals. But as fertiliser and pesticide usage increases, the level of organic matter comes down. "Any fertilizer is a salt. These salts prevent growth of micro-organisms," said director of Ecoscience Research Foundation, Sultan Ahmed Ismail.

Scientists agree soil quality gets affected even if chemicals are not directly used on them. "In our studies on population of earthworms - which are good indicators of soil health - even places like Guindy National Park had a low count. This is due to poor water management and soil erosion," said Ismail.

Indiscriminate use of chemical pesticides and fertilizers has resulted in soil quality deteriorating in several districts. This becomes a vicious cycle with farmers further increasing chemical fertilizer usage to reap better yield. "When a neighbouring farmer left water stagnant on his field for three to four days, the water turned ash colour due to chemicals on the field," said an organic farmer from Thiruvannamalai, C Parasuram. "Though I practice organic farming, water in my well too has become salty and undrinkable as chemicals from nearby farms percolate into ground affecting ground water in the whole area," he said.

But hope is not lost. Officials from Tamil Nadu Agriculture University say those practicing organic farming have started seeing positive changes. "In our surveys, we have found that organic carbon content in soil, where organic farming is being practiced, has gone up and stabilized," said professor and head of Department of Sustainable Organic Agriculture, Tamil Nadu Agricultural University, E Somasundaram.

Farmers also need to be told to rotate crops to keep soil healthy. Paddy crops always need to be followed by legumes like peanuts for increasing nitrogen content in soil. "In traditional farms, animals had a role. Now bulls have gone missing - as farmers use tractors for ploughing - and key nutrients from their dung and urine are missing, adding to the deteriorating health of the soil," said an ecologist, V Arun.

(Source: www.timesofindia.indiatimes.com**)**

01. Estuarine, Coastal and Shelf Science, 2015, **153:** Page: 29 – 37.

Seasonal variations of the composition of microbial biofilms in sandy tidal flats: Focus of fatty acids, pigments and exopolymers. Claire Passarelli, Tarik Meziane, Najet Thiney, Dominique Boeuf, Bruno Jesus, Mickael Ruivo, Christian Jeanthon, Cédric Hubas.

UMR BOREA 7208 CNRS/MNHN/UPMC/IRD, Muséum National d'Histoire Naturelle, Bâtiment des Arthropodes, CP53, 61 rue Buffon, 75231 Paris Cedex 5, France.

Biofilms, or microbial mats, are common associations of microorganisms in tidal flats; they generally consist of a large diversity of organisms embedded in a matrix of Extracellular Polymeric Substances (EPS). These molecules are mainly composed of carbohydrates and proteins, but their detailed monomer compositions and seasonal variations are currently unknown. Yet this composition determines the numerous roles of biofilms in these systems. This study investigated the changes in composition of carbohydrates in intertidal microbial mats over a year to decipher seasonal variations in biofilms and in varying hydrodynamic conditions. This work also aimed to assess how these compositions are related to microbial assemblages. In this context, natural biofilms whose development was influenced or not by artificial structures mimicking polychaete tubes were sampled monthly for over a year in intertidal flats of the Chausey archipelago. Biofilms were compared through the analysis of their fatty acid and pigment contents, and the monosaccharide composition of their EPS carbohydrates. Carbohydrates from both colloidal and bound EPS contained mainly glucose and, to a lower extent, galactose and mannose but they showed significant differences in their detailed monosaccharide compositions. These two fractions displayed different seasonal evolution, even if glucose accumulated in both fractions in summer; bound EPS only were affected by artificial biogenic structures. Sediment composition in fatty acids and pigments showed that microbial communities were dominated by diatoms and heterotrophic bacteria. Their relative proportions, as well as those of other groups like cryptophytes, changed between times and treatments. The changes in EPS composition were not fully explained by modifications of microbial assemblages but also depended on the processes taking place in sediments and on environmental conditions. These variations of EPS compositions are likely to alter different ecosystem processes such as biostabilisation or pollutants trapping.

Keywords: biofilms; biogenic structures; EPS; monosaccharide composition; fatty acids; pigments.

02. Food Control, 2015, **50:** Page: 574–580.

Comparison of microbial transfer rates from *Salmonella* spp. biofilm growth on stainless steel to selected processed and raw meat. Huhu Wang, Xinxiao Zhang, Qiuqin Zhang, Keping Ye, Xinglian Xu, Guanghong Zhou.

Key Laboratory of Meat Processing and Quality Control, Ministry of Education, College of Food Science and Technology, Nanjing Agricultural University, Nanjing 210095, PR China.

Salmonella biofilm cells can serve as a serious source of cross-contamination, both in the home and at food production sites. The objectives of this study were to determine the transfer rates (RTs) of *Salmonella* biofilm cells and to model the transfer process of biofilm cells from stainless steel surfaces to raw meat. The results showed that the RTs were significantly influenced by the types of meat products, with bacon and emulsified sausage showing higher RTs and roast pork showing lower RTs. Higher RTs of biofilm grown in a meat-based medium, Meat Thawing-Loss Broth (MTLB), were observed as compared to that in a standard growth medium (TSB). The logistic, exponential and multi-roots models could be used to satisfactorily describe the transfer of biofilm cells as demonstrated by use of MSE, F-test and R_2. There was no difference in attachment strength (reflected by the coefficients of transfer models) of biofilm grown in TSB or MTLB, as shown by the coefficients of r, D and B in three models. Compared with the exponential and the multi-roots models, the logistic model was able to more accurately fit the whole transfer process of biofilm cells. Our findings highlight the occurrence of cross-contamination with biofilm cells, and the models may provide useful tools in quantitative microbiological risk assessment of meat products.

Keywords: *Salmonella*; Biofilm; Transfer; Meat; Models.

E - Resources on Microorganisms

NATIONAL

Environmental Management and Policy Research Institute (EMPRI)
http://www.karnataka.gov.in/empri/Pages/home.aspx

Department of Microbiology and Biotechnology Centre
http://www.bcmsu.ac.in/

Institute of Microbial Technology
http://www.imtech.res.in/

National Collection of Industrial Microorganisms
http://www.ncl-india.org/ncim

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Woods Hole Marine Biological Laboratory
http://www.mbl.edu/

British Society for Antimicrobial Chemotherapy
http://bsac.org.uk/

Society for Industrial Microbiology
http://www.simhq.org/

Institute of Microbiology Chinese Academy of Sciences
http://www.im.ac.cn/en/new/index.php

EVENTS
Conferences / Seminars / Meetings 2015

2015 4th International Conference on Biotechnology and Food Engineering (ICBFE 2015). July 09 - 10, 2015. **Venue:** Chengdu, **China. Website:** http://www.icbfe.org/

Malaria: Translating Malaria Research to the Field. July 26 - 31, 2015. **Venue:** Girona, **Spain. Website:** http://www.grc.org/programs.aspx?id=12779

2015 5th International Conference on Environmental and Agriculture Engineering (ICEAE 2015). August 05 - 06, 2015. **Venue:** Paris, **France. Website:** http://www.iceae.org/

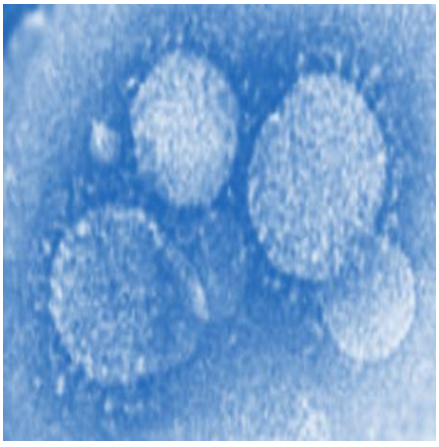
Influenza 2015. August 24 - 26, 2015. **Venue:** Birmingham, **UK. Website:** http://influenza.conferenceseries.com/

World Congress on Beneficial Microbes. August 25 - 27, 2015. **Venue:** Valencia**, Spain.**
Website: http://www.mirri.org/news-and-events/events/archive/2015/august/article/mirri-world-congress-on-beneficial-microbes.html

Middle East Respiratory Syndrome (MERS)

Middle East Respiratory Syndrome (MERS) is a viral respiratory illness that is new to humans. It was first reported in Saudi Arabia in 2012. The virus that causes MERS is called Middle East Respiratory Syndrome Coronavirus (MERS-CoV). Coronaviruses are common viruses that most people get some time in their life. Human coronaviruses usually cause mild to moderate upper-respiratory tract illnesses. However, MERS-CoV is different from any other coronavirus previously found in people.

MERS-CoV likely came from an animal source in the Arabian Peninsula. Researchers have found MERS-CoV in camels from several countries . We don't know whether camels are the source of the virus. Studies continue to provide evidence that camel infections may play a role in human infection with MERS-CoV. However, more information is needed.



MERS Symptoms

Some infected people had mild symptoms or no symptoms at all, but most people infected with MERS-CoV developed severe respiratory illness. They had fever, cough and shortness of breath. Others reported having gastrointestinal symptoms, like diarrhea and nausea/vomiting, and kidney failure. MERS can even be deadly. Many people have died.

How MERS Spreads

MERS-CoV is thought to spread from and infected person to others though respiratory secretions, such as coughing. In other countries, the virus has spread from person to person through close contact, such as caring for or living with an infected person.

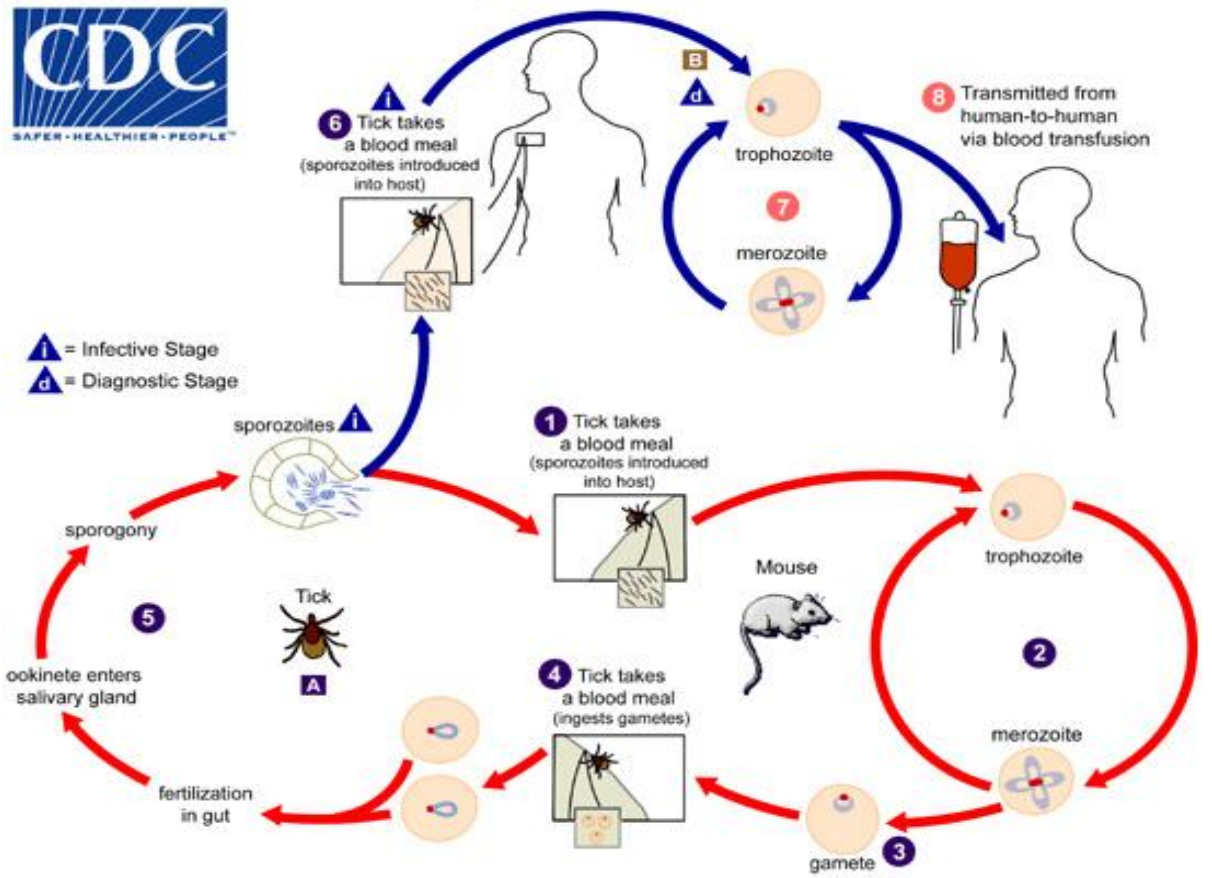
Protect yourself from Respiratory Illnesses

There is currently no vaccine to prevent MERS-CoV infection. CDC routinely advises to protect themselves from respiratory illnesses by washing hands often, avoiding close contact with people who are sick, avoiding touching their eyes, nose and mouth with unwashed hands, and disinfecting frequently touched surfaces.

Source: www.cdc.gov/features/novelcoronavirus/

Babesiosis

(Babesia microti, B. divergens, B. duncani)



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