

EAGLE PROTECT NITRILE GLOVES REDUCE PATHOGEN CROSS-CONTAMINATION RISK

And Why Vinyl Gloves Can Increase Cross-Contamination Risks

- Barry Michaels

EAGLE PROTECT NITRILE ARE LIKE TEFLON®

The latest research shows Eagle Protect Sensitive, FineTOUGH and Light & Tough nitrile gloves (subsequently called Eagle Protect nitrile gloves) have overall surface energy and transfer characteristics with extreme similarity to Teflon®, reducing the risk of potential cross-contamination in ready-to-eat (RTE) foods from food pathogens including: *Listeria monocytogenes*, Norovirus, Hepatitis A, Salmonella, Shigella, *S. aureus* and Enterohemorrhagic strains of *E. coli*.

VINYL HAS 3x CROSS-CONTAMINATION RISK THAN EAGLE NITRILE

These tests illustrate food and human “soils” that often contain disease producing microorganisms do not stick well to Eagle Protect nitrile gloves, with generic vinyl gloves having 3-times the net average cross-contamination potential as Eagle nitrile gloves.

CROSS-CONTAMINATION & DISPOSABLE GLOVES

We live in a sea of microorganisms, some of which cause disease, with many of these taking advantage of the human hand to enable transmission.

The hand should be envisioned as a biofilm consisting of both resident microbial species and transient flora (species) with physical characteristics that make it unlike all other surfaces. Even after repeated washings, the hand will quickly repopulate organisms adapted to living on human body surfaces, however when skin on the hand is damaged, transient species become colonizers. By understanding transfer to and from food surfaces via hands and surfaces contacted by hands, a significant factor in human disease transmission can be understood and addressed by developing effective mitigation strategies.

One such important cross-contamination preventive control measure and the subject of this paper is disposable glove use.

Glove Punctures

Cross-contamination can start with a single drop (0.05 mL) that can deliver billions of bacteria or viruses from soil origin to hands or surfaces. Drops can start as a “liquid bridge” of microbial contamination that flows from inside glove surfaces to cover the outer surfaces. Studies have shown that up to 18,000 Staphylococci can pass through a single glove hole during a 20-minute period, even though the hands were scrubbed prior to gloving. When glove puncture occurs cross-contamination is seen to be doubled.

Studies have compared barrier integrity of new vinyl and nitrile gloves, with the gloves tested under conditions of activity in which they are normally used or manipulated to simulate actual use. The gloves are then subjected to water leak tests. As shown in the chart below, there is a 10-fold increase in average failure rate of vinyl gloves compared to nitrile gloves.

Vinyl vs. Nitrile Glove Puncture Comparison

Glove Material	Average Failure Rate*
Vinyl	51.2%
Nitrile	4.6%

*Simulated or real use testing

Physical Chemistry

The science involved in cross-contamination is complex, involving the physical chemistry of surfaces, soils and pathogens. Liquid and soil transfer to and from surfaces are controlled by forces of attraction governed by the surface tension of liquids (or semi-solids) and the surface free energy of surfaces. Microorganisms hitch a ride on food or organic soils but also have surface free energy properties of their own, important in biofilm formation.

Glove puncture frequency and the effects of surface energy drive cross-contamination of food products related to glove use, resulting in compromised food safety.



VINYL GLOVES DESCRIBED AS “INFECTION CONTROL NIGHTMARES”

There is an accumulation of scientific evidence showing vinyl disposable gloves (over other types) are responsible for a majority of cross-contamination events in food handling related to glove use where disposable glove type is identified.

Surface Structure & Puncture Rate

Due to vinyl's uneven structure, having high plasticizer inclusions, numerous studies have shown vinyl gloves have an increased permeability to bacteria and virus, and in some cases, begin leaking as soon as they are donned, increasing the risk of cross-contamination for both the glove users and the food they are handling.

Studies show vinyl gloves have a 10-fold increase in the average failure rate when compared to nitrile gloves under conditions of activity. With the physical chemistry and puncture rate working harmoniously, drops of contamination from a glove leak are smeared over glove surfaces where surface energy factors take over, with both working harmoniously to spread cross-contamination.

Surface Free Energy

Compared to lower-stick nitrile gloves, generic brands of PVC gloves (vinyl) are more hydrophilic at around 8 mN/m² surface free energy units (milliNewtons / square meter) - these surfaces are more energetic, with pick-up and spread thermodynamically favored. This means food and human soil contaminants and associated microbial populations of

spoilage species and potential pathogens, are more easily picked-up and spread over vinyl glove surfaces and anything they touch, when compared to nitrile gloves.

From a food safety point of view, because food workers gloves are in direct contact with food, cross-contamination will follow the path of least resistance, in this case favoring vinyl glove pick-up and transfer.



WHY EAGLE NITRILE GLOVES REDUCE FOOD PATHOGEN CROSS-CONTAMINATION

Eagle Protect nitrile gloves, when measured for surface free energy (using a Zisman apparatus and surrogate soils), were shown to have overall surface energy and transfer characteristics with extreme similarity to Teflon®, reducing the risk of potential cross-contamination in RTE foods from food pathogens including; *Listeria monocytogenes*, Norovirus, Hepatitis A, Salmonella, Shigella, *S. aureus* and Enterohemorrhagic strains of *E. coli*.

Eagle Protect nitrile gloves were shown to have extreme similarity to Teflon®, reducing cross-contamination risks

These tests mean food and human “soils” that often contain disease producing microorganisms do not stick well to Eagle Protect nitrile gloves, with generic vinyl gloves having 3-times the net average cross-contamination potential as Eagle nitrile gloves.

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The unique surface characteristics of Eagle nitrile gloves, due to the raw material formulation and processes undertaken during manufacturing, make them an ideal food handling and preparation glove.

Disposable gloves have the potential to mitigate, transfer or amplify cross-contamination risks, therefore choosing the correct disposable glove to mitigate the risks of foodborne illness is essential for food handling companies. A single foodborne outbreak can result in severe illness or death to the consumer, and in monetary damages of millions of dollars to the company involved, affecting the brand's reputation for years to come.

Full details and references for the information included here can be found in Michaels B, 2017. **Summary of Hand & Glove Surface Cross-Contamination Potential in Retail Deli, Food Processing & Service Environments Based on Surface Energy Studies** (unpublished report on file with Eagle Protect PBC). Contact Eagle Protect for further information.

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