



# **Developments of the Antibacterial Industry in the United States**

11th Chinese Development Conference for Antimicrobial Industry (CDCAI-2017)

Robert (Bob) A. Monticello, Ph.D.  
Senior Technical Advisor  
International Antimicrobial Council



# **Advances in the Testing of Antibacterial Treated Textiles**

11th Chinese Development Conference for  
Antimicrobial Industry (CDCAI-2017)

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**Robert (Bob) A. Monticello, Ph.D.**  
**Senior Technical Advisor**  
**International Antimicrobial Council**

B.S. Microbiology  
M.S. Molecular Biology  
Ph.D. Microbiology and Biochemistry  
Fellowship in Molecular Medicine

- 22 years experience with antimicrobial agents on textiles
- Technical Secretary for the IBRG Committee on Textiles
- Vice-Chairman of the ASTM E35.15 Committee
- Active member of AATCC RA31 Committee
- Consultant for the OECD Task Force on Biocides
- Co-Founder of the International Antimicrobial Council

International Antimicrobial Council ([www.amcouncil.org](http://www.amcouncil.org))

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# What is the International Antimicrobial Council?

A not-for-profit organization dedicated to promoting the prudent and responsible use of antimicrobial agents and to the development and global harmonization of test methods and procedures that measure antimicrobial activity.



International Antimicrobial Council ([www.amcouncil.org](http://www.amcouncil.org))

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# **Who are Members of the International Antimicrobial Council?**

- Leading Brands and Retailers
- Antimicrobial Supply Companies
- Third Party Testing Laboratories

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# **What is the International Antimicrobial Council?**

- Regulatory Claims and EPA Guidance
- Global Test Method Harmonization and Development
- Test Laboratory Training and Certification

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# Where is the International Antimicrobial Council?

Regulatory Office

1629 K Street, Suite 300  
Washington, DC 20006

Technology Center

7400 Bay Rd. Pioneer Hall 129  
University Center, MI 48710



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# Where are the International Antimicrobial Council Certified Laboratories?



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# Presentation Agenda

## Advances in the Antibacterial Textile Industry

***How has the industry changed over the past few years?***

Marketing Odor Control to Consumers

***What is the new understanding of the relationship  
between us and our clothes?***

Understanding the “Clothing Microbiome”

***What new technologies exist that were not available only  
a few years ago?***

Current Antimicrobial Technologies on the Market

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# Presentation Agenda

## Advances in the Antibacterial Textile Industry

***How has the antimicrobial industry responded to these new challenges?***

Guidance documents, Improved Testing Standards and Laboratory Certification and Proficiency Training Programs

***What are the new developments that we should expect in the future?***

Advances coming from the IAC include Certified and Proficient odor control test methods

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*How has the industry changed over the past few years?*  
Marketing Odor Control to Consumers

**Antibacterial (anti-odor) treated  
textiles moves from being a  
“want” to a “requirement”**

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# Odor has a long term impact on consumer behavior



**Sight & Feel** send sensory memos that are delivered straight to the thalamus, “the big switchboard of the brain and from there out to the primary sensory cortices. These memos have an immediate impact on first impressions.



## **Smell** has the long term impact on perception

Our olfactory receptors are directly connected to the limbic system, the most ancient and primitive part of the brain, which is thought to be the seat of emotion. Smell sensations are relayed to the cortex, where ‘cognitive’ recognition occurs, only after the deepest parts of our brains have been stimulated. Thus, by the time we correctly name a particular odor as, for example, ‘offensive’, the odor has already activated the limbic system, triggering more deep-seated emotional responses.

Olfactory input winds its way through other brain regions, including the centers for memory and emotion, before reaching the thalamus. In neuroscience, they say a little bit nonchalantly that nothing reaches consciousness unless it has passed the thalamus, for olfaction, you have all this basic processing before you have conscious awareness of the odor triggering more memorable emotional responses.

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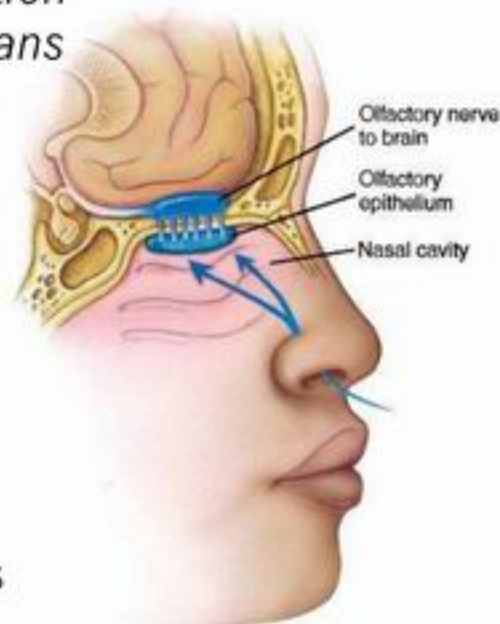


# Why is odor-control a consumer need?

An **odorant** is a substance capable of eliciting an olfactory response whereas **odor** is the sensation resulting from stimulation of the olfactory organs

## Quick Facts:

- Odors illicit very emotional responses and provide immediate feedback
- Smell is the strongest sense tied to memory
  - We can distinguish > 10,000 odors
  - Some odorants detectable at ppt level
- Odor perception varies with culture and expectations
- Odorants can have synergistic and masking effects
  - Odor analysis can be very challenging !



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# Consumers are spending over \$3 billion per year in post treatment odor-control products



- Specialty Detergents
- Laundry Scent Boosters
- Fabric Refreshers & Odor Eliminators
- Shoe Inserts
- Candles & Wax Innovations



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# Consumer Ranking of Importance of Functional Performance Features



1. Fit

**2. Controls Odor**

3. Wicks Moisture

4. Dries Faster

Lifestyle Monitor, Cotton Inc.  
2012



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# Consumers are loyal to the odor-control feature



- 90% of *current* users of textiles with an odor-control feature want to purchase *more* apparel, footwear and home textile products treated with odor-control



ANERCA 2013 Consumer Study

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*What is the new understanding of the relationship  
between us and our clothes?*

Understanding the “Clothing Microbiome”

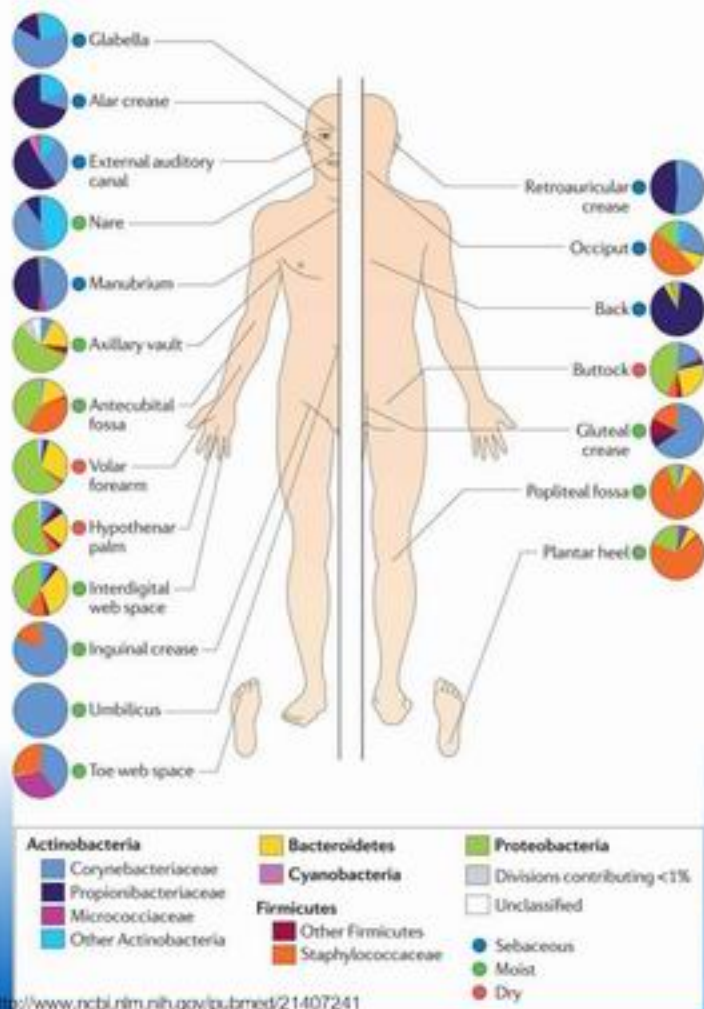
## **Development of a “Clothing Microbiome”**

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# The Human Microbiome



Frequency of the best studied skin microbes[4]

Organism	observations
<a href="#"><i>Staphylococcus epidermidis</i></a>	Common, occasionally pathogenic
<a href="#"><i>Staphylococcus aureus</i></a>	Infrequent, usually pathogenic
<a href="#"><i>Staphylococcus warneri</i></a>	Infrequent, occasionally pathogenic
<a href="#"><i>Streptococcus pyogenes</i></a>	Infrequent, usually pathogenic
<a href="#"><i>Streptococcus mitis</i></a>	Frequent, occasionally pathogenic
<a href="#"><i>Propionibacterium acnes</i></a>	Frequent, occasionally pathogenic
<a href="#"><i>Corynebacterium</i> spp.</a>	Frequent, occasionally pathogenic
<a href="#"><i>Acinetobacter johnsonii</i></a>	Frequent, occasionally pathogenic
<a href="#"><i>Pseudomonas aeruginosa</i></a>	Infrequent, occasionally pathogenic

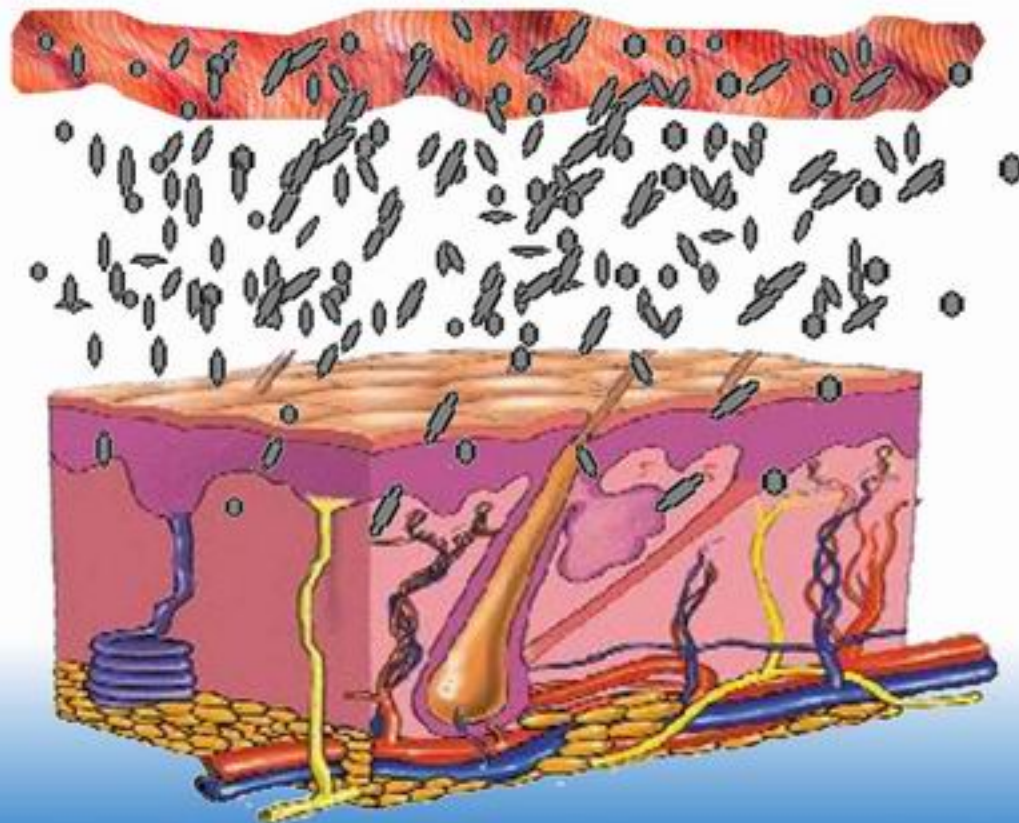


# Development of the Clothing Microbiome

## Environment

*Textiles as  
“Hospitable”  
surfaces for  
Biological  
Growth*

*Textiles as  
Vectors for  
Biological  
Transfer*



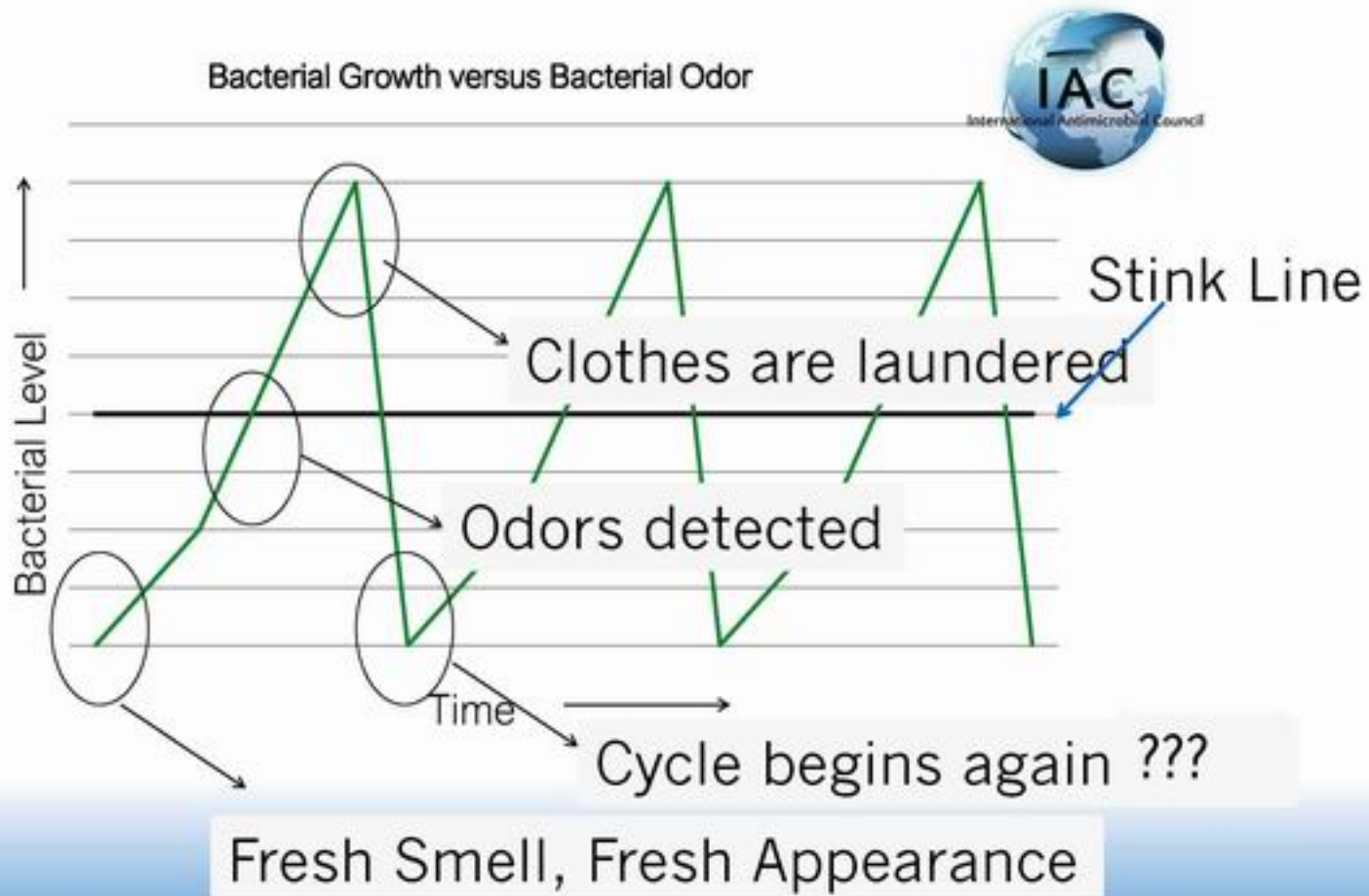
**Clothing**

**Skin**

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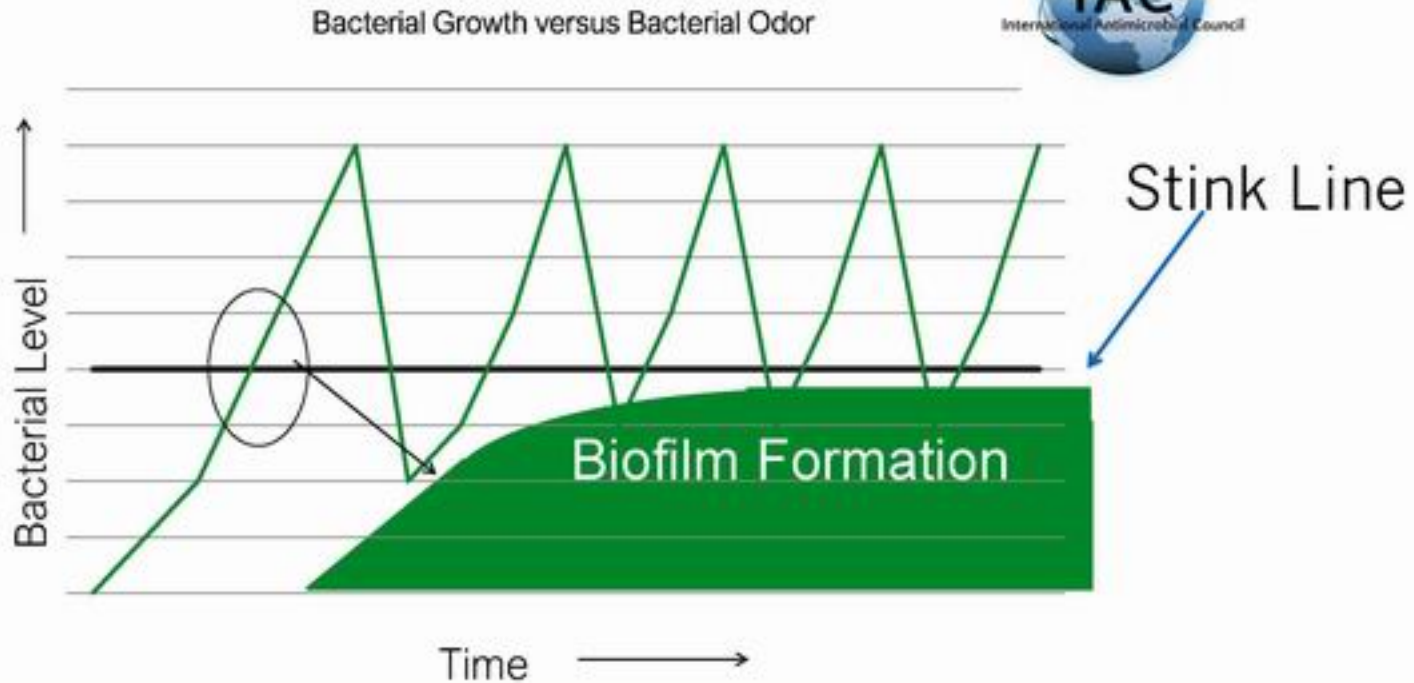
# Development of the Clothing Microbiome



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# Development of the Clothing Microbiome



Never quite fresh as new

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# Development of the Clothing Microbiome



<http://www.athleticbusiness.com/intramural-coed-basketball-playing-rules-vary-greatly.html>

- Skin introduces components for **Microbial Driven Odor Generation**
- Environment introduces odor

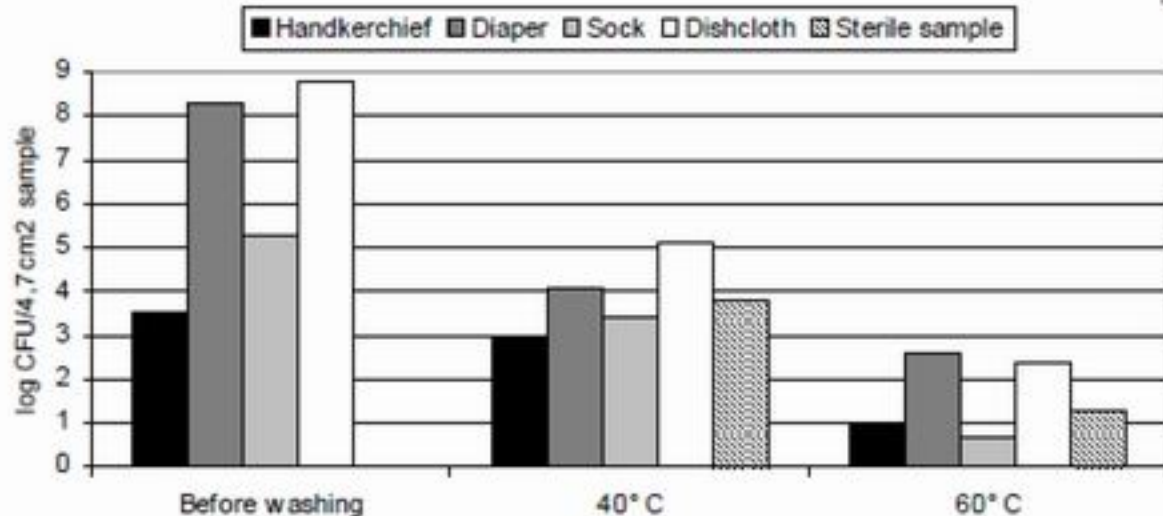


- Some microorganisms survive
- Stale, musty, urine, fecal smells remain
- **Bacterial Level increase with laundering**



- Washing introduces microorganisms
- Majority of body/environment odors removed

# Traditional washing methods no longer control bacteria



- Consumers are washing textiles at lower temperatures to save energy
- Most technical fabrics require a low temperature wash
- Testing at Norway's National Institute for Consumer Research shows that higher levels of bacteria remain on untreated articles when washed at lower temperatures

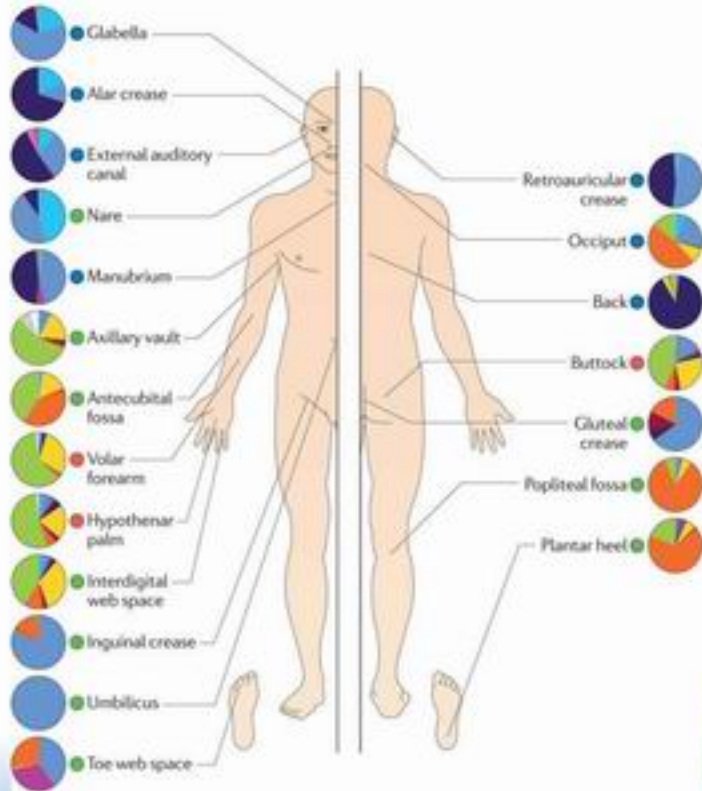
Arild, A. et al. "An Investigation of Domestic Laundry in Europe – Habits, Hygiene and Technical Performance." SIFO, Report No. 1:2003.

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# The Human and Clothing Microbiome



## Actinobacteria

- Corynebacteriaceae
- Propionibacteriaceae
- Micrococciaceae
- Other Actinobacteria

## Bacteroidetes

- Cyanobacteria
- Other Firmicutes
- Staphylococcaceae

## Proteobacteria

- Divisions contributing <1%
- Unclassified
- Sebacous
- Moist
- Dry



## Underarm:

- 3-hydroxy-3-methyl hexanoic Acid
- Isovaleric acid
- Thiols
- (S)-3-Methyl-3-Sulfanylhexasan-1-ol



## Foot:

- Methanethiol
- Ammonia
- Propanoic acid
- Isovaleric acid

- **35 different odorants** have been measured in textiles as a result of converting gland secretions to more volatile molecules by bacteria
- Bacteria vary by body region
- **Broad spectrum antimicrobial required**

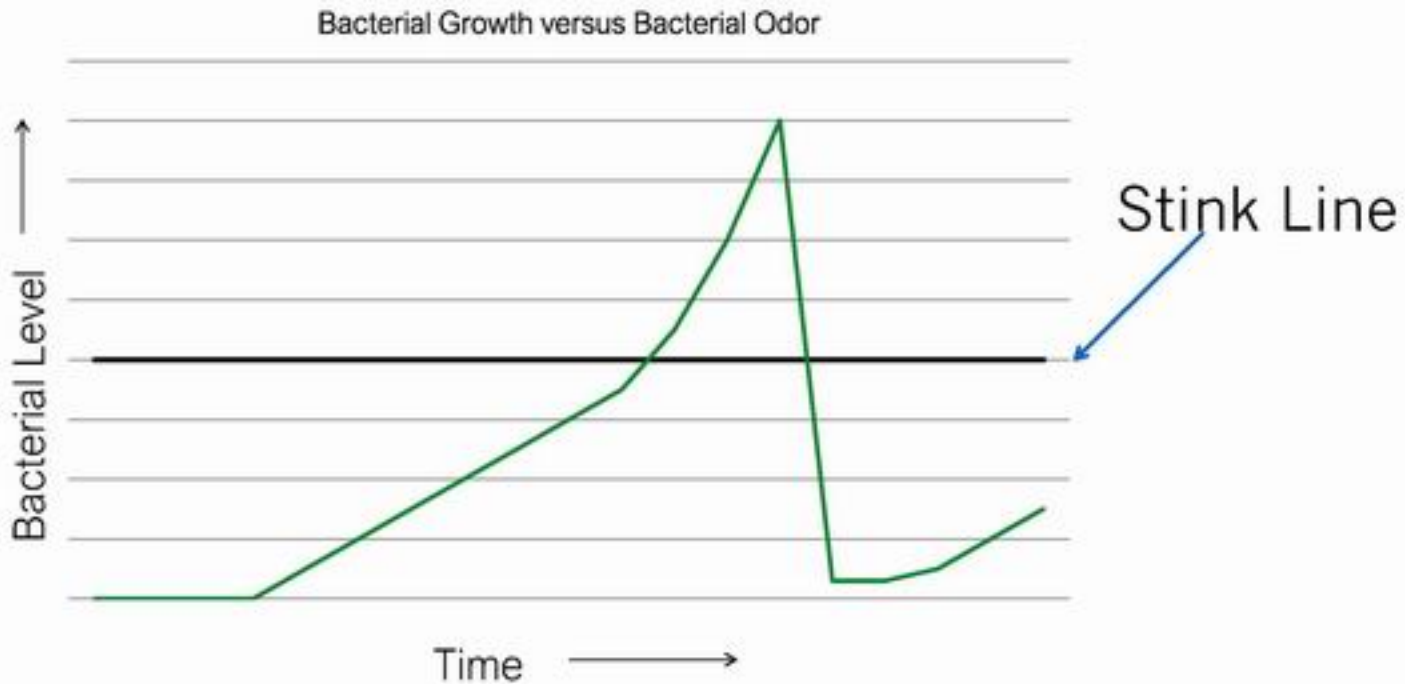


# How can antimicrobial treatments in textiles help?

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# Development of the Clothing Microbiome



**Fresh Smell, Fresh Appearance**  
**Use after Use**

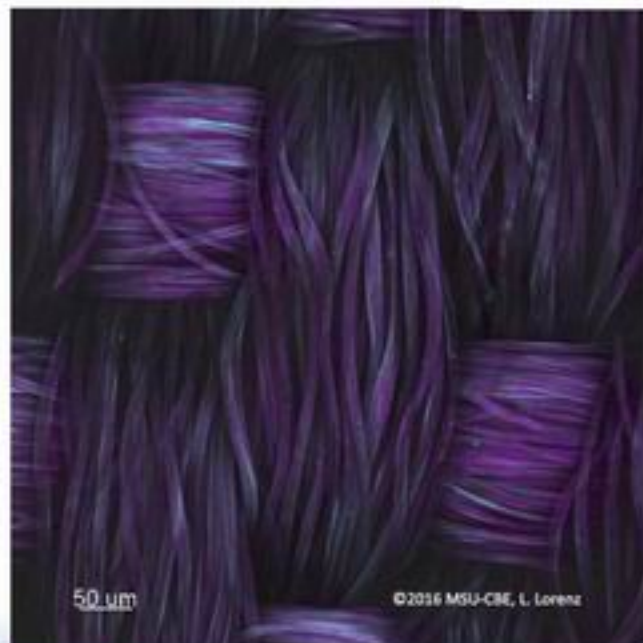
# Development of the Clothing Microbiome

Biofilm Formation on Fabric

100% Polyester Fabric



Untreated



Treated

Courtesy of  
Dow Chemical Silvadur

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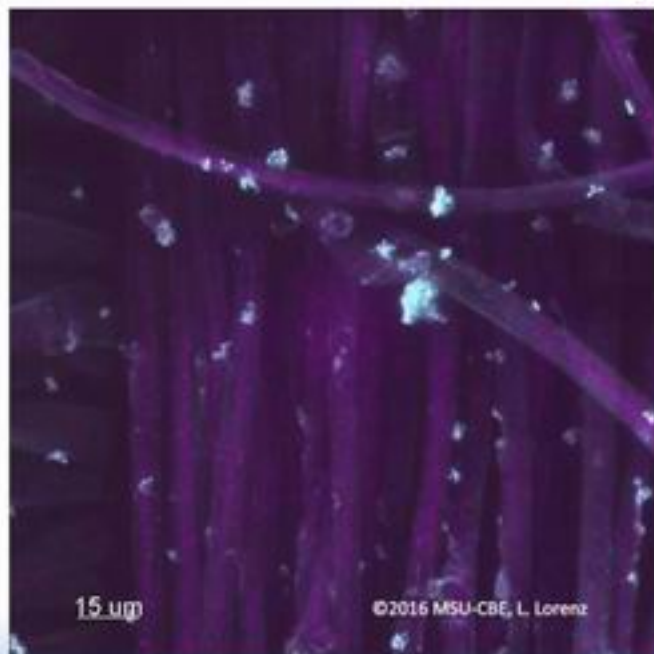
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# Development of the Clothing Microbiome

Biofilm Formation on Fabric

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*What new technologies exist that were not available only  
a few years ago?*

Current Antimicrobial Technologies on the Market

**New antimicrobial agents and  
delivery mechanisms make testing  
more challenging**

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# **Types of Antimicrobial Agents Currently Available**

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# How to choose the right odor-controlling product

There are many choices for odor control.

Particle based

Nano-particle based

Chemical based

Polymer based

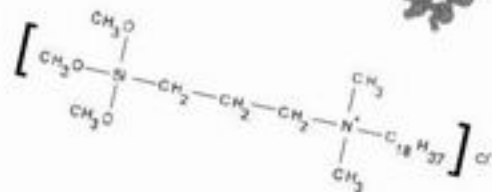
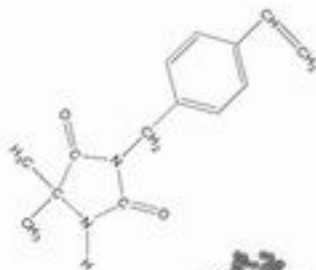
Organic based



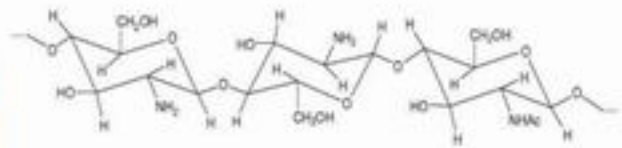
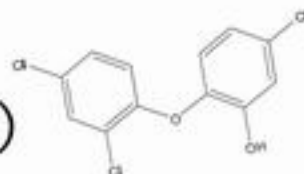
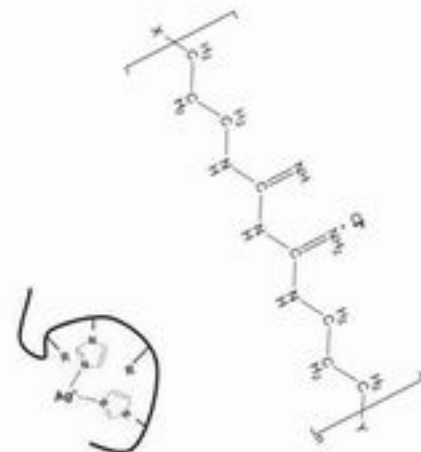
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# Types of Antimicrobial Agents



Silver particle  
Silver polymer  
Quat-Silane  
Zinc Pyrithione  
Biguanides  
Chitosan  
Copper  
Triclosan  
n-Halamines (Chlorine)



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# **Types of Standard Antibacterial Test Methods**

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# Standard Antimicrobial Test Methods

AATCC 147 "ZOI"



*"Zone of Inhibition"*

*"Dynamic Shaking"*

*"Static Contact"*

ASTM E2149-13  
"Dynamic Shake Flask"



ISO 20743, JIS L1902,  
AATCC100, IBRG TEX



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# Standard Antimicrobial Test Methods

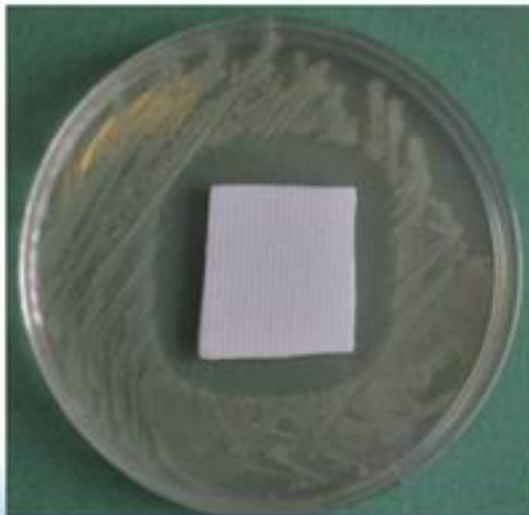
AATCC TM 147

*Antibacterial Activity Assessment of Textile Materials:  
Parallel Streak Method*

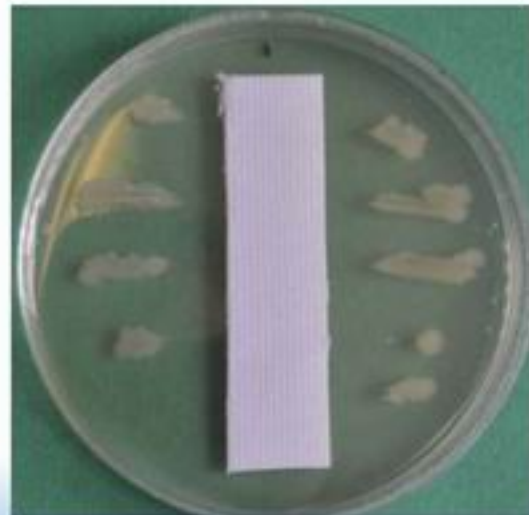
Kirby-Bauer



Modified Kirby-Bauer



AATCC TM 147

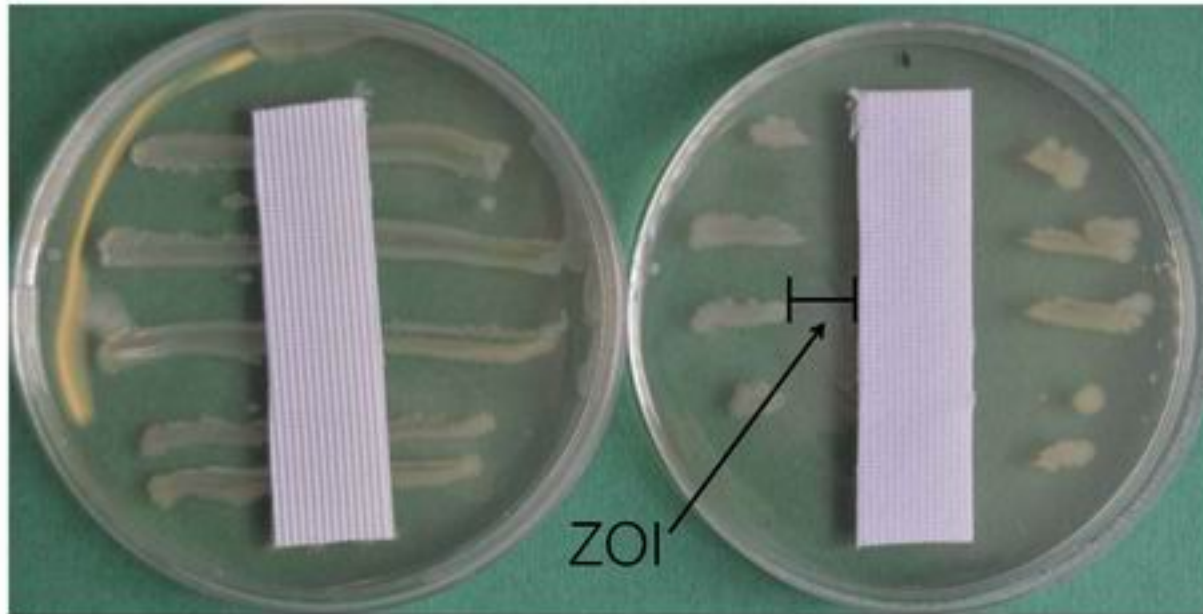


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# Standard Antimicrobial Test Methods

AATCC TM 147 *“Zone of Inhibition” (ZOI)*



Both fabrics are treated with effective antimicrobial agents. Only one of these fabrics will show activity using this test method



# Standard Antimicrobial Test Methods

ASTM E2149-13

*Standard Test Method for Determining the Antimicrobial Activity of Immobilized Antimicrobial Agents Under Dynamic Contact Conditions*



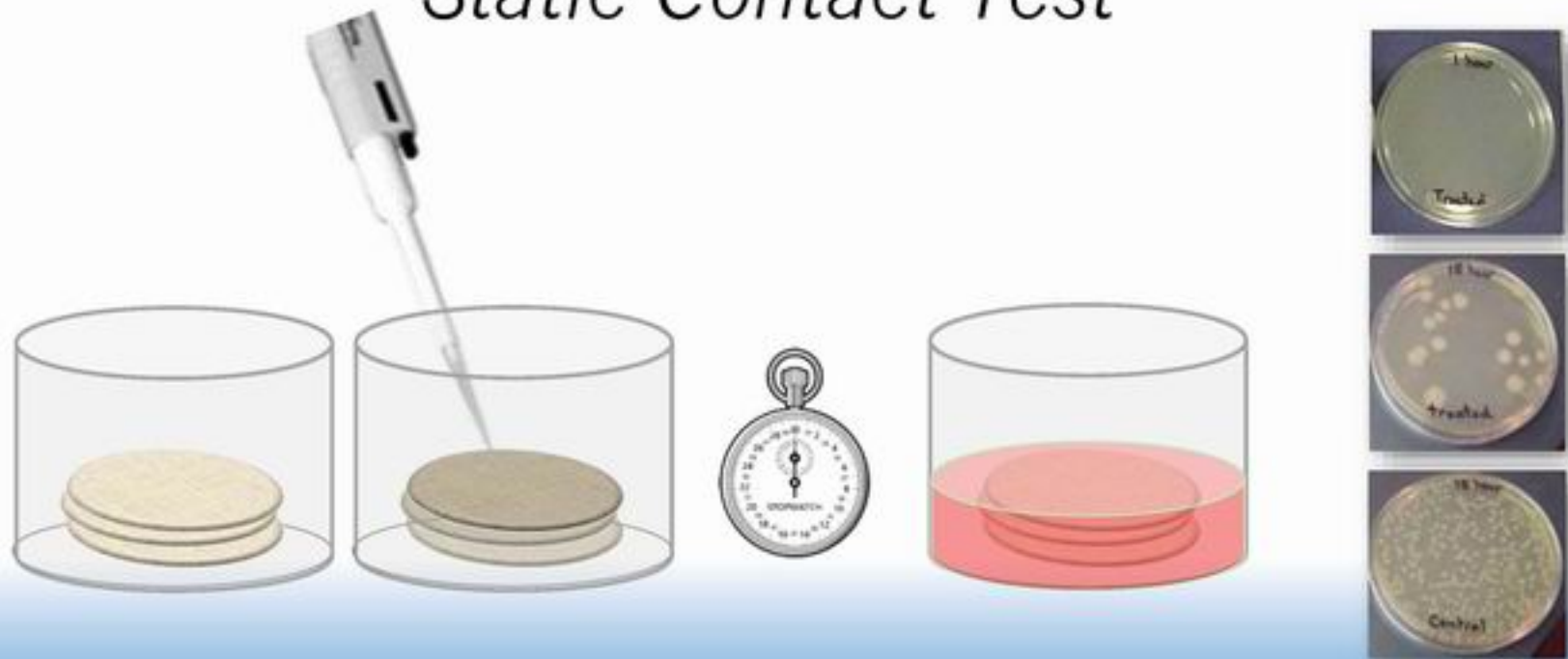
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# Standard Antimicrobial Test Methods

AATCC TM 100, JIS L1902, ISO 20743, ASTM wk45351

## *Static Contact Test*



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# Standard Antimicrobial Test Methods

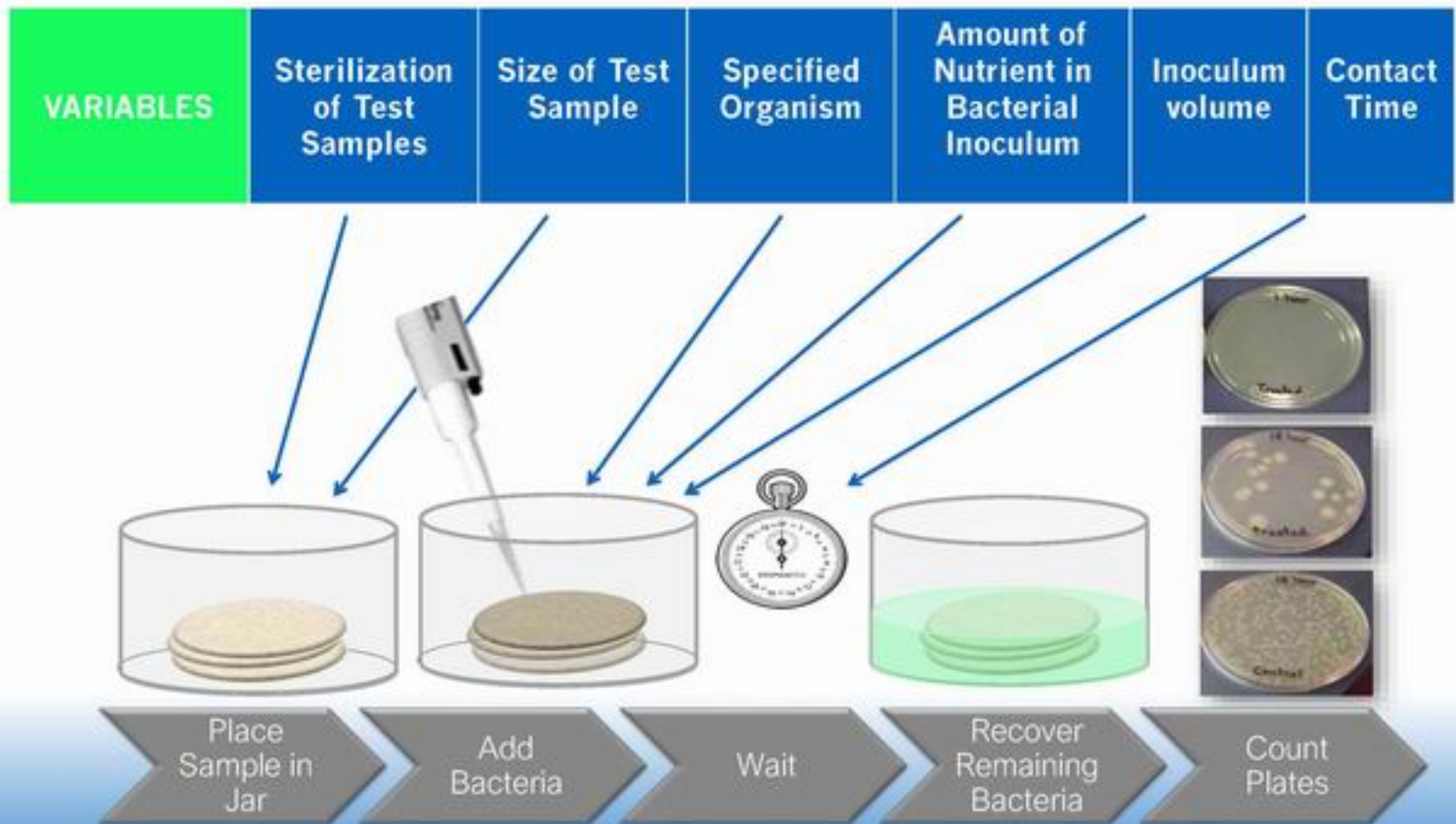
While test methods are all very similar, tremendous amounts of options/variability within these methods leads to problems with reproducibility both between and within Third Party Test Laboratories

VARIABLES	Sterilization of Test Samples	Size of Test Sample	Specified Organism	Amount of Nutrient in Bacterial Inoculum	Inoculum volume	Contact Time
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# Standard Antimicrobial Test Methods









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# Standard Antimicrobial Test Methods

	Sterilization of Test Samples	Size of Test Sample	Specified Organism	Amount of Nutrient in Bacterial Inoculum	Inoculum volume	Contact Time
AATCC100 	Optional	Variable depending on sample absorption	<i>Staph. aureus</i> <i>K. pneumoniae</i>	0% or 100%	1 ml	18-24 hours
ISO 20743/JIS L1902  	Optional	0.4 gram	<i>Staph. aureus</i> <i>K. pneumoniae</i>	5% NB (1:20)	0.2 ml	18-24 hours
IBRG TEX13/OECD TFB 	Not recommended	0.4 gram	<i>Staph. aureus</i> <i>Escherichia coli</i>	0.2% NB (1:500)	0.2 ml	24 hour
ASTM E2149-13 	None	1.0 gram	<i>Escherichia coli</i>	0%	50 ml	1-24 hours
(ASTM E35.15 wk #45351) 	None	0.4 gram	<i>Escherichia coli</i>	0.2% NB (1:500)	0.2 ml	24 hour

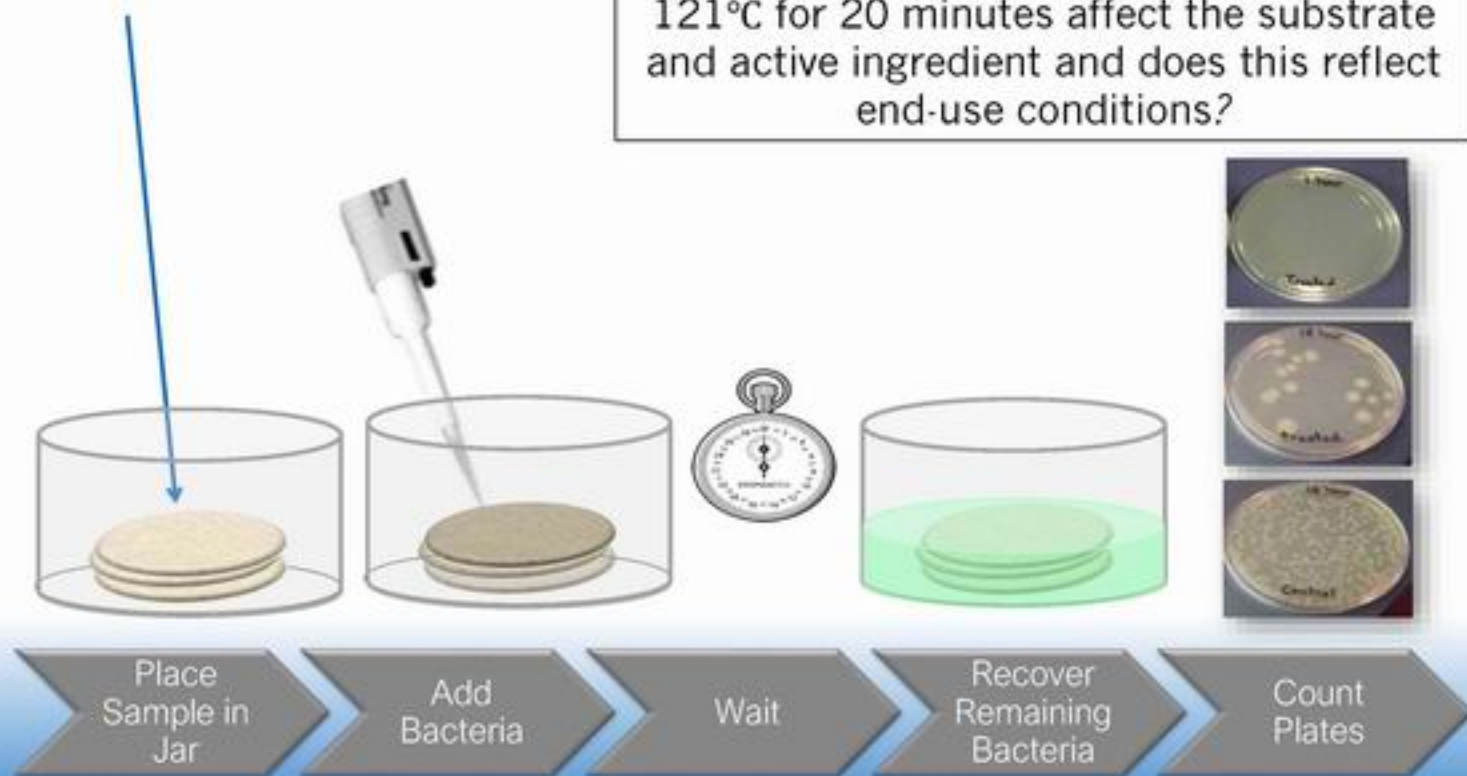
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VARIABLES	Sterilization of Test Samples	Size of Test Sample	Specified Organism	Amount of Nutrient in Bacterial Inoculum	Inoculum volume	Contact Time
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### 1. Options to Sterilize Test Samples

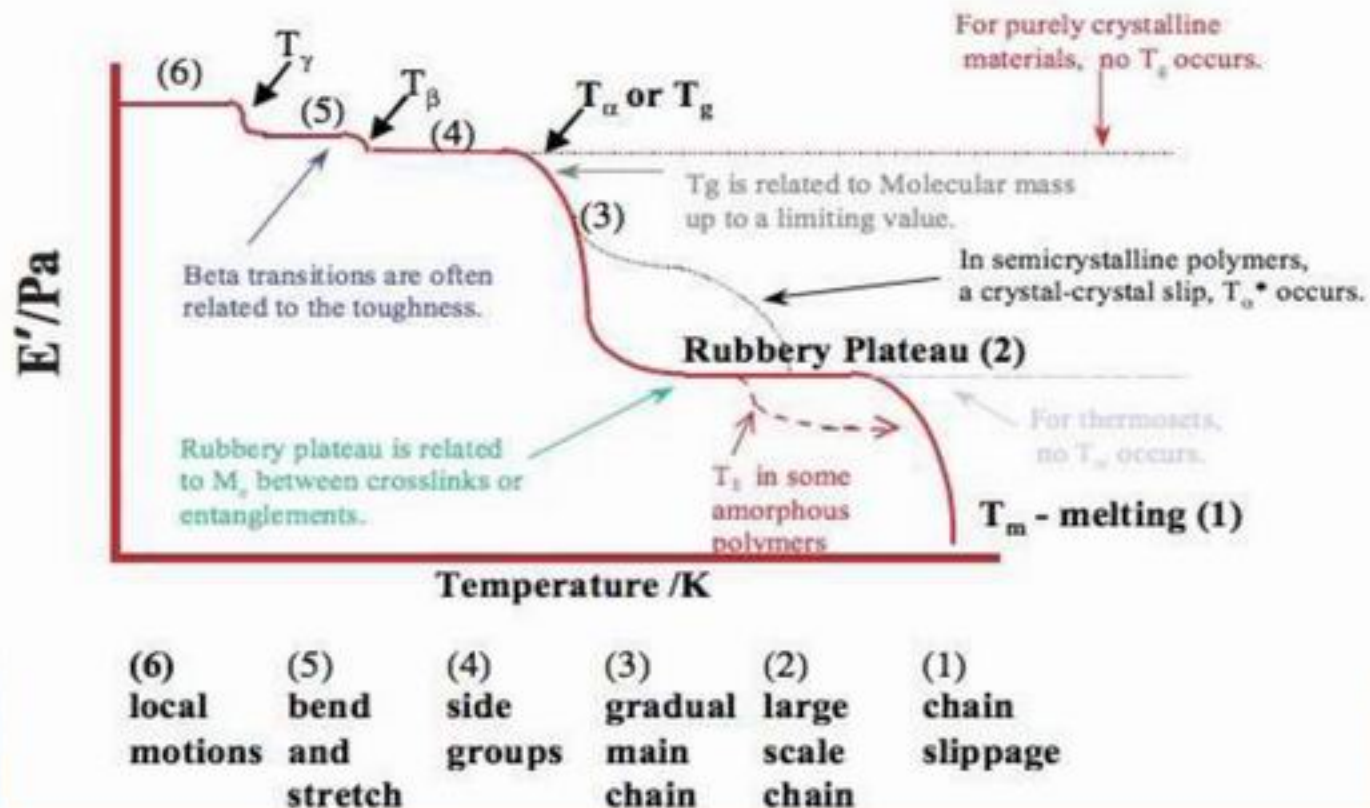
Optional in many methods. How does 121°C for 20 minutes affect the substrate and active ingredient and does this reflect end-use conditions?



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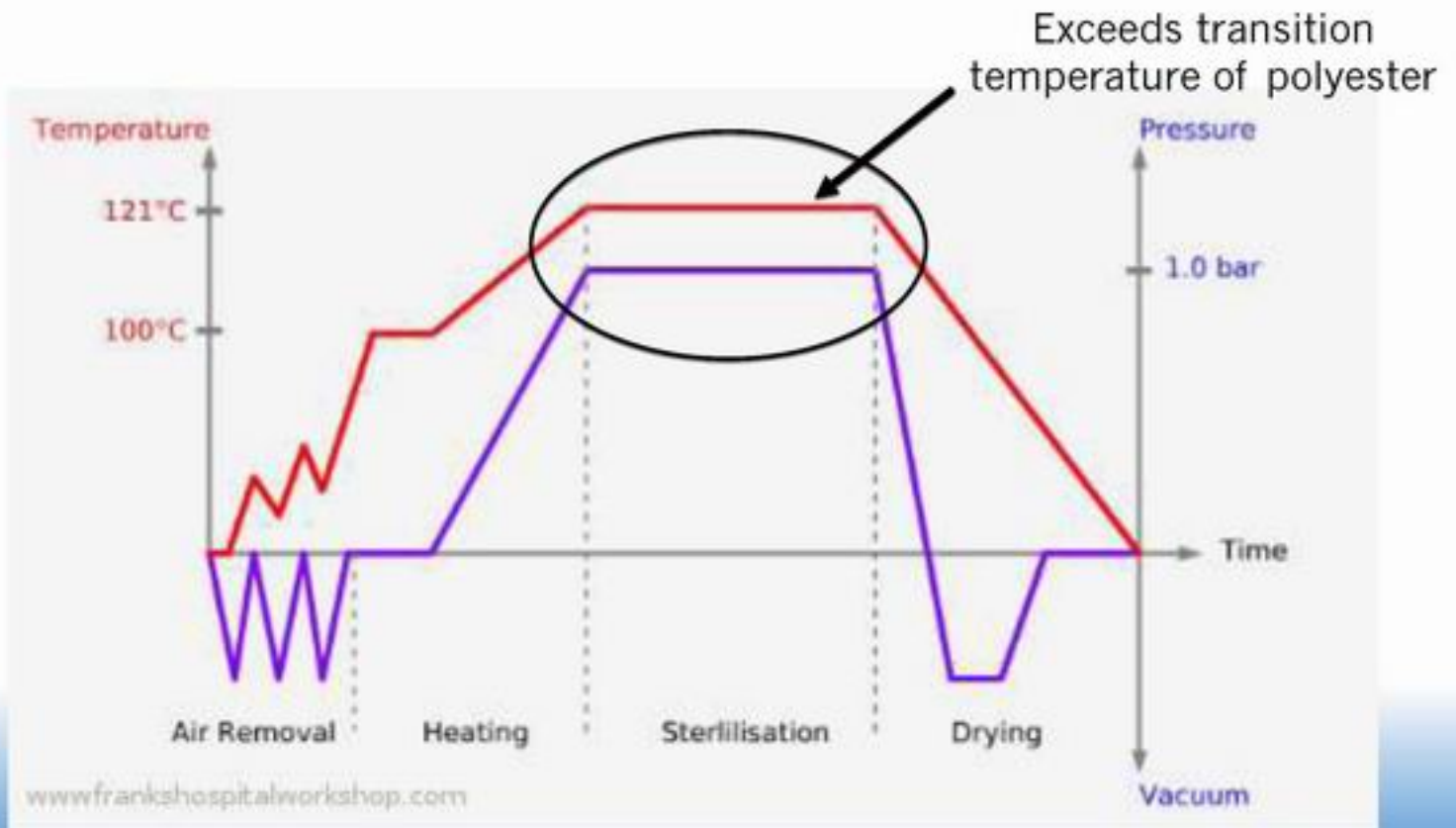
# Transition Temperatures and Typical Processing of Polyester



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# Temperatures and Times for Sterilization during Autoclave



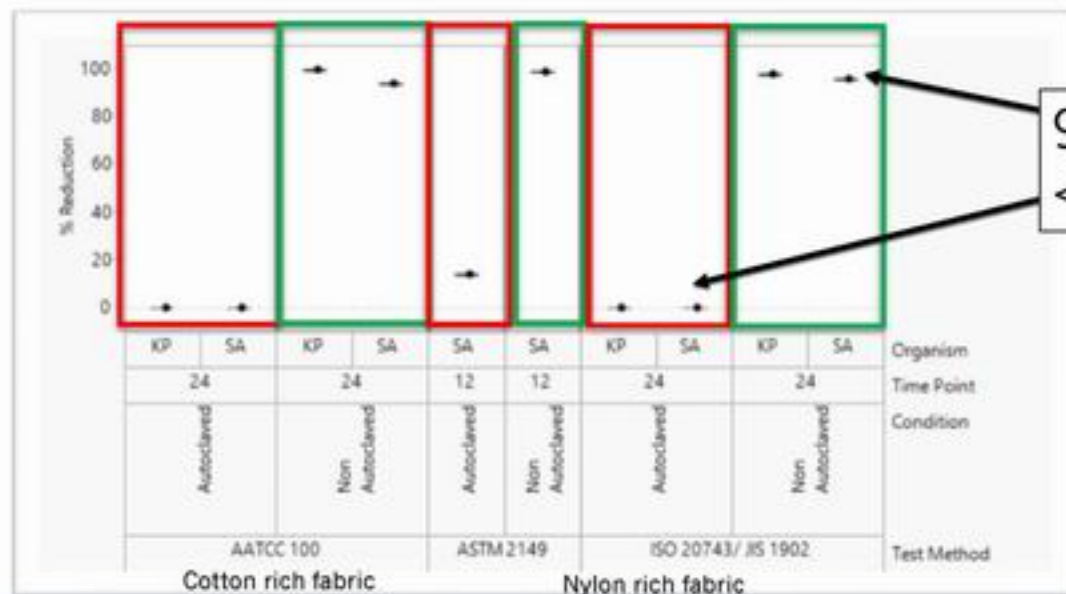
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VARIABLES	Sterilization of Test Samples	Size of Test Sample	Specified Organism	Amount of Nutrient in Bacterial Inoculum	Inoculum volume	Contact Time
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*How does the pre-sterilization of the sample affect the test results?*



99.9% reduction before  
<20% reduction after

**Autoclaving textile fabrics prior to testing can completely destroy the ability to detect the antimicrobial performance**

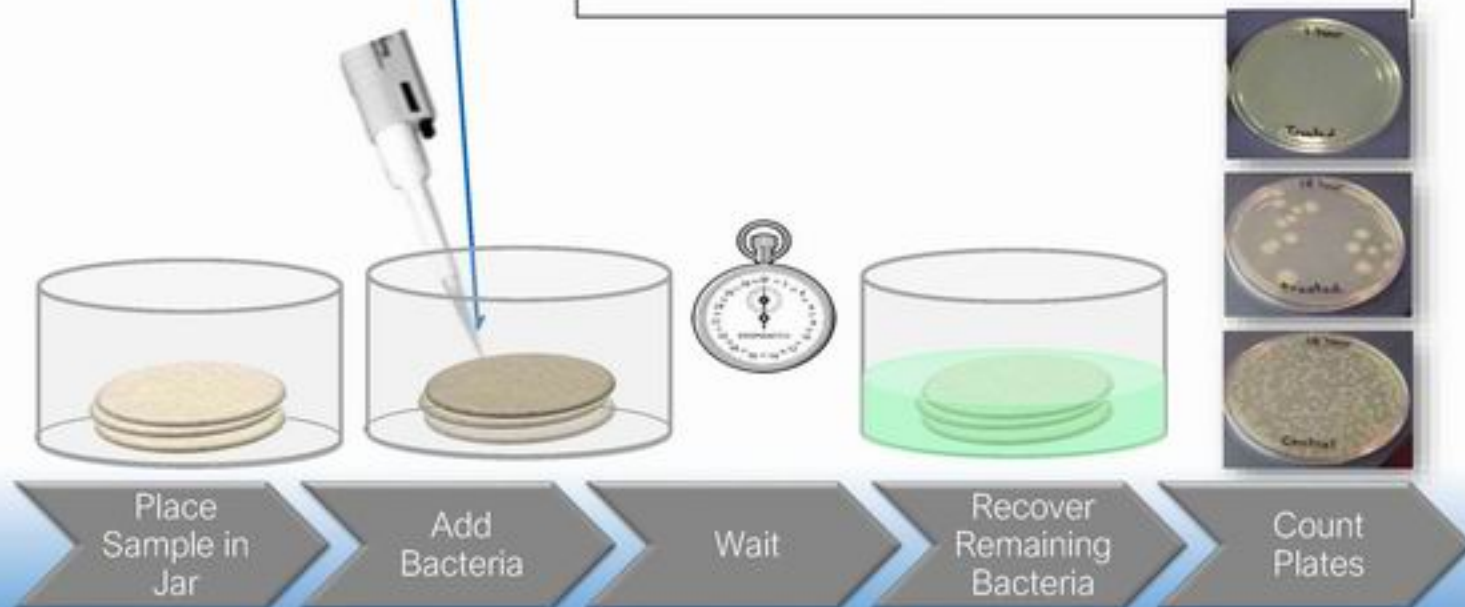
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VARIABLES	Sterilization of Test Samples	Size of Test Sample	Specified Organism	Amount of Nutrient in Bacterial Inoculum	Inoculum volume	Contact Time
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*Concentration of Nutrients in the bacterial inoculum*

Can be anywhere from 0% to 100%. Need enough nutrients to keep the bacteria alive and able to grow (if possible) but not too much to overwhelm the system and be unrealistic to an end-use situation



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## VARIABLES

Sterilization  
of Test  
Samples

Size of Test  
Sample

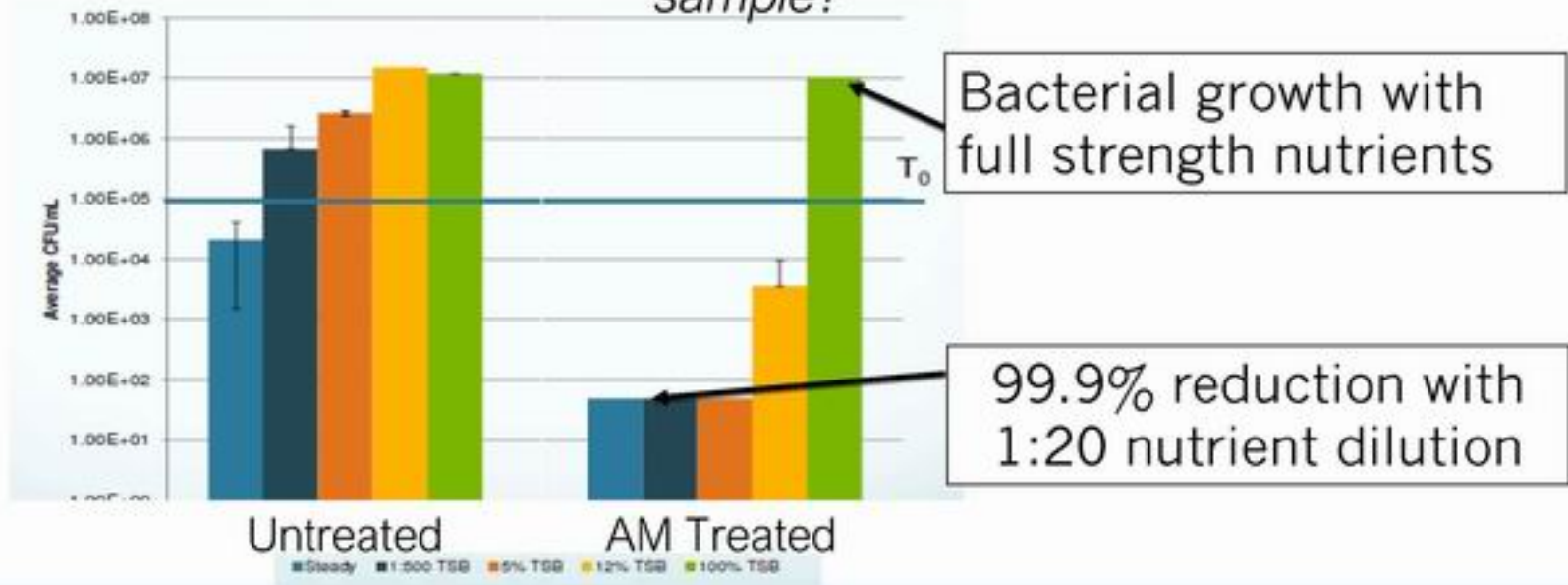
Specified  
Organism

Amount of  
Nutrient in  
Bacterial  
Inoculum

Inoculum  
volume

Contact  
Time

*How does the level of nutrients affect the growth of the bacteria on the sample?*



**High nutrient levels during testing can completely block the ability to detect the antimicrobial performance**

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# Challenges in the Antimicrobial Industry

Antimicrobial technologies have significantly advanced over the past 10 years.

- Polymer technologies have greatly enhanced durability while lowering the required levels of added antimicrobial agent

The original design of the currently used test methods was based off technologies no longer used in the market.

- organotins, organomercurials, the sodium salts of chlorinated phenols (tri, tetra, penta chlorophenols), Zinc Chloride, Mercuric Chloride, Copper-8-quinoliolate, Copper Sulfate, organoarsenicals, hexachlorophene, and formaldehyde

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# Challenges in the Antimicrobial Industry

Antimicrobial test methods have not been updated to compensate for these new and improved technologies

- AATCC100, JIS L1902, ISO20743

Many Textile Test Laboratories are unfamiliar with performing complicated microbiological test methods.

Test Laboratories are running the test methods that are not capable of detecting the antimicrobial activity on some treated textiles.

- AATCC147, ASTM E 2149

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# Challenges in the Antimicrobial Industry

Current test methods must be modified in order to properly measure the antimicrobial activity of some treated textiles

The antimicrobial testing industry must provide guidance documents and develop new standards that match today's unique technologies

Microbiological laboratories must be screened and certified to run these new guidelines and standards

Ongoing testing must be continuously monitored and mentored as new methods and modifications are developed

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# Challenges in the Antimicrobial Industry

*How has the antimicrobial industry responded to these new challenges?*

Guidance documents, Improved Testing Standards and Laboratory Certification and Proficiency Training Programs

**New AATCC, ASTM, IAC Documents and Programs**

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# New and Developing Test Methods for Antimicrobial Treated Textile Articles



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# New Developments at AATCC

## AATCC Test Standards

### **AATCC Test Method 100:** Antibacterial Finishes on Fabrics, Evaluation of.

AATCC has recognized that with the advancement of antimicrobial technologies in today's marketplace, there is a tremendous need to update and improve the current test methods




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# New Developments at AATCC

## **AATCC Test Method 100:** Antibacterial Finishes on Fabrics, Evaluation of.

- Removal of AATCC147 test method as screening tool
- Removal of pre-sterilization step (no autoclaving)
- Standardization of nutrient load in bacterial inoculums
- Standardization of exact sample weight (1 gram) 
- Standardization of exact bacterial inoculum volume

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# New Developments at AATCC

**AATCC Test Method 100:** Antibacterial Finishes on Fabrics, Evaluation of.

Discussion and possible ballot item vote on:

AATCC RA31 Committee on Antimicrobial Activity  
November 14, 2017



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# New Developments at ASTM

## ASTM E2922-15 Standard Guide for The Use of Standard Test Methods and Practices for Evaluating Antibacterial Activity on Textiles



- Lists all typical antimicrobial test methods used for measuring the antibacterial activity on textiles



- Highlights the accepted modifications used by testing laboratories to demonstrate this activity

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# New Developments at ASTM

## ASTM wk45351 DRAFT Standard Test Method for Quantitative Evaluation of the Antibacterial Properties of Porous Antimicrobial Treated Articles

- Follows OECD Guidelines for measuring antimicrobial activity on textiles
- Defines each particular variable that has caused reproducibility in the past with other methods



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# New Developments at ASTM

## ASTM wk56369 DRAFT Standard Test Method for Measuring the Durability of Antibacterial Agents of Porous Applied to Textiles

- Accelerated method for duplicating home laundering conditions (similar to AATCC61)
- Designed to reduce false positive or negative antimicrobial results often seen with other washing techniques (eq. AATCC135)



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# New Developments at IBRG and OECD

Other Common International Guides and Standards

**IBRG TEX13/005/1.0** – Quantitative Method for Evaluation Bactericidal Activity of Textiles and Porous Materials and Articles



**OECD** – Guidance Document for Quantitative Method for Evaluating Antibacterial Activity of Porous and Non-porous Antibacterial Treated Articles  
(ENV/JM/MOMO(2014)18)



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# **New Advances in Microbial Odor Detection Test Methods**

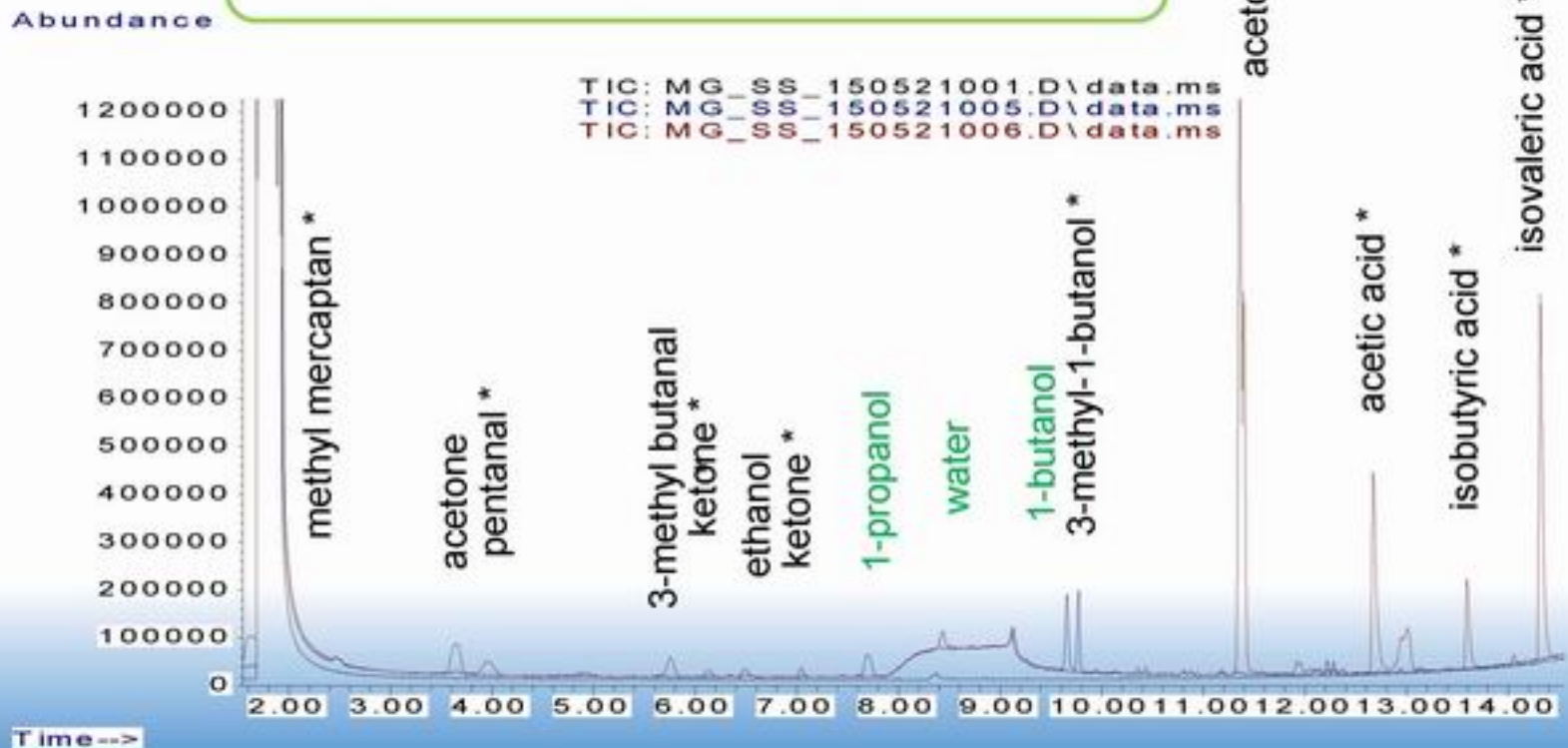
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# New Advances in Microbial Odor Detection Test Methods

Broad array of offensive odor bodies are generated by microorganisms;



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# **New Advances in Microbial Odor Detection Test Methods**

- Generation of foul odor as measured by human subjects
- Generation and Measurement of CO<sub>2</sub>
  - Bioconversion of Urea to Ammonia
- Bioconversion of leucine to Isovaleric Acid

# New Advances in Microbial Odor Detection Test Methods

## Sample Prep:

### **IAC Biofouling of Textiles from Pasteurized Cows' Milk:**

1. Cut 1 gram of both treated and untreated fabric samples into 1.5 x 1.5 inch samples and layer in separate sealable containers as described in the IAC recommended antimicrobial test method.
2. Apply 1 ml of Fat Free, Grade A, Pasteurized Cows' Milk (within expiration date) directly onto fabric sample making sure that all the milk gets absorbed into the fabric sample and NO milk gets deposited on the container.
3. Tightly seal containers and place in warm area, preferably in incubator set for 37C.
4. After 24-48 hours, carefully remove lid and smell for the presence of odor.

After designated time, samples were analyzed by GC-  
HS at elevated temperature and peaks were  
assigned. Samples also analyzed by Odor Panel

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# New Advances in Microbial Odor Detection Test Methods

*Objective: Demonstrate antimicrobial treated fabric odor control properties after 50 laundering cycles using Milk as food source and inoculum for bacterial catabolism.*

Sample Description	# washes	Sensory evaluation Analyst 1	Sensory evaluation Analyst 2
Untreated	50	Rancid, vomit, feet	More sour and foot like
Treated	50	Slight detergent and milk	No smell

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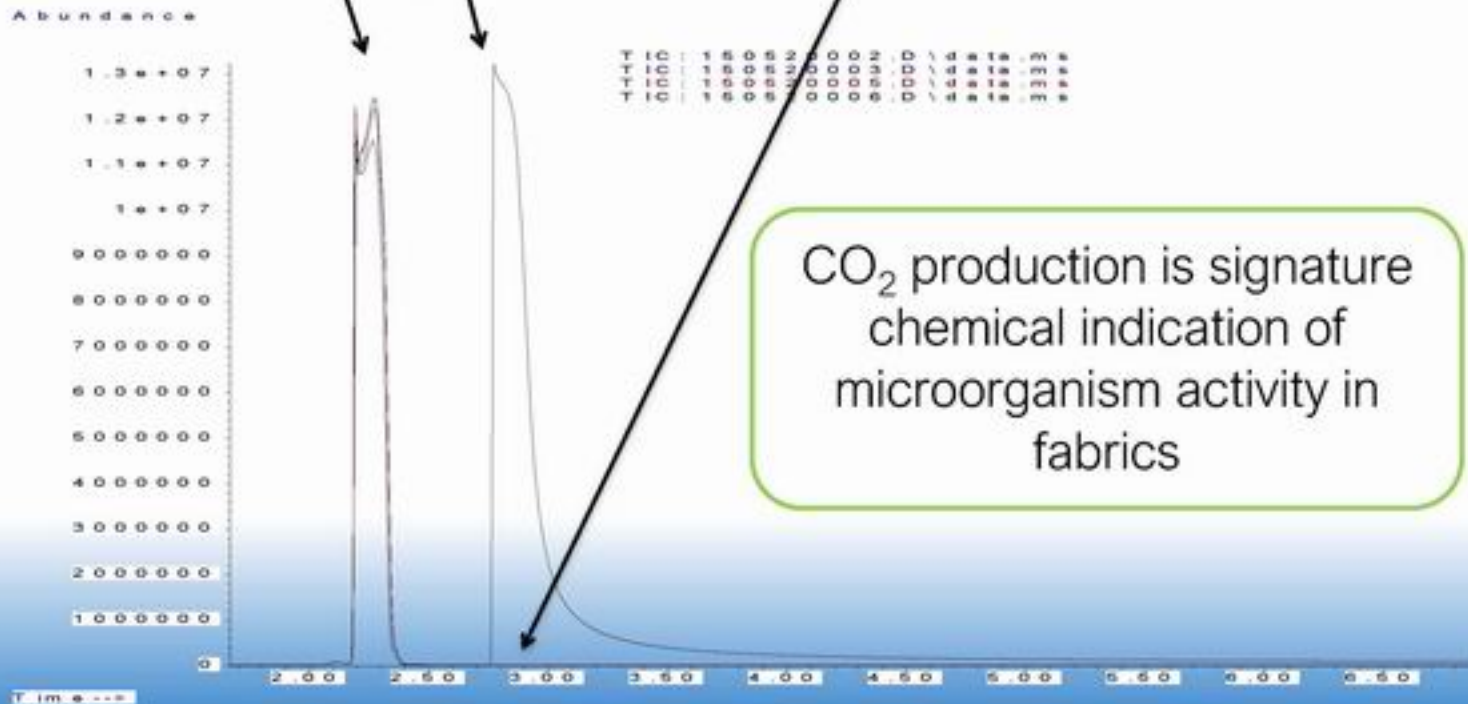


# New Advances in Microbial Odor Detection Test Methods

- GC Headspace/ Milk Test

Untreated: CO<sub>2</sub> Generation  
Carrier Gas: N<sub>2</sub>

Treated: CO<sub>2</sub> Generation



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# New Advances in Microbial Odor Detection Test Methods

*Objective: Demonstrate antimicrobial treated fabric odor control properties after 50 laundering cycles using Milk as food source and inoculum for bacterial catabolism.*

VOCs (100°C) Abridged	Untreated	Treated	Odor description/Threshold
methyl mercaptan	X		Decaying cabbage; 0.002 ppm (CDC)
isovaleric acid	X		Unpleasant food odor; 0.12-0.7 ppm
hexanoic acid	X		Goat-like; 3 ppm (Leffingwell)
decanoic acid *	X		Strong, rancid, 10 ppm (Leffingwell)

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# New Advances in Microbial Odor Detection Test Methods

AATCC Test Method XXX-2011

## Evaluation of Antimicrobial Efficacy on the Reduction of Bacterial Odor Using a Simplified Surrogate Organism and Volatiles Detection System

Developed in 2011 by AATCC committee RA31

### 1. Purpose and Scope

1.1 This procedure establishes a detection method to evaluate the effect of antimicrobial textile treatments on the amount of odor generated through bacterial activity using simple, inexpensive Drager columns.



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# New Advances in Microbial Odor Detection Test Methods

Effect of Treated Textiles on Bioconversion of Urea to Ammonia

**INTERNATIONAL BIODETERIORATION RESEARCH GROUP**

**TEXTILES GROUP**

**Work Instruction**

**IBRG TEX13-012**

**Effect of Treated Textiles on Bioconversion of Urea to Ammonia**

## **1 Introduction**

This protocol describes a method to intended to determine the odour inhibiting properties of textiles. The bioconversion of urea to ammonia is used as the test model.



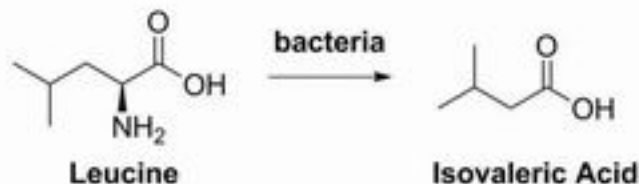
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# New Advances in Microbial Odor Detection Test Methods

Bioconversion of Isovaleric acid on untreated and treated textiles



## Bacterial Culture Preparation

*Staphylococcus aureus* ATCC 6538 was streaked for isolation on Tryptic Soy Agar and incubated overnight at 37°C. Post-incubation, the plate was examined to verify a pure culture. A sterile loop was used to pull one colony and inoculate 10 mL of Tryptic Soy Broth, which was then incubated overnight shaking at 30°C. The overnight culture was centrifuged and the supernatant was discarded. The cell pellet was re-suspended in synthetic sweat to a final concentration of 10<sup>6</sup> CFU/mL.

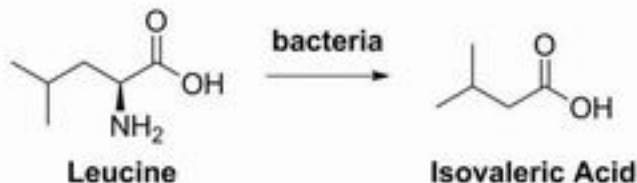


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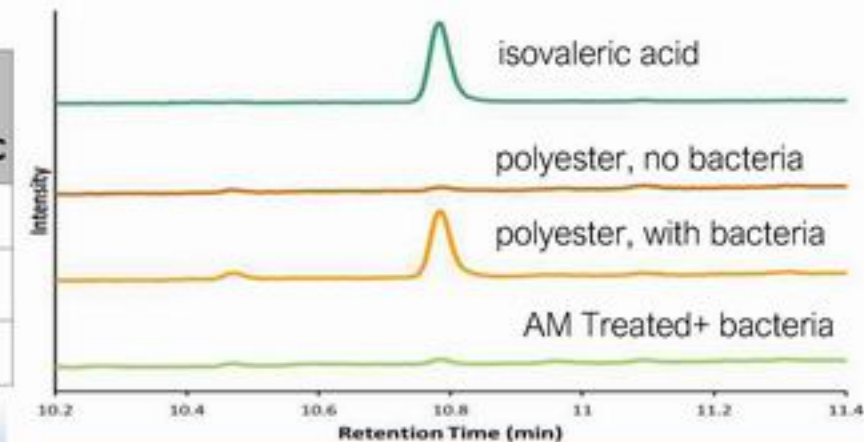
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# New Advances in Microbial Odor Detection Test Methods

Bioconversion of Isovaleric acid on untreated and treated textiles



Sample Description	µg isovaleric acid per g fabric
polyester, no Staph	0.4
polyester, with Staph	8.3
AM Treated PES + Staph	0.5

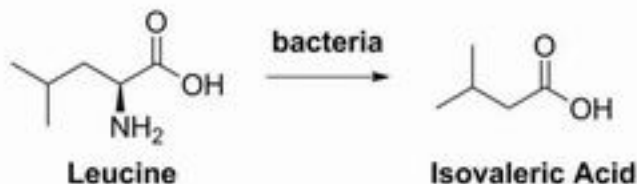


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# New Advances in Microbial Odor Detection Test Methods

Bioconversion of Isovaleric acid on untreated and treated textiles



- We are developing a method for evaluating odor-controlling, antibacterial technologies by monitoring isovaleric acid, a bacterial odor in human sweat
- Isovaleric acid was not detected on antimicrobial treated fabric (green line) vs untreated (orange)
- This method will be developed in combination with the Dow Chemical Company and the IAC entirely on SVSU Campus

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# Conclusions

**There have been great advances in antimicrobial technologies over the past few years.**

**Antimicrobial test methods need to be updated or modified in order to detect the antibacterial and antiodor activity on these treated textiles.**

**IAC provides guidelines and proficiency training programs that provide consistent, reliable test results using industry standard protocols.**



# IAC Recommendations



**Only use IAC Trained and Certified Test laboratories**

For a list of IAC Certified laboratories in your area, please contact the IAC ([www.amcouncil.org](http://www.amcouncil.org))

**Only accept test reports that contain a properly validated IAC Verification number**

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# IAC Recommendations



The image shows a SGS Test Report for IAC Certification. The report includes the following details:

- SGS Logo** and **IAC Certification Number** (00010010)
- Test Report** header with **Report No.** (00010010-01) and **Date** (Mar 01 2017)
- Client name**: Shanghai Xinghe Inc. (Shanghai Xinghe Inc.)
- Client address**: Room 100, No. 100, Zhongyuan Road, Shanghai
- Sample name**: Medical Device
- Product Code**: 100-01-0001
- Manufacturer**: 100-01-0001
- IAC Verification Number**: 100-01-0001 (highlighted with a red circle)
- SGS Information**: SGS is a member of the IAC and is responsible for the accuracy, integrity and/or completeness of the information.
- SGS Sample No.**: 100-01-0001-001
- SGS Reference No.**: 100-01-0001-001
- Date of sample received**: Feb 16 2017
- Testing period**: Feb 16 2017 - Mar 01 2017
- TESTS REQUESTED**: Antimicrobial activity test for the submitted sample after 4 cycles (1:10 washes, 1 cycle 2 washes)
- TEST METHODS**: Please refer to the next page(s)
- TEST RESULTS**: Please refer to the next page(s)
- SGS Authorized Signature**
- SGS IACI Standards Technical Services (Shanghai) Co. Ltd.**



Test Verification Number

**Allows traceability of all microbiological testing**

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# IAC Recommendations



Test Verification Number

Allows traceability of all microbiological testing

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# IAC Recommendations

*Where are the  
International Antimicrobial Council Certified  
Laboratories?*



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# Thank you for your attention

## 谢谢

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