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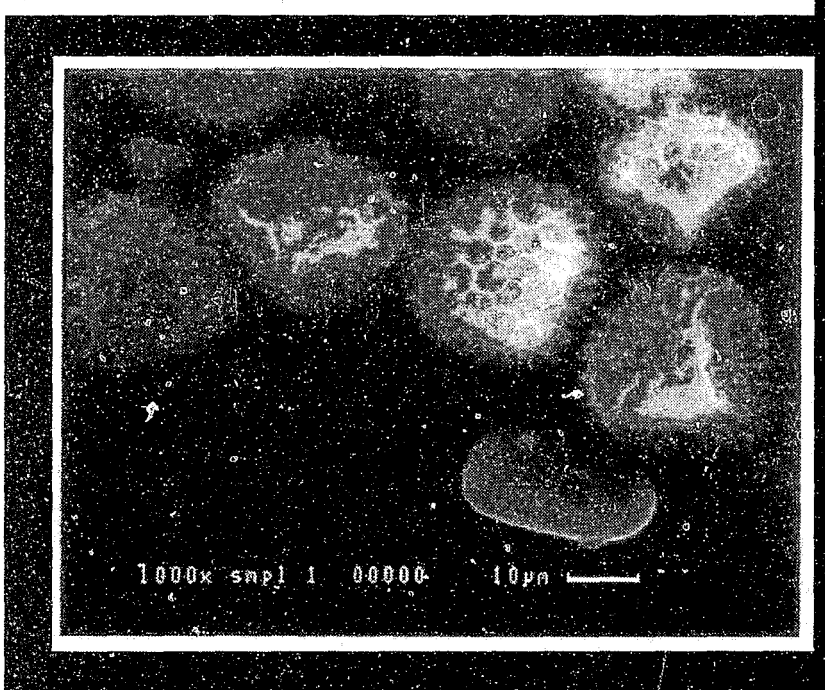


## Collection and Identification Guidelines for Traces from Latex Condoms

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# Collection and Identification Guidelines for Traces from Latex Condoms in Sexual Assault Cases

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Forensic laboratories are increasingly seeing sexual assault cases (rape, forcible sodomy, and child sexual abuse) in which the assailant wore a condom or the accused claims to have worn a condom. Lubricated condoms may be preferred for such crimes for the same reasons that lubricants such as petroleum jelly (Blackledge and Cabiness 1983) have been used in the past.

Although certainly not as definitive as a fingerprint or a DNA profile, condom lubricant traces can nonetheless be valuable associative evidence. Just as professional burglars wear gloves, it can be expected that habitual sex offenders will wear condoms, especially if their DNA profiles are already in a computer database.

A serial rapist was recently arrested in a major American city. He could clearly be linked to one rape because a condom was recovered and polymerase chain reaction (PCR) with subsequent DNA profiling performed with epithelial cells from the outside of the condom matched the victim, while the DNA profile from the seminal fluid inside matched the suspect. However, the assailant had worn a mask during all of the rapes, and none of the victims was able to visually identify him. Although the *modus operandi* was the same in all of the rapes, a closer association might have been made if there had been attempts to (1) identify the condom brand, (2) search the suspect, his car, and his apartment for unused condom packages (the chances are good that he used the same brand in all of the rapes), and (3) examine the vaginal/anal/oral swabs obtained upon medical examination of the other victims to see if condom lubricant traces were present and if they matched those in the recovered condom.

Procedures for the extraction of condom lubricant traces from evidence items (*e.g.*, cotton swabs, undergarments, or bedding) have recently been reported (Blackledge 1993; Blackledge and Vincenti, in press). Two cases are cited in the references. In one case, the assailant wore a lubricated condom, and in the other case, the assailant claimed to have worn a lubricated condom but did not.

In the first case, the assailant used a Sheik-Elite® Lubricated latex condom (made in Japan for Schmid Laboratories, Little Falls, NJ). These condoms contain a water-insoluble lubricant which is a silicone oil, polydimethylsiloxane (PDMS), of around 200 cSt viscosity. Also present in the lubricant formulation are large quantities of corn starch and much smaller quantities of lycopodium. Microscopic examination of an extract from an internal vaginal swab from the victim identified numerous corn starch grains, and examination of the filtered extract by infrared spectroscopy and mass spectrometry identified PDMS. However, the defense argued that the corn starch could have originated from the gloves worn during the medical examination.

In the second case, the accused admitted to having sex with the victim but claimed that it was consensual. He also claimed that he wore a condom, but it had broken. Both claims were denied by the victim. The accused was a member of the US Navy and claimed that the condom used was one of those provided to shipmates. These are latex condoms of the Prime® Lubricated brand (Ansell Incorporated, Dothan, AL). The sailor had previously been diagnosed with active acquired immunological deficiency syndrome (AIDS) and had attended the counseling program provided for service members with this condition. In this counseling program, service members are warned that if they engage in unprotected sex, they will be prosecuted for aggravated assault even if the sex is consensual.

Prime® Lubricated condoms also contain a PDMS liquid lubricant of around 200 cSt viscosity as well as corn starch. Internal vaginal swabs from the victim were examined, and no traces of PDMS or corn starch were found. This was fortunate since various brands of powdered latex examination gloves may contain corn starch, finely powdered silica, or talc.

In order for the finding of condom lubricant traces to be reliable and have evidential value, a protocol for collection and identification must be developed. This protocol should include (1) a medical examination of the victim, (2) the collection of physical evidence from the victim, any suspects, and the crime scene, and (3) inquiries about the recent sexual activities of the victim (*e.g.*, condom use, lubricant use, or douching). The protocol must address the need for protecting medical and investigative personnel from bloodborne pathogens and other safety hazards. It must also consider the requirements for other types of evidentiary examinations including latent impressions, both traditional serological examinations and DNA profiling, and examinations for hairs and fibers.

This paper proposes guidelines for the development of such a protocol. Dr. Robert E. Gaensslen, professor and director of forensic sciences at the University of New Haven in Connecticut, received a grant from the National Institute of Justice to conduct a survey to determine how sexual assault evidence is processed in different areas of the country. His survey will culminate in the publication of a guidebook on the most efficient methods to process sexual assault evidence. Hopefully, a protocol for the collection and processing of condom lubricant traces will be included.

## Medical Examination

### Gloves

Nonlubricated latex or plastic examination gloves must be worn. To counter potential claims that any particulates (*e.g.*, corn starch or talc) found on vaginal/anal/oral swabs could have originated from the examination gloves, swabs should be obtained prior to digital examination, and after the examination the investigator should collect and separately package the gloves worn by the examining physician.

### Sequence

Internal and external vaginal/anal/oral swabs of the victim should be obtained before digital examination to reduce the chance of contamination from the examiner's gloves.

### Number of Swabs

Most commercial sexual assault kits contain two swabs for each type of sample. Since serological/DNA examinations have potentially greater evidential value, rather than using one of these swabs for examinations for traces from latex condoms, an extra (third) swab should be used. This extra swab should also be air dried and treated like the others except that when the dried swab is packaged, it should be labeled "condom traces examination."

## Crime Scene

For safety reasons (such as protection from bloodborne pathogens), investigators should wear nonlubricated latex or plastic gloves while collecting and packaging evidence. Upon completion of the crime scene search, these gloves should also be collected and separately packaged. When searching the crime scene, vehicles, and premises of any suspects, investigators should look for used condoms, empty condom packages, or intact, unused condom packages.

When used condoms are found, DNA analysis should first be performed on recovered epithelial cells, blood stains, etc., originating from the victim and found on the outside of the condom. The DNA from the seminal fluid inside the condom can then be compared with the DNA of the suspect(s) or searched within a computer database. The condom brand can subsequently be identified as well as any particulates, lubricants, or spermicides present in the identified brand. With this information, the forensic laboratory can then examine vaginal/anal/oral swabs from the victim for matching traces.

If a discarded condom package is found, the first priority is to preserve any latent prints, although it is highly unlikely that any would be developed on the inside of the package. The inside of the package should be swabbed to obtain a standard of any particulates, lubricants, or spermicides used in this brand. This is important because it may be difficult to obtain a standard of the same brand that has the same lot number, and the company's formulation could have changed.

## Victim Interview

Most commercial sexual assault kits include forms that are completed by the medical examination personnel when questioning the victim. These forms usually include questions regarding condom use by the assailant during the assault and any use of condoms or lubricants during recent coitus prior to the assault. The investigator must ensure that these questions are asked and answered. If condom use by the assailant is alleged, try to obtain as much information about the condom as possible. For example, ask, What brand was it? If the victim doesn't know, then ask, What did the package look like? What color was the condom package? What color was the condom? Was it textured? Did you notice anything else about it? Not only can these questions help to identify the brand of condom used, but they may also help to establish false claims of sexual assault.

In a false sexual assault complaint, the complainant may claim that the accused wore a condom because he/she knows that no seminal fluid will be found during a physical examination. Then he/she will be unable to recall any details or he/she may mention a popular brand name such as Trojan®. However, no characteristic traces of this brand will be found upon examination of vaginal/anal/oral swabs. Also, if the victim says the assailant wore a condom, the investigator needs to obtain information about his/her other recent sexual activity, condom use, lubricant use (*e.g.*, K-Y Jelly®), douching, use of medical products for vaginal/anal insertion, etc. This is necessary in order to counter defense attorney claims that traces found could have originated from other sources. In some cases, it may be desirable to actually collect samples, if only for elimination purposes. If the victim is deceased, the investigator should try to obtain this information from individuals who knew the victim well (but are not suspects).

## Suspect Interview

If the suspect(s) is/are willing to talk and condom use is suspected, encourage the suspect(s) to provide as many details as possible, especially the condom brand name, where and when it was purchased, and where he/they disposed of it.

## Laboratory Examination

Since specific details for forensic laboratory protocols for the extraction and characterization of particulates, liquid lubricants, and the spermicide, nonoxynol-9, have been published previously (Blackledge 1993; Blackledge and Vincenti, in press), only a brief summary will be provided here.

Latex condoms may be either lubricated or nonlubricated. Although nonlubricated condoms will not contain any liquid lubricant or the spermicide, nonoxynol-9, both lubricated and nonlubricated latex condom brands may contain particulates such as corn starch (or other starches), lycopodium, talc, or finely-powdered silica, which may be exchanged. Both organic and inorganic particulates may be identified by light microscopy (polarized light microscopy with slightly uncrossed polars is especially useful for identifying starches or inorganic particles that are birefringent). The microscopic identification of starches

may be confirmed by allowing a dilute solution of iodine/potassium iodide starch detection reagent to flow under the coverslip and observing as the starch grains are slowly stained a dark purple. Scanning electron microscopy (SEM) may also be used, and due to its increased depth of field, it is especially good for lycopodium. SEM with energy-dispersive x-ray spectroscopy (EDS) is especially good for characterizing the inorganic particulates. Individual particles may be examined by EDS, or a large field of view may be characterized by elemental mapping. For example, elemental mapping for magnesium would help to show the presence and abundance of talc.

Lubricated latex condoms may either contain a wet (water-soluble) lubricant or a dry (water-insoluble) lubricant. Both types may also contain the spermicide, nonoxynol-9. When present, nonoxynol-9 usually comprises 5% to 15% of the lubricant formulation.

Carboxymethylcellulose, propylene glycol, parabens, polyethylene glycol, and quaternary ammonium compounds are some of the components frequently found in the formulation of wet condom lubricants. An advantage is that only a few different brands contain a wet formulation. For those that do, the combination of ingredients used and their relative proportions is likely to be unique for a given brand, or at least for that manufacturer. A disadvantage is that many feminine hygiene products for vaginal insertion as well as products advertised to produce a "natural" lubrication contain many of these same ingredients. Therefore, the mere finding of traces of these ingredients on vaginal/anal/oral swabs or other evidence items does not prove condom use. The evidence for condom use is stronger if it can be shown that the ingredients are present in the same relative proportions as in the condom standard.

Methods such as high performance liquid chromatography (HPLC) and gel permeation chromatography (GPC) may be used to show the presence and molecular weight distribution of polymers such as polyethylene glycol (PEG) as well as the presence and molecular weight distribution of nonoxynol-9. However, the easiest procedure probably would be to extract the cotton swab with methanol, filter the extract, evaporate it down to a few drops, and drip the remaining drops onto a 3M IR Card (3M Company, St. Paul, MN) or AgCl window and obtain its infrared spectrum. Although this would not separate the lubricant components, it should produce a "fingerprint" characteristic of the total formulation. This could be compared with the pattern obtained from precoitus and postcoitus vaginal swabs from a volunteer when her partner wore that brand of condom.

Most latex condom brands contain a dry liquid lubricant which is invariably PDMS. The PDMS used in condoms is a raw mixture of oligomers ranging in molecular weight from the low thousands to at least 20,000 Daltons. PDMS is easily identified by Fourier transform infrared spectroscopy (FT-IR) by extracting the swab with dichloromethane, filtering the extract, and then evaporating a few drops onto a 3M IR Card or salt plate. If nonoxynol-9 is present, it may be separately extracted and identified by extracting the swab with a minimum volume (about 10 drops) of distilled water. The water extract is placed on a C18 solid phase extraction cartridge (3 ml size) which is then eluted with methanol. Any PDMS will be held by the cartridge, and there will be enough nonoxynol-9 in the methanol extract to produce an identifiable FT-IR spectrum when the methanol extract is evaporated onto a 3M IR Card or AgCl plate. The swab can then be extracted with dichloromethane to obtain the PDMS.

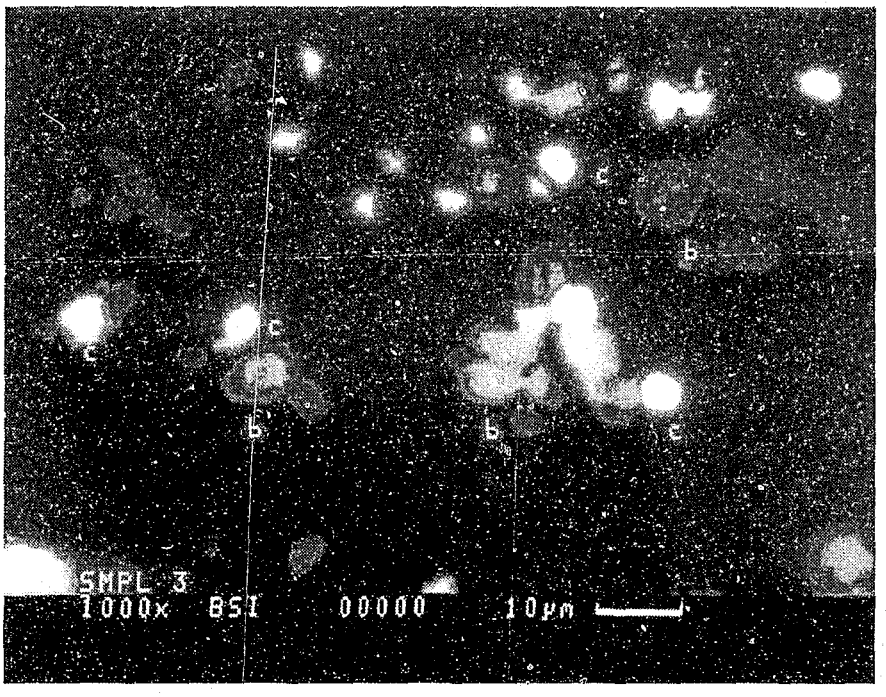
Although many condom manufacturers use a PDMS lubricant with a viscosity of around 200 cSt, there is some variation. Samples have been encountered with a viscosity as low as 100 cSt and as high as 350 cSt. A method for determining the average PDMS chain length or average molecular weight has been described (Lipp 1986) and has been specifically applied to PDMS from condoms (Blackledge, in press). This procedure may be valuable to show that the PDMS detected is in the viscosity range typical of that used in condoms. Methods such as GPC which show the molecular weight distribution as well as the average molecular weight might be capable of even more discrimination. Fortunately, PDMS is seldom encountered in feminine hygiene products for vaginal insertion, nor is it usually sold separately as a lubricant for sexual activities. In lists of ingredients on commercial labels, PDMS is often listed as dimethicone or simethicone.

One should resist the urge to extract the cotton swab (or other evidence items) with a solvent and then inject that extract into a capillary column gas chromatograph/mass spectrometer/data system (GC/MS/DS). Most likely, no useful data will be obtained, the background of the system will raise to unacceptably high levels, and the primary operator will be infuriated.

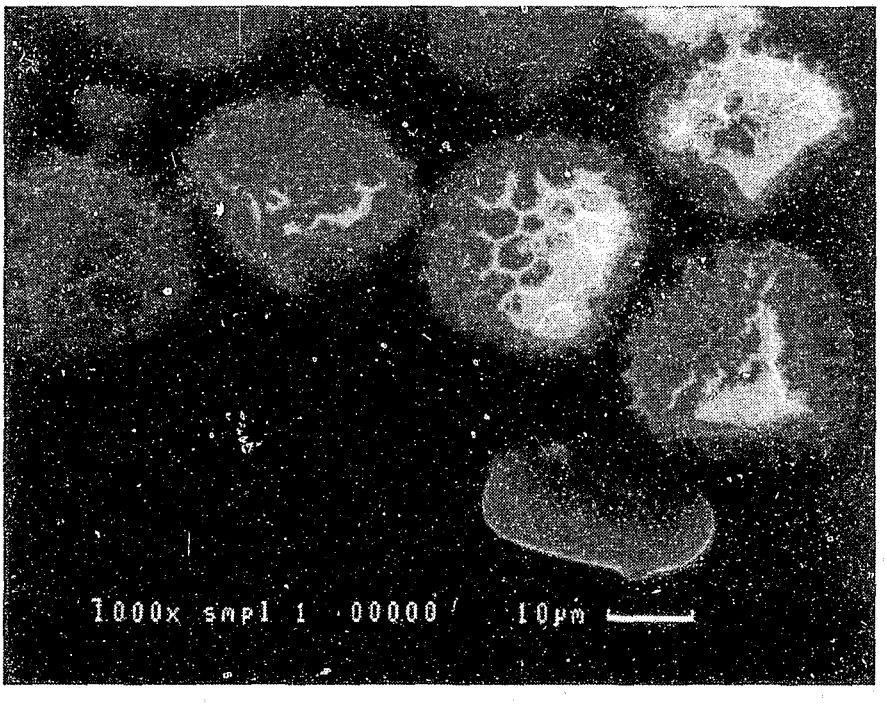
Although the PDMS, PEG, and nonoxynol-9 that may be present in various lubricated condom brands is not amenable to identification and characterization by the mass spectrometers commonly found in forensic laboratories, they can be examined with more specialized mass spectrometers and techniques. One method is desorption chemical ionization mass spectrometry (DCI-MS). DCI-MS is an extremely sensitive method (typical total sample amounts are 20 ng to 200 ng). DCI-MS examination results with 12 different latex condom brands containing PDMS, with vaginal swab samples from volunteers, and with samples from two cases have been reported (Blackledge and Vincenti, in press). DCI-MS was also able to identify PDMS in a vaginal swab that had previously been extracted with dichloromethane for FT-IR identification. Although examination by DCI-MS would have to be performed by an outside contractor, it is worth considering in cases where it is crucial to show whether condom lubricant traces are present.

## Summary

As habitual sex offenders increase their use of condoms in criminal assaults, law enforcement personnel must become aware of the potential for traces from condoms to associate a suspect(s) with a crime or series of crimes. Guidelines for the collection of these traces and for their examination in the forensic laboratory have been provided. Readers are encouraged to submit their suggestions or criticisms to the author or directly to Dr. Robert E. Gaensslen for inclusion in his guidebook for processing sexual assault evidence. His address is as follows: Dr. Robert E. Gaensslen, Director of Forensic Sciences, University of New Haven, West Haven, CT 06516 (telephone: 203-932-7116 or telefax: 203-932-7403).




*SEM backscatter image at 1000x.*




*SEM image at 1000x of particles from an $R_3$ Extra® latex condom; lycopodium spores and at lower right, a potato starch grain.*

Note: SEM images provided by Kurt J. Gaenzle, Materials Engineering Laboratory, Naval Air Station North Island, San Diego, CA.

## Disclaimer

The opinions or assertions contained herein are the personal views of the author and are not to be construed as official. Names of commercial products or manufacturers are provided for identification, and inclusion does not imply endorsement by the Naval Criminal Investigative Service.

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