Taking off the Toxic Gloves: An Investigation of Phthalates and Other Chemicals of Concern in Food-Handling Gloves

Ecology Center's Healthy Stuff program
Ann Arbor, MI
Lauren Olson, Gillian Z. Miller, Ph.D., and Mike Belliveau[1]
[1]Environmental Health Strategy Center

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SUMMARY

Plasticizer chemicals are added to polymers such as polyvinyl chloride (commonly called PVC or vinyl) to make them flexible for applications like food-handling. These plasticizers are not bound to the vinyl and can leech into the environment and food. A common plasticizer is the class of chemicals called *ortho*-phthalates, abbreviated to phthalates. Food is the primary source of exposure to several phthalates, and gloves and other food-handling equipment contribute to unintentionally adding phthalates to food. Phthalates have endocrine disrupting abilities; therefore, their presence in food is alarming.

We studied two streams of single-use disposable vinyl food-handling gloves: those imported for distributors to sell and those in use at restaurants. In all, we found that 1 in 6 or 14% of gloves tested contain phthalates. Four phthalates were found in some vinyl gloves, alone or in combination with one another: DEHP (the most toxic), DINP (the unsafe alternative), DIDP (has growing concern) and DPHP (closely related to DIDP, increasingly used). This study is the first time that DPHP has been identified in food-handling gloves to the authors' knowledge. DOTP, a terephthalate, was the most commonly used as a plasticizer in gloves. Regardless of which plasticizer is used to make vinyl gloves, the plasticizer makes up a large percentage of the glove's weight—upwards of 30%—of an unbound, highly mobile molecules. Safer alternatives to vinyl gloves are available, including bare hands with proper washing, polyethylene (preferred), and nitrile (acceptable).

Our study found that 2 out of 3 restaurants visited use vinyl gloves. The presence of phthalates in vinyl gloves is inconsistent across glove distributors and restaurants due to inadequate supply chain management. With vinyl gloves being so commonly used at restaurants, it presents the possibility for any glove to contain phthalates and indirectly add phthalates to food. Gloves containing phthalates were in use at four restaurant locations: McDonald's (2 locations), Wendy's (1), and Burger King (1). Some restaurants use only polyethylene gloves, which from our study includes Subway, Panera Bread, and Starbucks restaurants.

INTRODUCTION

The Motivation for the Study

The aim of the study was to understand to what extent phthalates are still used in plastic disposable food service gloves in the U.S. Disposable gloves are ubiquitous at every stage of food production. Gloves made of flexible polyvinyl chloride (PVC), or vinyl, are popular due to their durability and relatively low cost. Vinyl dominates the market for gloves used in handling, processing, and serving food. To make vinyl gloves flexible, manufacturers add high levels of plasticizer chemicals--typically around 30% by weight. These plasticizers migrate into foodstuffs touching the vinyl and people ingest them.

Among plasticizers, *ortho*-phthalate esters ("phthalates") were historically dominant and have contaminated food for decades. While levels of many specific phthalates have declined, recent research shows that food remains the primary source of human exposure to these hazardous compounds.[1] Phthalates in food likely come from multiple sources. In this study, we analyzed vinyl food-handling gloves for phthalate and non-phthalate alternative plasticizers.

Phthalates and Health

Phthalates may contribute to health and developmental problems in humans, especially children. In a review of epidemiological studies, researchers found a consistent connection between phthalates and specific poor health outcomes.[2] Among girls and boys, phthalates are likely to increase the occurrence of allergies and asthma as well as behaviors related to attention deficit disorder. In boys, phthalates cause an increase in congenital malformations affecting the genitals, including decreased distance between anus and penis which can result in lower sperm quality, lower fertility, and increased risk of prostate cancer. Exposure to phthalates affects the level of hormones in men and women of reproductive age. Epidemiological studies show a connection between elevated phthalates and puberty timing—specifically early puberty in girls and male development of gynecomastia or enlargement or swelling of breast tissue.

Due to the toxicological and epidemiological studies, the U.S. Consumer Product Safety Commission (CPSC) convened a Chronic Hazard Advisory Panel (CHAP) "to study the effects of all phthalates and phthalate alternatives as used in children's toys and childcare articles."[1] They recommended a permanent ban on certain phthalates, detailed in *Table 1*.

Table 1: Regulations on Phthalates

Country	Regulatory Body	Name and Year enacted	Phthalates	Guidelines
United States	Consumer Product Safety Commission	Consumer Product Safety Improvement Act of 2008, 2014	DBP, BBP, DEHP, DINP	Banned from children's toys and childcare articles greater than 0.1%[1]
United States: California	California Office of Environmental Health Hazard Assessment	Proposition 65, 1988-2013 depending on phthalate	DEHP, BBP DIDP, DINP, DBP, DnHP	Warning of chemical use must be on the packaging[3]
European Union	European Chemicals Agency	2011, entry 51 of Annex XVII. Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)	DEHP, DBP, BBP, DIBP	Banned from children's toys and childcare articles greater than 0.1%[4]
European Union	European Commission	2011, Regulation No 10/2011	DEHP, DBP, BBP, DINP, DIDP (and all other phthalates banned)	Banned in plastic food contact materials intended for fatty foods if more than 0.05% of the final product[4]
European Union	European Chemicals Agency	REACH Authorisation for Substances of Very High Concern, 2011	DEHP, DBP, DIBP, BBP, and additional phthalates	All uses are banned unless specific uses have been exempted[4]
Japan	Ministry of Health, Labour and Welfare	On the Use of PVC Gloves for Foods, 2000	DEHP	Banned from PVC gloves[5]

Country	Regulatory Body	Name and Year enacted	Phthalates	Guidelines
Japan	Ministry of Health, Labour and Welfare	On the Plasticizer (DEHP) Eluted from PVC Medical Devices, 2002	DEHP	Banned from medical devices and gloves[5]
Japan	Ministry of Health, Labour and Welfare	Amendment to the standards for devices, containers package 2002	DEHP, DINP	Banned from food packaging materials in contact with fatty foods and toys that are held in the mouth[5]

See *Table A: Chemical Names and Acronyms* for more information on the chemicals mentioned.

Phthalates and Food

The contamination of food by these endocrine-disrupting compounds is of particular concern. Phthalates migrate into food products from food contact materials used in food processing, in packaging or from food service gloves worn by workers. In general, phthalates in vinyl have been shown to leach, migrate, and off-gas into the environment.[6–8]

Although phthalates are present in many consumer products, food is believed to be the primary source of several phthalates.[9–11] The CHAP report on phthalates tabulated the estimated daily exposures for pregnant women, women of reproductive age, infants, toddlers, and children.[1] In each subpopulation, food, beverages, and drugs via direct ingestion--not children's toys or personal care products--were the most significant contributors to phthalate exposure. A recent study has also shown that people who frequently eat at restaurants tend to have had higher phthalate levels in their bodies.[11]

Researchers have identified no single primary source of phthalates in the U.S. food supply chain, but our prior work and that of others suggest more highly processed foods tend to have higher phthalate concentrations.[7,8,12–14] Food packaging, including printing inks and adhesives, may be a source for some foods, but processing equipment is probably a common source.[15] Cao *et al.* detailed the following potential sources of phthalates in food in a review article: vinyl tubing, vinyl gaskets in metallic caps for glass jars, vinyl gloves, aluminum foil paper laminates, and coatings on cookware.[7]

It's important to note that polymers other than vinyl can contain phthalates. Our 2018 report "Sources of Phthalates in Dairy Farm Equipment" found a high level of phthalates in a milking equipment part made of synthetic rubber called a teat cup liner or inflation.[16] These liners go into a milking machine directly over a cow's teat.

Previous Studies on Phthalates in Vinyl Gloves

A few researchers have studied the transfer of phthalates from food-handling gloves into food. Tsumura *et al.* investigated whether phthalates in vinyl food-handling gloves were a source of DEHP in packed lunches sold in Japanese convenience stores and restaurants.[13] They found higher levels of phthalates in cooked food products (touched with vinyl gloves) than in uncooked food (not yet touched with vinyl gloves). They also found lower phthalate levels in packaged lunches at a factory where workers did not wear vinyl gloves compared to a factory where workers wore vinyl gloves. In another experiment, wearing vinyl gloves with phthalates, they handled food for 1 to 2 seconds and found an increase in the amount of phthalates in the food.[17]

Some studies have tested whether restrictions on phthalates have helped to decrease phthalate food contamination. To follow up on their previous research, Tsumura *et al.* analyzed meal samples from three hospitals in Japan for eight phthalates after Japan had passed a ban on gloves containing DEHP in 2000.[18] Overall, they found hospital foods had one-third less DEHP after the ban. The same research group also tested baby food before and after the ban on DEHP in gloves and found similar results.[17]

Petersen and Jensen investigated whether food contact materials in the marketplace complied with phthalate limits that went into effect in the European Union (EU) on July 1, 2008.[14] In addition to gloves, they tested conveyor belts, lids from packed foodstuff in glass jars, and tubes for liquid food. Out of twenty tested glove samples, five contained phthalates above EU limits. In a follow-up study in 2016, the researchers found five out of eight gloves tested did not meet the regulation.[12]

Previous studies of vinyl food-handling gloves are summarized in *Table 2*.

Table 2: Previous Studies on Phthalates in Vinyl Gloves

Research Article	Phthalates Studied	Other Additives or Glove Types Studied	Results of Vinyl Glove Testing
Tsumura *et al.* 2001[13]	• DEHP • DINP • BBP	Non-phthalate plasticizers	• 1 glove with 41% DEHP • 1 glove with 30.1% DEHP, 3.2% DEHA, 7.5% DINP, and a small amount of BBP • 2 gloves tested
Wakui *et al.* 2001[20]	• DEHP • DINP	Polyethylene, natural rubber, and nitrile gloves. Reported on non-phthalate plasticizers, lubricants, antioxidant, vulcanizers and other chemicals	• 1 vinyl glove had DEHP and DINP • 16 gloves tested
Petersen and Jensen 2010[19]	• DEHP • DINP • DIDP • BBP • DBP		• 6 gloves with 5-50% total phthalates • 14 gloves with less than 0.05% total phthalates • 20 gloves tested
Chao *et al.* 2013[21]	• DEHP • DBP	Vinyl, nitrile and neoprene gloves tested for phthalates	• Vinyl gloves showed 17 times more DEHP extracted into hexane than nitrile gloves • 9 gloves tested
Petersen and Jensen 2016[12]	• DEHP • DINP • DIDP • BBP • DBP		• 5 gloves with levels higher than 0.1% DEHP, BBP, DINP, DIDP and 0.05% DBP • 3 gloves with lower levels • 8 gloves tested

See *Table A: Chemical Names and Acronyms* for more information on the chemicals mentioned

Dermal Exposure

Some researchers have studied how phthalates on a person's hands may expose them through hand-to-mouth contact or transdermal absorption.[22] One set of experiments showed that DEHP on the skin chemically broke down into one of its metabolites, a known endocrine disruptor, which permeated human skin substantially.[23,24] Earlier research found that skin absorption was highest for the lowest molecular weight phthalate studied (DEP) and decreased significantly with the higher molecular weight phthalates.[25] In a study of phthalates in diapers, Ishii *et al.* found that depending on the phthalate, 0.006%-2.4% of the phthalates in diapers migrated into simulated sweat. In that study, due to the low levels of phthalates in the diapers, the authors determined that skin absorption did not pose a substantial risk to babies.[26]

The Danish Environmental Protection Agency studied the migration of phthalates into a sweat and saliva under various simulated conditions.[27] They found the highest migration rates occurred during sucking (like a small child mouthing a toy) and during ultrasonic vibration (like for adult sex toys).

Skin wipe studies by Gong *et al.* have found consistent amounts of phthalates on the skin, highest on the hands, without the use of gloves.[22] They estimated that transdermal absorption rates of the palm and back of hand vary between 0.09 and 0.21 (µg/kg)/day. In a similar study, Giovanoulis *et al.* found phthalates on hands as high as 100 µg/cm^2 without the use of gloves.[28]

Food-handling gloves contain high levels of phthalates and are in intimate contact with the wearer's skin. The transdermal absorption studies noted here allow us to infer that phthalates in gloves will enter the human body during wear. Workers wearing gloves are also likely to ingest phthalates when hands are not washed after glove use and before eating.

Glove Types

Aside from vinyl, food-handling gloves include nitrile (also known as nitrile butadiene rubber, NBR), polyethylene (PE), and latex (natural rubber). In *Table 3* and *Table 4* summarize chemical attributes of these common glove materials. *Table 3* lists a chemical lifecycle assessment score for each material; *Table 4* lists what is known about the migration of additives from each of the materials.

Table 3: Chemical Footprint of Food-handling Glove Materials

Material	Chemical Footprint Score (100 is most benign)	Manufacturing Process Benchmark	Chemicals of Concern Used
Vinyl	0	Every manufacturing step involves the use of chemicals of high concern as defined by GreenScreen Benchmark 1	Chlorine, ethylene dichloride, and vinyl chloride monomer
Nitrile butadiene rubber	16.7	Some manufacturing steps include chemicals of high concern as defined by GreenScreen Benchmark 1, and others do not	The Benchmark 1 chemicals include 1,3-butadiene and acrylonitrile
Polyethylene	50	For each manufacturing step, no core chemical inputs are chemicals of high concern as defined by GreenScreen Benchmark 1	Ethylene, the monomer used to manufacture polyethylene, has received GreenScreen Benchmark 2

Plastics Scorecard Version 1.0 is a method to evaluate plastics based on their lifecycle and use.[29]

Although latex gloves are commercially available, they are not a viable alternative. Natural rubber latex gloves are generally not recommended for food-handling because of the risk of users developing potentially life-threatening latex allergy. The U.S. Food and Drug Administration updated its food code in 2013, recognizing natural rubber latex gloves as an allergen.[30] The average prevalence of latex allergies worldwide is 9.7% for healthcare workers, 7.2% for susceptible patients, and 4.3% among the general population.[31] Arizona, Oregon, Rhode Island, Hawaii, and other states have bans on latex gloves used in the food service industry.[32] National Institute for Occupational Safety and Health and Occupational Safety and Health Administration do not recommend latex gloves.[33,34] Non-latex gloves only rarely cause allergic reactions, although nitrile gloves contain vulcanization accelerators that occasionally cause contact dermatitis.[35]

Table 4: Migration Studies of Polymers Used in Food-handling Gloves

Material	Research	Findings
Polyethylene	Wakui *et al.* (2001)[20]	Low migration of antioxidants and a lubricant into n-hexane
	Dopico-Garcia (2007)[36]	No migration of antioxidants from commercial samples of polyethylene packing into food simulants
Nitrile	Wakui *et al.* (2001)[20]	Moderate migration into n-hexane of two vulcanization accelerators and several antioxidants
	Kawamura *et al.* (2002)[37]	Moderate migration into n-hexane of two vulcanization accelerators and several antioxidants
	Chao *et al.* (2013)[21]	Low levels of DEHP extracted, 17 times less than vinyl gloves

See *Table A: Chemical Names and Acronyms* for more information on the chemicals mentioned

Product engineers should complete chemical hazard assessments on all plasticizers and other additives before their use in products. One option is Clean Production Action's GreenScreen® For Safer Chemicals, a tool that uses authoritative lists and trained assessors to determine the hazard profile of a substance. GreenScreen assessments for the relevant phthalates are in the Appendix, *Table B: Comparative Hazard Assessment of Chemical Plasticizers Used in Vinyl Food service Gloves.*

METHODS

Gloves Obtained from Distributors

To obtain a representative sampling of vinyl food-handling gloves available in the marketplace, we used the Panjiva database. Panjiva tracks the importation of products into the United States by collecting data on the contents of shipping containers entering U.S. ports. We analyzed 36 months of data from Panjiva from August 2015 to August 2018. We found that there are 41 manufacturers of non-medical disposable gloves, nearly all based in China except one based in the United Kingdom. To our knowledge, the U.S. makes no disposable gloves; 32 distributors import gloves from abroad according to trade data.

Between June 2018 and April 2019, we obtained 60 types of disposable vinyl gloves for food-handling, representing 43 brands, from 22 distributors. According to data from Panjiva, these distributors account for 94% of shipments of non-medical vinyl gloves. Of these 60 gloves, we obtained 12 gloves as a convenience sample from other available sources that might supply food processors and restaurants, including restaurant supply stores and a warehouse club store. We also consulted the research report by Allied Market Research.[38] *Table 5* lists the glove distributors we sampled food-handling gloves from for this study.

Table 5: Distributors as Identified Through Panjiva Data for Vinyl (Non-Medical) Gloves from August 2015 to August 2018

Distributor	Percentage of Total Shipping Containers of Vinyl Food-Handling Gloves Imported	Number of Manufacturing Companies Supplying Distributor
The Safety Zone	39.5%	21
Inteplast Group	20.7%	11
Rofson Associates	7.6%	3
AMMEX	5.9%	6
Bunzl Distribution / Bunzl International / Bunzl Canada (FoodHandler)	4.5%	10
Handgards	3.7%	12
Volk Protective Products	3.0%	4
AmerCareRoyal	2.6%	13
Ansell	1.7%	5
Daxwell	1.3%	4
Liberty Glove & Safety	0.7%	2
Elara Food service Disposables	0.6%	4
Prime Source	0.5%	4
511 Food service Co.	0.5%	2
Akers Industries	0.4%	1
Agio Group	0.3%	1
Uline	0.05%	1
Sara Glove	0.01%	1
GD Care	No data	No data
Gordon Food service	No data	No data
Medline	No data	No data
Victoria Bay	No data	No data
Westchester Protective Gear	No data	No data

Although most distributors sell gloves under their own brand names, it appears that some provide “white label” gloves, meaning a distributor packages the gloves with another brand or

corporation name. For example, Gordon Food service has no records of importing vinyl gloves, yet they sell “Gordon Foods” brand disposable gloves made in China at their stores.

Gloves from Restaurant Chains

In addition to gloves obtained from distributors, we collected disposable food-handling gloves used at major restaurant chains. We chose thirteen top restaurants by U.S. sales according to Restaurant Business Online plus two other chains Tim Horton’s (#62) and Popeye’s (#25) that are owned by the same parent companies.[39]

Our research teams at partner organizations collected gloves from restaurants with a citizen science approach. Collectors were instructed to place gloves into a zip-top polyethylene bag and take photos of the box of gloves, with the consent of employees at the restaurants. We sought to collect gloves from different locations of each of these restaurants. In all, 15 restaurant chains were sampled by our research teams as listed in *Table 6.* We collected a total of 63 gloves from 56 restaurant locations in 14 states.

Table 6: Restaurant Chains in Disposable Glove Study

Restaurant Name	Ranking in U.S. Sales 2018	Restaurant Type	Restaurant Chain Ownership
Burger King	5	Fast Food	Restaurant Brands International
Chick-fil-A	7	Fast Food	Cathy Family
Chipotle Mexican Grill	13	Fast Casual	Chipotle Mexican Grill
Domino's	9	Fast Food	Bain Capital
Dunkin' Donuts	8	Fast Food	Dunkin' Brands Group, Inc.
KFC	12	Fast Food	Yum! Brands, Inc.
McDonald's	1	Fast Food	McDonald's
Panera Bread	11	Fast Casual	JAB Holding Company
Pizza Hut	10	Fast Food	Yum! Brands, Inc.
Popeye's	25	Fast Food	Restaurant Brands International
Starbucks	2	Fast Food	Starbucks
Subway	3	Fast Food	DeLuca Family
Taco Bell	4	Fast Food	Yum! Brands, Inc.
Tim Horton's	62	Fast Food	Restaurant Brands International
Wendy's	6	Fast Food	The Wendy's Company

Instrumental Analysis

A Thermo Scientific Nicolet iS5 Fourier Transform Infrared (FTIR) spectrometer was used by Ecology Center researchers in attenuated total reflection (ATR) mode with a diamond crystal. FTIR is a widely used tool for determining the chemical identity of materials. Each glove was placed on the ATR sample stage, and a spectrum was obtained from the FTIR from 4000-450 cm^{-1}. For some gloves, a spectrum was also obtained using a solvent extract. To avoid cross-contamination the ATR stage was thoroughly cleaned with isopropyl alcohol after each spectrum was obtained.

The resulting infrared spectra were analyzed visually and compared against a library of known spectra to detect the presence of phthalates and other known plasticizers. The gloves were also analyzed to determine polymer type so that all vinyl gloves were verified as being made of PVC.

Our spectral library included *ortho*-phthalates and non-phthalate plasticizers such as DINCH and DOTP. We visually examined the spectra to identify absorption bands unique to each chemical to avoid misidentification.

Gas Chromatography/Mass Spectrometry (GC/MS) Analysis

Gloves determined to contain phthalates according to our FTIR screening were sent for further analysis at Eurofins, a contract laboratory. Their test method quantifies *ortho*-phthalates by following test method CPSC-CH-C1001-09.4. The method uses solvent extraction followed by internal standard addition and analysis of the extract by gas chromatography-mass spectrometry (GC-MS) for phthalates and other plasticizers of interest.

RESULTS

Gloves Obtained from Distributors
We tested 60 disposable vinyl food-handling gloves from 24 distributors. Of these, 10 gloves (from 7 distributors) contained *ortho*-phthalates (16.7% of gloves tested).

A full list of the gloves tested can be found in the Appendix: *Table C: Food-handling Vinyl Gloves from Distributors Results* and *Table D: Non-Vinyl and/or Non-Food-handling Gloves from Distributors Results.*

Gloves Collected from Restaurants
In all, our research teams collected 63 disposable food-handling gloves from 56 unique restaurant locations in 14 states. 41 of the gloves collected at restaurants were vinyl and 4 of these (10%) contained phthalates.

Vinyl gloves were collected from 38 of 56 locations visited, or 68% of all restaurant locations visited. If not using vinyl, the restaurants used polyethylene (20 locations, 32% of all locations) or nitrile gloves (3 locations, 5% of all locations). Panera Bread, Subway, and Starbuck's use polyethylene gloves for food-handling (although one location of Starbuck's reported the use of vinyl gloves for cleaning). Most McDonald's locations used both polyethylene and vinyl gloves, with employees reporting the vinyl was used for finished food-handling and polyethylene for the grill or raw food. *Table 7* shows the glove materials used at different restaurants and *Table 8* is a representation of the safest to most toxic glove material choices of restaurants.

Sometimes the glove box was not available in the restaurants that were visited, and in those cases the distributor, brand, and product number are unknown. Our results show that the same restaurant chain does not necessarily have the same types of gloves at all locations. Full results are in the Appendix: *Table E: Gloves from Restaurants Test Results.*

Table 7: Material identification of restaurant glove samples by FTIR analysis

Restaurant	**Glove Type (Number of Gloves Tested)**	***Ortho*-Phthalates Found in Gloves**
Burger King (9 locations)	Polyethylene (4)	None detected
	Vinyl (5)	1 glove with DINP, small amount of DIDP
Chick-fil-A (1 location)	Vinyl (1)	None detected
Chipotle Mexican Grill (5 locations)	Vinyl (4)	None detected
	Polyethylene (1)	None detected
Domino's (1 location)	Nitrile (1)	None detected
Dunkin' Donuts (1 location)	Vinyl (1)	None detected
KFC* (3 locations)	Vinyl (2)**	None detected
	Nitrile (1)**	None detected
McDonald's (15 locations)	Vinyl (12)	2 gloves with DINP, small amount of DIDP
	Polyethylene (8)	None detected
Panera Bread (1 location)	Polyethylene (1)	None detected
Pizza Hut (1 location)	Vinyl (1)	None detected
Popeye's (1 location)	Vinyl (1)	None detected
Starbucks (4 locations)	Polyethylene (4)	None detected
	Vinyl (1)	None detected
Subway (2 locations)	Polyethylene (2)	None detected
Taco Bell* (5 locations)	Nitrile (2)**	None detected
	Vinyl (3)**	None detected
Tim Hortons (1 location)	Vinyl (1)	None detected
Wendy's (9 locations)	Vinyl (10)	1 glove with DINP, small amount of DIDP

*Two locations are combined KFC and Taco Bell restaurants

**One glove is from a combined KFC and Taco Bell restaurant

Table 8: Representation of the Safest to Most Toxic Glove Material Choices of Restaurants

The findings presented in the table do not guarantee that all restaurant locations will be consistent.

All Vinyl Food-handling Gloves (Distributors and Restaurants)

In all, we collected 101 vinyl food-handling gloves of gloves for analysis and found that 14 of these contained *ortho*-phthalates. Ten of 31 distributors had produced gloves with phthalates and sourced their gloves from over 44 manufacturers, as shown in *Table 9.* One additional distributor produced gloves with phthalates, Intco, but they were medical gloves and the results are in *Table D* of the Appendix.

Table 9: Phthalate Detection in All Vinyl Gloves by Distributor

Glove Distributors	No. of Suppliers*	No. of Vinyl Gloves with Phthalates	No. of Vinyl Gloves Tested
FoodHandler/ Bunzl	10	3	6
Omar, Inc.	NA	2	8
Inteplast Group	11	2	4
Tronex Safety	NA	1	10
AmerCareRoyal	13	1	7
511 Foods	2	1	3
AMMEX	6	1	3
Akers Industries, Inc.	1	1	1
Gordon Food service	NA	1	1
Prime Source	4	1	1
SmartChoice	NA	0	8
The Safety Zone	21	0	6
Unknown	NA	0	6
Elara	4	0	4
Spring-Fill	NA	0	4
Ansell	5	0	3
Daxwell	4	0	3
GD Care	3	0	3
Handgards	12	0	3
Volk Protective Products	4	0	3
Liberty Glove & Safety	2	0	2
Noble	NA	0	2
Rofson	3	0	2
Agio Group Inc.	1	0	1
Ambitex	NA	0	1
Medline	NA	0	1
Sara Glove	1	0	1
ServGuard	NA	0	1
Uline	NA	0	1
Victoria Bay	NA	0	1
Westchester Protective Gear	NA	0	1
Total	**107**	**14**	**101**

NA = No data available

*Suppliers are manufacturing companies supplying gloves to the distributor according to data on non-medical vinyl gloves imported from 2015-2018, from U.S. Trade data compiled by Panjiva.

The most common plasticizer used was DOTP. Of the eleven phthalates quantified by GC/MS, four were found in some gloves: DINP, DIDP, DPHP, and DEHP. In most cases the phthalate compounds were found in combination, except for DPHP, which present by itself. The 100 vinyl gloves collected from distributors and restaurants fall into these categories:

- DOTP, a non-phthalate alternative plasticizer (85)
- DOTP and a smaller amount of DINCH – another non-phthalate alternative plastizer (1 glove, tested only 3 out of 86 gloves without *ortho*-phthalates and DOTP)
- DINP and a smaller amount of DIDP (11 gloves)
- DPHP (3 gloves)
- DINP and DEHP, and a lesser amount of DIDP (1 glove)

Table 10 shows the plasticizer results in further detail.

Table 10: Plasticizers in Disposable Vinyl Food-handling Gloves from Distributors and Collected from Restaurants

Plasticizer	Frequency of Detection in Vinyl Gloves (n=101)	In the Gloves That Contained the Specified Phthalates: Percentage by Weight		
		Minimum	Maximum	Mean
Phthalate Plasticizers				
All *ortho*-phthalates	14%	21.50%	41.56%	33.89%
DEHP	1%	7.66%	7.66%	7.66%
DINP	11%	16.40%	40.80%	32.41%
DIDP	11%	0.11%	3.44%	1.23%
DPHP	3%	21.50%	24.90%	23.03%
Non-Phthalate Plasticizers				
DOTP (DEHT)	84%*	27.90%	34.00%	32.30%
DINCH	1%*	2.59%	2.59%	2.59%

*3 gloves of 86 without *ortho*-phthalates were tested by GC/MS to quantify DOTP and DINCH. The rest of the gloves were screened for the presence of DOTP and DINCH using FTIR.

See *Table A: Chemical Names and Acronyms* for more information on the chemicals mentioned

DISCUSSION

14% of vinyl food-handling gloves tested still contain hormone-disrupting *ortho*-phthalates.
We found four different *ortho*-phthalates in about one out of six disposable food service gloves made of PVC. Of the 31 distributors, one of three sold gloves containing phthalates in at least one sample. We also found phthalates in gloves from three of the fifteen restaurant chains where we acquired some gloves for testing.

The presence of phthalates in vinyl gloves is inconsistent across glove distributors and restaurants, suggesting poor global supply chain management.
We found that some vinyl gloves from the same brand contain phthalates, and some do not. Within a given restaurant chain, phthalates were found in some vinyl gloves but not in others. The production of vinyl gloves, as well as plasticizers like phthalates, takes place predominantly in China. In some cases, multiple manufacturers supply a single distributor. For example, Omar Powder Free Vinyl gloves contained *ortho*-phthalates in 2 out of 9 samples, all from different boxes or restaurant locations. Absent screening every new box of gloves for phthalates with specialized testing equipment, restaurants and other purchasers of vinyl food-handling gloves cannot assure that the gloves are free of phthalates. Two distributors of the 31 investigated used marketing to indicate they were free of one or more phthalates on their boxes, SmartChoice and Safety Zone, and our tests corroborated this claim.

Scientific evidence continues to grow on the hazards of and exposure to *ortho*-phthalates.
Because of growing evidence of reproductive and developmental toxicity and harm to brain development from human health studies and animal testing, phthalates have been widely banned from use in toys and childcare articles, and virtually all uses in the European Union (see *Table 1: Regulations on Phthalates)*. Our testing reveals that four different *ortho*-phthalates are still used in plastic disposable gloves in the U.S., including the following compounds still produced in high volumes:

- DEHP, the most studied phthalate with unsafe cumulative health risks;
- DINP, an anti-androgen like DEHP, meaning it disrupts the hormone testosterone;
- DIDP, another endocrine-active phthalate; and
- DPHP, a newer phthalate similar to DIDP but never formally assessed for safety.

Human biomonitoring studies in the U.S. and Europe show that exposure to DEHP is gradually declining but exposure to these other three phthalates has steadily increased.

“Drop-in” phthalate substitutes raise concerns due to human exposure and data gaps.
With the market for flexible vinyl products slowly moving away from *ortho*-phthalates, other chemical plasticizers are being used as safer substitutes. Like phthalates, these drop-in substitutes are used in large amounts and are continually released from products like disposable gloves, resulting in human exposure. Environmental health researchers have raised concerns that many of the non-phthalate alternative plasticizers have not been thoroughly studied, and often only by the chemical manufacturers.

Our testing of vinyl food service gloves revealed that the most common plasticizer used is DOTP (also known as DEHT). DOTP is considered a safer alternative to *ortho*-phthalates, although data gaps remain, particularly concerning possible endocrine disruption. New research showing the interaction of DOTP with hormone receptors underscores the need to test this chemical further.[40–42] Exposure to DOTP is widespread and omnipresent.[43–45] Biomonitoring conducted by the U.S. Centers for Disease Control's National Health and Nutrition Examination Survey showed that all age groups, sexes, and ethnicities had a known metabolite of DOTP in their bodies.[45]

One vinyl glove contained DINCH. Human exposure to this endocrine-disrupting plasticizer is increasing, according to biomonitoring studies.[45–47] Production and use of DINCH is increasing.[47]

Non-vinyl safer alternatives are widely available, from soap and water to safer plastics. Fortunately, safer alternatives are widely available that prevent exposure to *ortho*-phthalates and non-phthalate alternatives. Since the intended function of disposable food service gloves is to prevent the spread of infectious disease, one has to consider the research that demonstrates that proper and frequent hand washing with regular soap and water works as well or even better than disposable gloves.[48,49] Local or state health authorities do not universally require the use of gloves for food-handling. Where glove use is required or desired, a far safer glove material than vinyl is polyethylene, which does not require plasticizers and contains few other additives and, unlike vinyl, does not require highly toxic chemicals to manufacture or pose end-of-life concerns like toxic combustion byproducts or leaching of toxic additives. We found that restaurant chains such as Subway, Panera Bread, and Starbucks have chosen to use polyethylene food service gloves as the safest and most sustainable material of choice.

RECOMMENDATIONS

We recommend the use of bare hands washed correctly with soap and water, and when this is not possible to use polyethylene gloves. If a glove with more dexterity and heat resistance is required, nitrile gloves can be used though they are not the preferred option. We do not recommend latex gloves due to allergy potential and because some states have outlawed their use for food preparation.

We do not recommend vinyl gloves. Regardless of which plasticizer is used to make vinyl gloves, the plasticizer makes up a large percentage of the glove's weight—typically upwards of 30%. The plasticizers are small molecules, unbound to the vinyl polymer. A person regularly wearing vinyl gloves is therefore likely to be highly exposed to the plasticizer, and some of the plasticizer is likely to be transferred to food products. Under these conditions, even safer plasticizers like DOTP could potentially be cause for concern. Better choices are glove materials, such as polyethylene, that do not require a third of their weight to be unbound, highly mobile molecules. Recommendations are ranked in *Table 11.*

Table 11: Ranking of Environmentally Healthy Choices for Glove Material Food-handling

Glove Material for Food Handling		ACTION	Rationale	Potential of Chemicals to Migrate	Hazards of Production Chemicals
1. None (No Gloves)	Soap and water	**PREFER** (unless not allowed)	Frequent and proper hand washing with soap and water (and no antimicrobials) work.	**LOW**	**LOW**
2. Poly	Polyethylene (PE)	**PREFER**	In terms of chemical hazards, this is the best glove material across its lifecycle with a relatively low amount of additives.	**LOW**	**LOW**
3. Nitrile	Nitrile Butadiene Rubber (NBR)	**USE (but seek alternative)**	Nitrile is preferable to PVC and latex. However, polyethylene is preferable to reduce lifecycle hazards and prevent allergic reactions.	**MOD**	**MOD to HIGH**
4. Vinyl without Phthalates	Polyvinyl Chloride (PVC) with non-*ortho*-phthalate plasticizers	**PHASE- OUT**	Usually not possible to determine if gloves are phthalate-free. Also, alternative gloves eliminate exposure all plasticizers and avoid life cycle impacts.	**HIGH**	**HIGH**
5. Latex	Natural rubber and treated natural rubber	**AVOID**	In some people, severe allergic reactions to latex proteins are life-threatening.	**HIGH**	**NOT RATED**
6. Vinyl with Phthalates	Polyvinyl Chloride (PVC) with *ortho*-phthalate plasticizers	**AVOID**	High hazards from a toxic class of chemical plasticizers and life cycle impacts.	**HIGH**	**HIGH**

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- Safer Chemicals Healthy Families
- Healthy Babies Bright Futures
- Toxic-Free Future
- WEACT for Environmental Justice
- Center for Food Safety
- Earthjustice
- Environmental Defence (Canada)
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- Natural Resources Defense Council
- Safer States

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APPENDIX

Table A: Chemical Names and Acronyms

Acronym	Other Acronym or Name	Chemical Name	Chemical Abstract Service (CAS) Number
BBP		Benzyl butyl phthalate	85-68-7
DBP		Dibutyl phthalate	84-74-2
DCHP		Dicyclohexyl phthalate	84-61-7
DEHA		Bis(2-ethylhexyl) adipate	103-23-1
DEHP		Di-(2-ethylhexyl) phthalate	117-81-7
Diamyl phthalate			131-18-0
DIBP		Diisobutyl phthalate	84-69-5
DIDP		Diisodecyl phthalate	26761-40-0, 68515-49-1
DINCH	D9CH, Hexamoll	1,2-Cyclohexane dicarboxylic acid diisononyl ester	166412-78-8
DINP		Diisononyl phthalate	28553-12-0, 68515-48-0
DNHP		Di-n-hexyl phthalate	84-75-3
DNOP		Di-n-octyl phthalate	117-84-0
DOTP	DEHT, DEHTP	Dioctyl terephthalate	6422-86-2
DPHP	B2PHP	Bis(2-propylheptyl) phthalate	53306-54-0

Table B: Comparative Hazard Assessment of Chemical Plasticizers Used in Vinyl Food service Gloves[50–58]

Chemical Plasticizer Names & CAS Registry Numbers		**GreenScreen™ Benchmark**		**Human Health Hazards – Group 1**					**Fate**		**Data Gaps on Hazards**
				C	**M**	**R**	**D**	**E**	**P**	**B**	
Chemical Class: *ortho*-Phthalates											
DEHP DOP	Di(2-ethylhexyl) phthalate 117-81-7	**1**	**AVOID** – Chemical of High Concern	**MOD HIGH**	**LOW**	**HIGH**	**HIGH**	**HIGH**	**very LOW**	**LOW**	
DINP	Diisononyl phthalate 28553-12-0 and 68515-48-0	**1**	**AVOID** – Chemical of High Concern	**Prop 65**	**LOW**	**HIGH**	**HIGH**	**HIGH**	**very LOW**	**very LOW**	Carcinogenicity (according to GreenScreen) & Neurotoxicity
DIDP	Diisodecyl phthalate 68515-49-1 and 26761-40-0	**LT-1**	**AVOID** – likely Chemical of High Concern	**MOD**	?	*MOD LOW*	**HIGH**	*HIGH MOD*	**LOW**	**LOW**	?
DPHP	Di(2-propylheptyl) phthalate 53306-54-0	**U**	**UNSPECIFIED** due to data gaps	**DG** **MOD**	**LOW**	**LOW**	**LOW**	*MOD*	**LOW**	**very LOW**	Carcinogenicity, Neurotoxicity, and Respiratory Sensitization
Chemical Class: non-Phthalate Plasticizers											
D9CH DINCH	Diisononyl cyclohexane-1,2-dicarboxylate 166412-78-8 and 474919-59-0	**2**	**U.S.E but** search for safer substitute	**LOW**	**LOW**	**LOW**	**LOW**	**MOD** *MOD*	**MOD**	**LOW**	Respiratory Sensitization
DOTP DEHT	Di(2-ethylhexyl terephthalate 6422-86-2	**3_{DG}**	**U.S.E but** still opportunity for improvement	**LOW**	**LOW** *LOW*	*LOW* **LOW**	**LOW**	*LOW* **DG**	**very LOW**	**LOW**	Neurotoxicity and Respiratory Sensitization

Group 1 Human Health Hazards:

C	Carcinogenicity	Causes cancer
M	Mutagenicity	Causes genetic mutations
R	Reproductive toxicity	Interferes with normal reproduction MOD
D	Developmental toxicity	Harms fetal or childhood development
E	Endocrine Activity	Causes hormone disruption

Other Hazard Indicators

BOLD	Values based on test data
Italics	Estimated values and lower confidence
	Moderate hazard ranking
DG	Data Gaps remain unfilled
Prop 65	Known to California to cause cancer

Fate: **P** Persistence (breaks down slowly in the environment) **B** Bioaccumulative (builds up in food web and humans)

LT-1 Meets one or more GreenScreen™ Benchmark 1 criteria based on authoritative lists, and is most likely a Benchmark 1 chemical

Table C: Food-handling Vinyl Gloves from Distributors Results

				GC/MS Results					
Glove	**Distributor**	**SKU and/or UPC**	**FTIR Results**	**DEHP (%)**	**DINP (%)**	**DIDP (%)**	**DPHP (%)**	**DOTP (%)**	**DINCH (%)**
Hy Five Powder Free Vinyl Gloves	511 Foods	GVP9-C/626521003001	PVC + DOTP	-	-	-	-	-	-
AmerCareRoyal General Purpose Blue Vinyl Gloves	AmerCareRoyal	RDVG-100BL	PVC + DOTP	-	-	-	-	-	-
AmerCareRoyal General Purpose Vinyl Gloves	AmerCareRoyal	RDVG-100L	PVC + DOTP	-	-	-	-	-	-
AMMEX Ivory Stretch Vinyl Exam Gloves	AMMEX	ILHD	PVC + DOTP	-	-	-	-	-	-
Anchor Vinyl Powder Free Gloves	AmerCareRoyal	22991 / 811033012348	PVC + DOTP	-	-	-	-	-	-
Awear Eco-Friendly Vinyl Gloves	AmerCareRoyal	AWEAR-100L	PVC + DOTP	-	-	-	-	-	-
Bandit Black Vinyl Powder Free Gloves	AmerCareRoyal	28991 / 811033015196	PVC + DOTP	-	-	-	-	-	-
Clean Hand Premium Vinyl Gloves Lightly Powdered	Volk Protective Products	71070 / 10020181000757	PVC + DOTP	-	-	-	-	-	-
Clean Hand SuperStretch Vinyl Glove Powder Free	Volk Protective Products	81075C / 10020181003208	PVC + DOTP	-	-	-	-	-	-
Clean Hand Vinyl Glove Powder Free	Volk Protective Products	81077C / 10020181000788	PVC + DOTP	-	-	-	-	-	-
ClearTouch Food service Vinyl Gloves	Medline	CLE300VTMEACH	PVC + DOTP	-	-	-	-	-	-
Daxwell Synthetic Gloves General Purpose Powder-Free	Daxwell	F10001694	PVC + DOTP	-	-	-	-	-	-
Daxwell Vinyl Powder Free Gloves	Daxwell	F10001749B/810168021843	PVC + DOTP	-	-	-	-	-	-
Daxwell Vinyl Pre-Powdered Gloves	Daxwell	F10001746B/810168021911	PVC + DOTP	-	-	-	-	-	-
DuraSkin Powder-Free Vinyl Disposable Gloves	Liberty Glove & Safety	2910W/744897010543	PVC + DOTP	-	-	-	-	-	-
DuraSkin Pre-Powdered Green 6.5mil Vinyl Disposable Gloves	Liberty Glove & Safety	2904W/744897037472	PVC + DOTP	-	-	-	-	-	-
Dura-Touch 34-725 Vinyl Disposable Glove	Ansell	34-725	PVC + DOTP	-	-	-	-	-	-

				GC/MS Results					
Glove	**Distributor**	**SKU and/or UPC**	**FTIR Results**	**DEHP (%)**	**DINP (%)**	**DIDP (%)**	**DPHP (%)**	**DOTP (%)**	**DINCH (%)**
Dura-Touch 34-755 Powdered Vinyl Disposable Glove	Ansell	34-755	PVC + DOTP	-	-	-	-	-	-
Edge Vinyl Gloves Powder Free	AmerCareRoyal	23991 / 811033013178	PVC + DOTP	-	-	-	-	-	-
FoodHandler Aloe Synthetic Vinyl Gloves	FoodHandler/Bunzl	103-AL16-CP	PVC + Phthalates	-	-	-	-	-	-
FoodHandler Classic Vinyl Gloves	FoodHandler	102-FH16	PVC + Phthalates	7.66	31.90	0.24	ND	NT	NT
FoodHandler Contact Vinyl Gloves Powder Free	FoodHandler/ Bunzl	102-FHCN16	PVC + Phthalates	ND	29.30	0.20	ND	NT	NT
GlovePlus Blue Vinyl Industrial Latex Free Disposable Gloves	AMMEX	IVBPF	PVC + Phthalates	ND	ND	ND	24.90	NT	NT
GPX3 Clear Vinyl Industrial Latex Free Disposable Gloves	AMMEX	GPX3	PVC + DOTP	-	-	-	-	-	-
Great Glove Stretch Vinyl Powder-Free Glove	GD Care	NMSTV70015	PVC + DOTP	-	-	-	-	-	-
Great Glove Vinyl Blue Powder-Free Gloves	GD Care	BNM70015	PVC + DOTP	-	-	-	-	-	-
Great Glove Vinyl Powder-Free Glove	GD Care	NM70015	PVC + DOTP	-	-	-	-	-	-
Hy Five Powder Free Blue Vinyl Gloves	511 Foods	GVP9-BLC/626521008891	PVC + Phthalates	ND	31.60	0.27	ND	NT	NT
Hy Five Powdered Vinyl Gloves	511 Foods	GLV35-C/626521006514	PVC + DOTP	-	-	-	-	-	-
Inteplast Vinyl Gloves Powdered	Inteplast Group	VP003/762935000363	PVC + Phthalates	ND	37.10	1.99	ND	NT	NT
Inteplast Vinyl Gloves Powder-Free	Inteplast Group	VF003/76293500288	PVC + DOTP	-	-	-	-	-	-
JobSelect Synthetic Vinyl Powder Free	FoodHandler	103-416	PVC + DOTP	-	-	-	-	-	-
Kitchen Essentials Powder-Free Vinyl Gloves	Gordon Food service	397381	PVC + Phthalates	ND	ND	ND	21.50	NT	NT
Naturalfit Synthetic Gloves	Handgards	304362503	PVC + DOTP	-	-	-	-	-	-
Noble Powder Free Vinyl Gloves	Noble	394365L	PVC + DOTP	-	-	-	-	-	-
Noble Powdered Vinyl Gloves	Noble	394360M	PVC + DOTP	-	-	-	-	-	-
Odyssey Blue Vinyl Glove Powder Free	AmerCareRoyal	18991 / 811033013505	PVC + Phthalates	ND	33.20	3.36	ND	NT	NT

				GC/MS Results					
Glove	**Distributor**	**SKU and/or UPC**	**FTIR Results**	**DEHP (%)**	**DINP (%)**	**DIDP (%)**	**DPHP (%)**	**DOTP (%)**	**DINCH (%)**
Omar Powder Free Vinyl Gloves	Omar, Inc.	18114800371 / 5312	PVC + DOTP	-	-	-	-	-	-
Omar Powder Free Vinyl Gloves	Omar, Inc.	181148000395 / 5314	PVC + DOTP	-	-	-	-	-	-
OneSafe Blue Vinyl Gloves	FoodHandler	102-1SF216BL	PVC + DOTP	-	-	-	-	-	-
OneSafe Clear Vinyl Gloves	FoodHandler	102-1SF-216	PVC + DOTP	-	-	-	-	-	-
prepfit Powder Free Vinyl Gloves	Elara	FVP201	PVC + DOTP	-	-	-	-	-	-
prepfitBLUE Powder Free Vinyl Gloves	Elara	FV201BL	PVC + DOTP	-	-	-	-	-	-
prepfitFLEX Powder Free Vinyl Gloves	Elara	FVP401	PVC + DOTP	-	-	-	-	-	-
prepfitMAX Powder Free Vinyl Gloves	Elara	FV201	PVC + DOTP	-	-	-	-	-	-
Prime Source Lightly Powdered Vinyl Disposable Gloves	Prime Source	750061205	PVC + Phthalates	ND	ND	ND	22.70	NT	NT
Rofson Vinyl Glove Powder Free	Rofson	PFV200L / 00713094004686	PVC + DOTP	-	-	-	-	-	-
Sara Glove Vinyl Disposable Powder Free Industrial/Food service Gloves	Sara Glove	85-VI-SM-CS-C45	PVC + DOTP	-	-	-	-	-	-
Snugfit Vinyl Gloves Powder Free	Handgards	304362123	PVC + DOTP	-	-	-	-	-	-
SunnyCare Vinyl Disposable Glove Powder Free	Agio Group Inc.	7801/094922522030	PVC + DOTP	-	-	-	-	-	-
SureSafe Vinyl General Purpose Gloves Lightly Powdered	Akers Industries, Inc.	V322I/759326223227	PVC + DOTP	ND	39.30	1.02	ND	ND	ND
The Safety Zone Powder Free Blue Vinyl Gloves	The Safety Zone	GVP9-LG-1C-BL	PVC + DOTP	-	-	-	-	-	-
The Safety Zone Powder Free Clear Vinyl Gloves	The Safety Zone	GVP9-LG-1	PVC + DOTP	-	-	-	-	-	-
The Safety Zone Powder Free Natural Synthetic Gloves	The Safety Zone	GVP9-MD-1C-SY	PVC + DOTP	-	-	-	-	-	-
The Safety Zone Powdered Clear Vinyl Gloves	The Safety Zone	GVDR-LG-1	PVC + DOTP	-	-	-	-	-	-
Uline Vinyl Gloves - Powdered, 3 Mil, Clear	Uline	S-15388M	PVC + DOTP	-	-	-	-	-	-
Valugards Vinyl Disposable Gloves	Handgards	304340183	PVC + DOTP	-	-	-	-	-	-

				GC/MS Results					
Glove	**Distributor**	**SKU and/or UPC**	**FTIR Results**	**DEHP (%)**	**DINP (%)**	**DIDP (%)**	**DPHP (%)**	**DOTP (%)**	**DINCH (%)**
VersaTouch Powdered Vinyl Disposable Glove	Ansell	34-750	PVC + DOTP	-	-	-	-	-	-
Victoria Bay Synthetic Vinyl Powder Free Multipurpose Gloves	Victoria Bay	149179/895415003612	PVC + DOTP	-	-	-	-	-	-
Westchester Protective Gear 4 Mil Industrial Grade Lightly Powdered Vinyl Gloves	Westchester Protective Gear	2700	PVC + DOTP	-	-	-	-	-	-

ND= Not Detected, NT= Not Tested. See *Table A: Chemical Names and Acronyms* for more information on the chemicals mentioned

Table D: Non-Vinyl and/or Non-Food-handling Gloves from Distributors Results

				GC/MS Results					
Glove	**Distributor**	**SKU and/or UPC**	**FTIR Results**	**DEHP (%)**	**DINP (%)**	**DIDP (%)**	**DPHP (%)**	**DOTP (%)**	**DINCH (%)**
Cole-Parmer Nitrile Glove	Cole-Parmer	15954-45	Nitrile	-	-	-	-	-	-
Duraskin Nitrile Glove	Liberty Glove & Safety	T2010W/L	Nitrile	-	-	-	-	-	-
Fisherbrand Nitrile Glove	Fisher Scientific	19-130-1597C	Nitrile	-	-	-	-	-	-
Grip Gards Blue Stretch Hybrid Gloves	Handgards	GG Blue PF 10/100	Polyethylene	-	-	-	-	-	-
Grip Gards Stretch Hybrid Gloves	Handgards	GG Clear PF 10/100	Polyethylene	-	-	-	-	-	-
Intco Clear Vinyl Gloves 4.0 +/- 0.3g Medium	Intco Medical		PVC + DOTP	-	-	-	-	-	-
Intco Clear Vinyl Gloves 4.5 +/- 0.3g Large	Intco Medical		PVC + DOTP	-	-	-	-	-	-
Intco Clear Vinyl Gloves 4.5 +/- 0.3g Medium	Intco Medical		PVC + DOTP	-	-	-	-	-	-
Intco Clear Vinyl Gloves 5.0 +/- 0.3g Large	Intco Medical		PVC + Phthalates	ND	16.4	0.11	ND	NT	NT
Intco Clear Vinyl Gloves 5.0 +/- 0.3g Medium	Intco Medical		PVC + DOTP	-	-	-	-	-	-
Intco Clear Vinyl Gloves 5.0 +/- 0.3g X-Large	Intco Medical		PVC + Phthalates	ND	22.60	0.50	ND	27.90	ND
The Safety Zone Powder Free Clear Poly Gloves	The Safety Zone	GDSH-XL	Polyethylene	-	-	-	-	-	-
ValuGards Powder Free Stretch Gloves	Handgards	303363293	Polyethylene	-	-	-	-	-	-

ND= Not Detected, NT= Not Tested

See *Table A: Chemical Names and Acronyms* for more information on the chemicals mentioned

Table E: Gloves from Restaurants Test Results

Glove	Distributor	State	Results from FTIR analysis	DEHP (%)	DINP (%)	DIDP (%)	DPHP (%)	DOTP (%)	DINCH (%)
Burger King- Glove	Unknown	MD	Polyethylene	-	-	-	-	-	-
Burger King- Glove	Unknown	MI	Polyethylene	-	-	-	-	-	-
Burger King- Glove	Unknown	MI	Polyethylene	-	-	-	-	-	-
Burger King- Tronex Embossed Disposable Poly Gloves	Tronex Safety	MI	Polyethylene	-	-	-	-	-	-
Burger King- Tronex Safety New Age Vinyl Gloves	Tronex Safety	CO	PVC + phthalate	ND	31.10	3.44	ND	ND	ND
Burger King- Tronex Safety New Age Vinyl Gloves	Tronex Safety	DC	PVC + DOTP	-	-	-	-	-	-
Burger King- Tronex Safety New Age Vinyl Gloves	Tronex Safety	MD	PVC + DOTP	-	-	-	-	-	-
Burger King- Tronex Safety New Age Vinyl Gloves	Tronex Safety	ME	PVC + DOTP	-	-	-	-	-	-
Burger King- Tronex Vinyl Powdered Disposable Gloves	Tronex Safety	MD	PVC + DOTP	-	-	-	-	-	-
Chick-Fil-A- Sani-Sure Vinyl Powdered Gloves	Rofson	DC	PVC + DOTP	-	-	-	-	-	-
Chipotle- C-2 Hybrid Gloves	AmerCareRoyal	WA	Polyethylene	-	-	-	-	-	-
Chipotle- Glove	Unknown	ME	PVC + DOTP	-	-	-	-	-	-
Chipotle- Jobguard Stretch Vinyl Multi-Purpose Glove	Spring-Fill	DC	PVC + DOTP	-	-	-	-	-	-
Chipotle- Jobguard Stretch Vinyl Multi-Purpose Glove	Spring-Fill	MI	PVC + DOTP	-	-	-	-	-	-
Chipotle- Jobguard Stretch Vinyl Multi-Purpose Glove	Spring-Fill	PA	PVC + DOTP	-	-	-	-	-	-
Domino's- Westchester Protective Gear Powder Free Black Nitrile Disposable Gloves	Westchester Protective Gear	MI	Nitrile	-	-	-	-	-	-
Dunkin' Donuts- ServGuard Vinyl Multi-Purpose Gloves	ServGuard	MI	PVC + DOTP	-	-	-	-	-	-
KFC- Omar Powder Free Vinyl Gloves	Omar Medical Supplies, Inc.	MI	PVC + DOTP	-	-	-	-	-	-
KFC/Taco Bell- Omar Powder Free Vinyl Gloves	Omar Medical Supplies, Inc.	DC	PVC + DOTP	-	-	-	-	-	-
KFC/Taco Bell- Tronex Nitrile Powder-Free Gloves	Tronex Safety	ME	Nitrile	-	-	-	-	-	-
McDonald's- Glove	Unknown	DC	PVC + DOTP	-	-	-	-	-	-
McDonald's- Glove	Unknown	DC	Polyethylene	-	-	-	-	-	-
McDonald's- Glove	Unknown	DC	Polyethylene	-	-	-	-	-	-
McDonald's- Glove	Unknown	MA	Polyethylene	-	-	-	-	-	-
McDonald's- Glove	Unknown	MI	Polyethylene	-	-	-	-	-	-
McDonald's- Glove	Unknown	NJ	Polyethylene	-	-	-	-	-	-
McDonald's- Glove	Unknown	PA	Polyethylene	-	-	-	-	-	-

Glove	Distributor	State	Results from FTIR analysis	DEHP (%)	DINP (%)	DIDP (%)	DPHP (%)	DOTP (%)	DINCH (%)
McDonald's- Glove	Unknown	UT	PVC + DOTP	-	-	-	-	-	-
McDonald's- Grill Glove Blue Poly	Omar, Inc.	OR	Polyethylene	-	-	-	-	-	-
McDonald's- Omar Powder Free Vinyl Gloves	Omar, Inc.	ME	PVC + DOTP	-	-	-	-	-	-
McDonald's- Omar Powder Free Vinyl Gloves	Omar, Inc.	ME	PVC + Phthalates	ND	40.80	0.76	ND	ND	ND
McDonald's- Omar Powder Free Vinyl Gloves	Omar, Inc.	MI	PVC + Phthalates	ND	37.30	0.71	ND	ND	ND
McDonald's- Omar Powder Free Vinyl Gloves	Omar, Inc.	PA	PVC + DOTP	ND	ND	ND	ND	34.00	ND
McDonald's- Omar Powder Free Vinyl Gloves	Omar, Inc.	SC	PVC + DOTP	-	-	-	-	-	-
McDonald's- Tronex Disposable Vinyl Glove (Powder Free)	Tronex Safety	NY	PVC + DOTP	ND	ND	ND	ND	33.50	ND
McDonald's- Tronex Disposable Vinyl Glove (Powder Free)	Tronex Safety	WA	PVC + DOTP	-	-	-	-	-	-
McDonald's- Tronex Disposable Vinyl Glove (Powder Free)	Tronex Safety	DC	PVC + DOTP	-	-	-	-	-	-
McDonald's- Tronex Disposable Vinyl Glove (Powder Free)	Tronex Safety	DC	PVC + DOTP	-	-	-	-	-	-
McDonald's- Tronex Disposable Vinyl Glove (Powder Free)	Tronex Safety	NY	PVC + DOTP	-	-	-	-	-	-
Panera- Econofit Plus Synthetic Polyethylene Gloves	Ambitex	MI	Polyethylene	-	-	-	-	-	-
Pizza Hut- Glove	Omar, Inc.	MI	PVC + DOTP	-	-	-	-	-	-
Popeyes- Inteplast Vinyl Gloves Powder-Free	Inteplast Group	MI	PVC + DOTP	-	-	-	-	-	-
Starbucks- Jobguard Clear Embossed Food service Gloves	Spring-Fill	DC	Polyethylene	-	-	-	-	-	-
Starbucks- Jobguard Clear Embossed Food service Gloves	Spring-Fill	PA	Polyethylene	-	-	-	-	-	-
Starbucks- Jobguard Clear Embossed Food service Gloves	Spring-Fill	WA	Polyethylene	-	-	-	-	-	-
Starbucks- Jobguard Poly Glove	Spring-Fill	MI	Polyethylene	-	-	-	-	-	-
Starbucks- Jobguard Vinyl Multi-Purpose Glove	Spring-Fill	MI	PVC + DOTP	-	-	-	-	-	-
Subway- Glove S005096R	Subway	DC	Polyethylene	-	-	-	-	-	-
Subway- Glove SS005095L	Subway	MI	Polyethylene	-	-	-	-	-	-
Taco Bell- The Safety Zone Vinyl Gloves	The Safety Zone	MI	PVC + DOTP	-	-	-	-	-	-
Taco Bell- The Safety Zone Vinyl Gloves	The Safety Zone	MI	PVC + DOTP	-	-	-	-	-	-

Glove	Distributor	State	Results from FTIR analysis	DEHP (%)	DINP (%)	DIDP (%)	DPHP (%)	DOTP (%)	DINCH (%)
Taco Bell- Tronex Nitrile Powder-Free Disposable Gloves	Tronex Safety	MD	Nitrile	-	-	-	-	-	-
Tim Hortons- Ambitex Powder Free Vinyl Gloves	Ambitex	MI	PVC + DOTP	-	-	-	-	-	-
Wendy's- Glove	Unknown	MA	PVC + DOTP	-	-	-	-	-	-
Wendy's- Inteplast Vinyl Gloves Powdered	Inteplast Group	MI	PVC + Phthalates	ND	38.40	1.53	ND	ND	ND
Wendy's- Smart Choice General Purpose Vinyl Gloves Powder Free	SmartChoice	MD	PVC + DOTP	-	-	-	-	-	-
Wendy's- SmartChoice General Purpose Vinyl Gloves Powder Free	SmartChoice	ME	PVC + DOTP	-	-	-	-	-	-
Wendy's- SmartChoice General Purpose Vinyl Gloves Powder Free	SmartChoice	NJ	PVC + DOTP	-	-	-	-	-	-
Wendy's- SmartChoice General Purpose Vinyl Gloves Powder Free	SmartChoice	PA	PVC + DOTP	-	-	-	-	-	-
Wendy's- SmartChoice General Purpose Vinyl Gloves Powder Free	SmartChoice	WA	PVC + DOTP	ND	ND	ND	ND	33.80	2.59
Wendy's- SmartChoice General Purpose Vinyl Gloves Powdered	SmartChoice	CA	PVC + DOTP	-	-	-	-	-	-
Wendy's- SmartChoice General Purpose Vinyl Gloves Powdered	SmartChoice	MI	PVC + DOTP	-	-	-	-	-	-
Wendy's- SmartChoice General Purpose Vinyl Gloves Powdered	SmartChoice	WA	PVC + DOTP	-	-	-	-	-	-

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